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The factors influencing waste management for economic development—the perspective of Nelson Mandela bay municipality residents

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The rapid increase in volume and variety of solid waste as a result of continuous economic growth, urbanization, and industrialization has become an intractable problem for the public and private sectors, making it difficult to ensure effective and sustainable waste management. The study sought to understand the perspective of Nelson Mandela Bay Municipal residents on their perceived influence of municipal waste management on economic development. The study used a quantitative techniques approach, with a structured questionnaire. Data was collected from 255 respondents. The quantitative question aimed to determine if the influence was positive or negative, and the Likert scale question had a scale of 1 to 5. This research identified various types of waste, assessed challenges, and evaluated waste's potential for resource creation. The study concluded that municipal waste includes organic, paper, plastic, metal, glass, food, garden, hazardous, construction, demolition, and non-recyclable waste. Environmental pollution is a major challenge, and 26 factors positively influence waste to wealth. Waste to wealth can be achieved through social behavior, education/knowledge, MSWM governance, and economic feasibility for MSWM. The research also highlighted the importance of land attributes, budget allocation, trained personnel, and government regulations. The framework proposed aims to minimize urban poverty while preserving the environment and supporting the present urban economy. Urban communities can utilize solid waste management as a mechanism to foster economic development. The fundamental question is whether stakeholders will continue to ignore waste's potential demands and benefits for urban economic growth.

KEYWORDS

solid waste management, circular economy, sustainable development, waste to wealth, economic development

1 Introduction

Waste and its management are worldwide phenomena linked to virtually all human endeavors and integral parts of existence (Adeniran et al., 2018). Poorly controlled waste contaminates oceans, obstructs drainage systems, leads to floods, transmits illnesses through carriers, and exacerbates respiratory problems due to waste incineration (Abubakar et al., 2022); additionally, waste contamination is considered the second most important issue after water quality (Vij, 2012).

Solid waste management (SWM) is a crucial but frequently neglected service that has a significant impact on sustainable development and other societal elements, as emphasized by Rodic and Wilson (2017). The 2030 Agenda for Sustainable Development has 17 objectives, 12 of which specifically address solid waste management (SWM), highlighting the need for integrated solid waste management planning (ISWMP) (Rodic and Wilson, 2017).

Mandpe et al. (2023) noted that while solid waste is commonly considered an environmental issue due to its typical disposal in landfills, its management can also foster business development and entrepreneurship in urban areas. Gough et al. (2013) noted that there has been insufficient exploration of the theoretical and practical challenges associated with studying entrepreneurship in low-income countries with a focus on waste.

According to the United Nations (2020), organic waste, including food scraps and garden waste, accounts for a significant proportion of solid waste and may be converted into compost, providing an enormous untapped opportunity to manage waste efficiently and create jobs. According to Alpizar et al. (2020), most cities try to implement large, expensive waste-to-resource programs employing foreign technology, which frequently fail owing to a lack of acceptable models. Smaller, low-tech, decentralized models that use community resources are working (Devlin et al., 2023). Rasmeni and Madyira (2019) argue that municipal solid waste (MSW) disposal in South Africa is a serious environmental issue due to the population and limited undeveloped areas.

The South African Waste Act 59 of 2008 empowers the Ministers of Environmental Affairs and Finance to introduce incentives and disincentives to change waste generation and management behavior (Godfrey and Oelofse, 2017). Economic motivation may indirectly affect behavior by providing incentives and disincentives through price, which is more cost-effective and dynamic than command and control (Cohen, 2014).

Thus, academics and practitioners need to study the role of solid waste management in economic development toward strategic solutions to turn waste into wealth in urban settlements (Yukalang et al., 2018). Yukalang et al. (2018) recommend that scholars and practitioners examine the significance of solid waste management in economic growth to develop strategic methods for transforming trash into wealth in metropolitan areas.

Therefore, this study aims to investigate solid waste management as a means to boost economic development in NMBM. The study explores factors influencing solid waste management with the aim of creating a waste management framework that can facilitate Integrated Solid Waste Management (ISWM) and foster economic growth. The study's key question was to identify the effect of factors influencing municipal waste on economic development, and this was based on the respondents' perceptions.

Literature study, observation, and practical experience reveal that waste management systems can promote economic development, thereby lessening the strain on the overburdened municipality's services and infrastructure. The Nelson Mandela Bay Municipality in South Africa has not yet tested the potential of waste management to enhance economic development, prompting this study.

2 Literature review

This section aims to highlight or clarify literature on solid waste management, the challenges posed by improper management, and what constitutes local economic development, with the goal of identifying options for achieving urban economies.

2.1 Solid waste management

According to Mohee et al. (2015), solid waste management is one of the greatest global challenges, not only because it affects the environment or health but also because poor SWM implementation hinders national sustainable development (SD). Eurostat (2017)), solid waste encompasses any material that has been abandoned or disposed of. However, solid waste management has advanced and become inclusive by incorporating energy-efficient, health-, and environmentally friendly technology, as well as reducing, reusing, and recycling (3Rs) (Patel et al., 2021). A study by Oduro-Appiah et al. (2017) agrees that managing solid waste should be based on four fair principles: making sure everyone has access to waste management systems for public health reasons; removing trash safely; being efficient enough to get the most benefits for the least amount of money; and making the best use of resources. Knickmeyer (2020) stated that integrating waste reduction measures improves solid waste management, and that government incentives boost involvement and foster a waste separation culture. Therefore, it is crucial to connect policy waste reduction plans and programs to include individuals and companies in waste reduction.

Wilson et al. (2012) define waste as any substance that its original user or owner has dumped, which may or may not be helpful to others. However, if left untreated, waste becomes a nuisance, causing issues for people. Ranjbari et al. (2021) stated that waste characterization provides significant data for planning effective waste management systems and devising recycling or treatment solutions. NMBM showed intriguing tendencies between income levels, with recyclables (paper, cardboard, metal, glass, and plastics) accounting for 37% of residential waste (NMBM IWMP, 2016). Thirty nine percentage of the waste is organic waste, primarily from the kitchen and garden, which has the potential for recycling (NMBM IWMP, 2016). Paper, cardboard, metal, e-waste, organics, glass, plastic, construction debris, hazardous materials, other materials, and fine/coarse materials are wasteful (Chen et al., 2020), whereas Adeniran and Shakantu (2022) included building and demolition debris and non-recyclable waste.

2.2 Challenges of solid waste management

For effective and sustainable waste management practices, solid waste management presents a number of challenges (David et al., 2020). Some of the key challenges include increasing waste generation, inadequate infrastructure, improper waste segregation, limited recycling and resource recovery, environmental and health impacts, financial constraints, behavioral and cultural challenges, and hazardous and electronic waste management, among others

(Roy et al., 2023). Waste management services and practices in South Africa clearly demonstrate a lack of service delivery in the provision of all public sector services. Environmentally and socially unacceptable, these practices necessitate a better understanding and management of South Africa's total waste generation, including the tons of waste recycled, treated, dumped in landfills, and exported (Department of Environmental Affairs, 2018). Njoku et al. (2019) identified a significant issue with waste production, particularly the generation of dust and litter, which contributes to pollution in nearby areas. Dumbili and Henderson (2020) identified other challenges, which include the obstruction of drainage systems, blockage of waterways, and littering of streets and sewage banks. Guerrero et al. (2013) also recognized stakeholder behavior as a problem, identifying government agencies, corporate organizations, and individuals, among others. Paletta et al. (2019) identified another challenge associated with waste processes and recycling companies, highlighting the potential for these protocols to cause more harm than good because of the waste they generate. Knickmeyer (2020) named some social factors that make it hard to reduce waste. These include the absence of programs to raise awareness about waste, the inability to separate household trash, and a lack of recycling infrastructure, all of which cause a lot of trash to end up in landfills.

Yang et al. (2023) also highlighted the challenges of air pollution, greenhouse gas emissions, and surface water pollution resulting from waste generation. The negative effect of improper waste disposal is perilous; hence, managing waste in an environmentally sound manner is crucial for mitigating these impacts (Suryawan and Lee, 2023).

Al-Dailami et al. (2022) noted that the mode of transportation can either impede or facilitate waste generation. This factor can pose challenges by influencing the volume of waste generated and the collection of such waste. Korhonen et al. (2018) emphasized the importance of new consumption culture and traditional practices in achieving circularity. This involves user groups and communities sharing the use, function, service, and value of physical products. Babanyara et al. (2010) identified environmental pollution, including the marine ecosystem, as another challenge arising from waste generation. Continuous waste generation leads to widespread pollution, causing further challenges. According to Ismail and Latifah (2013), there has been an increase in waste generation. Economic and population growth, which presents the challenge of providing sufficient waste disposal facilities, including landfills, to accommodate waste. Idowu et al. (2019) further highlighted that inefficient landfilling practices in Africa have led to issues such as poor hygiene, limited access to clean water, and inadequate sanitation. Ara et al. (2021) also highlighted that with the rapid growth of population and urbanization, the quantity of solid waste generated has been increasing at an alarming rate, thereby putting immense pressure on waste management systems to handle and dispose of the waste effectively. The effective management of solid waste demands substantial financial means for the development of infrastructure, operational expenses, and maintenance (Abdel-Shafy and Mansour, 2018). According to the findings of Kumar (2016), numerous municipalities and waste management entities encounter financial limitations, creating challenges in allocating funds for the implementation of contemporary waste management technologies and the establishment of state-of-the-art facilities.

Changing public behavior and approaches concerning waste management also presents a multifaceted challenge, as observed by Mathew et al. (2023). To promote the adoption of sustainable waste management practices, such as minimizing waste generation, practicing appropriate waste segregation, and advocating for recycling, it is necessary to undertake awareness campaigns, provide education, and foster community engagement (Knickmeyer, 2020). The proper disposal of hazardous waste, including chemicals, medical waste, and electronic waste (e-waste), poses specific challenges (Garlapati, 2016). These types of waste require specialized handling, treatment, and disposal methods to prevent environmental contamination and protect human health (Heacock et al., 2016). Ferronato and Torretta (2019) indicated that the lack of appropriate facilities and regulations for hazardous waste management exacerbates these challenges.

Tackling these challenges necessitates a holistic approach encompassing various aspects. This includes investing in waste management infrastructure, conducting public awareness campaigns, establishing policy and regulatory frameworks, advancing technologies, and fostering international cooperation to facilitate the exchange of best practices and knowledge (Michael et al., 2023).

2.3 Local economic development

Local economic development (LED) involves local activities and measures to address socioeconomic issues by capitalizing on economic possibilities (Makhathini et al., 2020). LED requires cooperation between local governments, companies, community organizations, and other stakeholders, according to Doe et al. (2023). LED aims to boost economic growth, create jobs, raise living standards, and promote a region's wellbeing, according to Kaletnik and Lutkovska (2020). LED initiatives can support business development and entrepreneurship, skills training and workforce development, infrastructure development, collaboration and networking, tourism and cultural development, investment attraction and retention, and social and community development. Kuik et al. (2023) state that LED helps local firms boost entrepreneurship and build small and medium-sized enterprises. Entrepreneurship and SMEs drive social and economic improvement in rural regions, notably South African municipalities, according to Enaifoghe and Vezi-Magigaba (2023).

LEDs also provide training, vocational education, and industry-specific efforts to improve local labor skills (Mori and Stroud, 2021). Local economic growth attracts and retains investment in physical infrastructure, such as transportation networks, industrial parks, utilities, and other amenities, to support enterprises and investments (Islamovna, 2022). Drummond et al. (2021) suggest that leveraging the area's natural, cultural, and heritage assets to attract and retain infrastructure is crucial for generating tourist activities, promoting local goods, and creating jobs related to tourism. These initiatives encourage government agencies, corporations, educational institutions, and community

organizations to collaborate on innovation, information exchange, and collaborative action (Madanaguli et al., 2022).

Finally, LED may address poverty, inequality, and social exclusion through targeted programs that promote social cohesion, inclusion, and equitable economic opportunities (Gupta and Vegelin, 2016). LED methods vary by location and necessity (Ferreira et al., 2023). They consider the area's economic, social, and environmental qualities to maximize its strengths, resources, and potential (Ambarwati et al., 2023). Under apartheid, South Africa had a regional planning strategy with strong central government control that discouraged LED projects in towns and cities, reducing local autonomy (Kamara, 2017).

Local administrations or other key stakeholders can lead LEDs. Local and regional governments, business unions, CBOs, and NGOs often participate in public-private partnership (PPP) initiatives. The variety of techniques used ranged from official business support and place marketing to community economic development and self-reliance. Local communities, authorities, external agencies, or non-profit organizations in rural or urban regions undertake local economic activity known as LED (Nel, 2019).

2.4 Strategies for transforming waste into wealth and capacity

Waste-to-energy (WTE) conversion as an economic resource and wealth, according to Hoang et al. (2022), addresses waste management and energy generation by using waste as fuel. WTE facilities use cutting-edge technology to convert waste into energy instead of landfilling or incinerating it (Vaish et al., 2019).

WTE conversion may boost resource utilization, energy generation, waste management savings, employment creation, economic growth, and carbon footprint reduction (Liang et al., 2022). WTE project success and economic viability rely on waste type and content (Ibikunle et al., 2020), technology, legal frameworks, and market conditions (Khan et al., 2022).

Transforming waste into wealth involves converting it into useful goods, energy sources, or raw materials, reducing landfill waste and creating economic opportunities (Liang et al., 2022). Reusing waste is a circular economy alternative to linear economies, promoting resource efficiency, and sustainability (Weitz et al., 2002). Practice allows for the recovery, compounding, or use of metal as usable material, thereby lowering the demand for virgin resources and their environmental impact. Reusing plastic and organic waste as construction materials or biofuels can also help to reduce waste. Households incentivize recycling, and some sell their rubbish to scavengers for cash (3Rs) (Weitz et al., 2002).

In conclusion, this section highlights a gap in the literature: there is no model or framework to assist residents in using solid waste management as an economic instrument. There is also an absence of a grassroots framework promoting integrated waste management methods to boost economic growth through citizen input. The majority of efforts are executed by the public sector, resulting in a disconnect as individuals do not engage effectively because the solutions fail to address the difficulties they perceive on the ground.

3 Methodology

This section presents the research design and the description of the study area of the research. The section links the study's actual practical application, and the theoretical underpinnings outlined in the literature review. The characteristics of the study area and the research questions presented in the introduction influenced the study design's selection. Thus, it becomes essential to justify the study area to place the study design inside a meaningful and pertinent framework.

3.1 Research design

This study sought to establish a framework for solid waste management to promote economic development in metropolitan areas. The quantitative research design included structured questionnaire surveys and descriptive analysis to ascertain the types of waste generated, the challenges they present, and the factors influencing the role of municipal waste in fostering economic growth.

The study used a method called "purposeful sampling," which was explained by Tongco (2007). The sample frame was made up of people who lived in Central, Walmer E, and Summerstrand, which are all in the Nelson Mandela Bay Metropole. A questionnaire-based survey was conducted from January to April 2021 to gather feedback from the case study respondents, which led to the recruitment of 255 participants out of the targeted 303.

Mean scores and standard deviations were computed using SPSS version 15 based on data frequencies. A 5-point Likert scale employs an ordinal measurement of agreement or disagreement to evaluate the variables. The Likert scale effectively quantifies attitudes (Yaska and Nuhu, 2024). To evaluate and interpret the mean ratings, a scale was employed: 1, severely disagree (>1.0 and ≤ 1.8); 2, disagree (>1.8 and ≤ 2.6); 3, undecided/neutral (>2.6 and ≤ 3.4); 4, agree (>3.4 and ≤ 4.2); and 5, strongly agree (>4.2 and ≤ 5.0). This study employed a 0.7 threshold to evaluate the internal consistency of the constructs' elements, with Cronbach's alpha values between 0.70 and 0.95.

3.2 Respondent's profile

Table 1 presents a summary of the respondents' demographics, encompassing factors like sex, residential location, duration of residency, educational attainment, and monthly family earnings. Examining these data aids in comprehending the demographic attributes of the sample and extracting valuable observations for diverse objectives.

This section provides insights into the gender distribution of the 255 surveyed population and indicates that the majority of respondents were female (54.5%) or male (42.2%), while a small percentage (3.1%) preferred not to disclose their gender. In terms of area of residence, the section shows a relatively even distribution among the three areas, with Walmer E having a slightly higher percentage of 34.5% against Summerstrand (32.2%) and Central

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TABLE 1 Respondents' profile.

	Frequency	%
Gender	*N = 255*	
Male	108	42.4
Female	139	54.5
Prefer not to say	8	3.1
Total	255	100.0
Area of residence	*N = 255*	
Walmer	88	34.5
Summerstrand	82	32.2
Central	85	33.3
Total	255	100.0
Period of residence	*N = 255*	
<1	24	9.4
1–5	172	67.5
6–10	4	1.6
10–15	12	4.7
Above 15	43	16.9
Total	255	100.0
<1	24	9.4
Highest educational qualification	*N = 255*	
No formal education	30	11.8
Primary school	22	8.6
Matric/TVET cert	117	45.9
University certificate	80	31.4
Post grad	1	0.4
Missing	5	2.0
Total	255	100.0
Monthly household income range	*N - 255*	
0–3,500	144	56.5
3,501–7,500	34	13.3
7,501-15000	43	16.9
15,001–25,000	15	5.9
25,001–40,000	2	0.8
Above 40%	0	0.0
Missing	17	6.7
Total	**255**	**100.0**

(33.3%). As presented in Table 1, with regard to the duration of residence of the respondents, the majority had lived in the area for 1–5 years (67.5%), while others had lived there for <1 year (9.4%), 6–10 years (1.6%), 10–15 years (4.7%), or more than 15 years (16.9%). Additionally, a significant portion (45.9%) had completed Matric/TVET certification, while others had no formal education (11.8%), primary school (8.6%), university certificates (31.4%), postgrade (0.4%), or 2.0%. Regarding the range of monthly household income, 56.5% the respondents earned between R0 and R3,500, while 13.3%, 16.9%, 5.9%, and 0.8% earned R3,501–R7,500, R7501–R15,000, R15001–R25,000, and R25001-R40000, respectively. None earned above R40,000, while 6.7% were missing.

4 Findings

This section presents the findings, the data analysis, and the interpretation of the results that were found from the collected data from the residents of Walmer E, Summerstrand, and Gqeberha Central. Furthermore, it begins by discussing the types of waste that respondents generate, then delves into the challenges these wastes pose, examines the impact of municipal waste on economic development, and concludes with factors that influence the role of municipal waste in local economic development.

4.1 Waste type generated by respondents

The case study findings, as shown in Figure 1, suggest that the largest waste produced is food remnants and other organic wastes, as reported by 240 respondents. Two hundred and twenty eight respondents reported using polystyrene bags and other plastic materials as the next most common waste. A total of 173 respondents reported producing cans and other metals, 164 reported producing glass material, and 141 reported producing newspapers and other waste papers. Furthermore, 115 respondents reported producing human waste (nappies and wipes), while 89 respondents reported producing oil waste. According to Figure 1, 82 respondents reported producing old clothes as waste; 46 respondents reported producing domestic hazardous waste (such as old paint and cleaning materials); and 44 respondents reported producing garden rubbish. Finally, 24Nr reported generating E-waste, which refers to discarded electronics, while 16Nr reported generating construction waste.

4.2 Challenges posed by waste generated

The purpose of the survey, as presented in Table 2, was to understand from the respondents' point of view the challenges posed by the waste generated, and the ranking results are presented in Table 2. With a mean score of 3.62, dust and litter in the surrounding area ranked first in the list of challenges posed by clogged drains, stakeholder behavior, diminished tourism, the presence of recycling companies, and poor waste processes [2nd (MS = 3.61), 3rd (MS = 3.46), 4th (MS = 3.44), 5th (MS = 3.39), and 6th (MS = 3.36)], respectively. The 7th to 13th most common equipment types were available for managing waste (MS = 3.35), awareness programs (MS = 3.32), household separation (MS = 3.31), air pollution (MS = 3.25), contributions to greenhouse gas emissions (MS = 3.20), transportation modes (MS = 3.17), and surface water pollution (MS = 3.15). The fourth highest ranking of the challenges posed by the waste generated, as indicated by the respondents and as shown in Table 2, is the high generation of waste (MS = 3.09), followed by the challenge of the transportation route

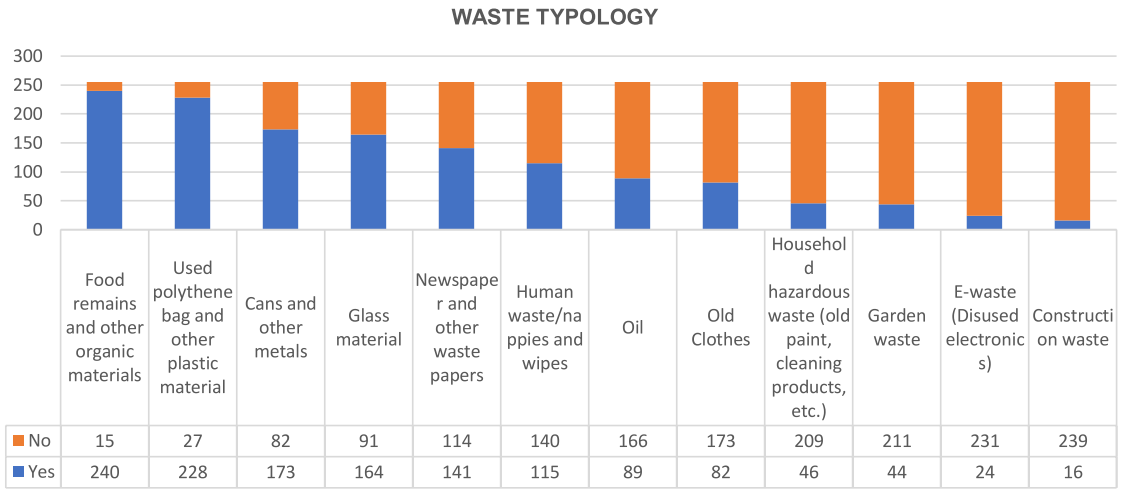

FIGURE 1
Waste typology (Author's data analysis, 2023).

(MS = 3.01). The last six challenges, which ranked 16th to 21st, were culture and tradition (MS = 2.96), hydrogeology pollution (MS = 2.62), increasing demand for landfill use (MS = 2.57), aquatic biota (MS = 2.46), site geology (MS = 2.33), and topography (MS = 2.22).

4.3 Influence of municipal waste on economic development

The theme presented in Table 3 sought to underscore the respondents' perceptions of the influence of municipal waste on economic development, and the factors related to this theme were collated from the literature. The survey asked whether the effect was positive or negative, and the Likert scale was used to measure the effect on a scale ranging from negative 5 to positive 5. The analyzed results are ranked and presented in Table 3.

The respondents indicated that the use of incentive schemes as a factor has a positive influence on municipal waste as a tool for economic development, with a mean score of 3.22; this factor was the most important factor. Second is the extent of the knowledge and understanding of waste management methods and health/sanitation/environment within households, which is indicated to have a positive influence with a positive mean score of 3.20.

The presence and efficiency of formal or informal waste separation had a positive influence on the overall country, with a mean score of 3.16 and ranking third.

The fourth to 10th most common laws were enforcement of laws (MS = 3.11), extent of knowledge and understanding of human behavior and waste management methods within households (MS = 3.09), presence and effectiveness of private and/or public waste disposal (MS = 3.09), presence and efficiency of formal or informal waste collection (MS = 3.09), stability/reliability of funds for MSWM (MS = 3.04), availability of safe technology and human workforce (MS = 2.99), and presence and effectiveness of an integrated long-term MSWM strategy (MS = 2.98).

Additionally, the extent of knowledge and understanding of waste handling methods within households (MS = 2.97); the profitability of market systems that rely on recycled-material throughput; the involvement of small businesses, middlemen, and large industries/exporters (MS = 2.95); land attributes such as terrain, ownership, and development that dictate MSWM (MS = 2.87); budget allocation to MSWM (MS = 2.84); and the extent of trained personnel in MSWM positions (MS = 2.82) are ranked 11th to 15th, respectively, in terms of the factors that influence municipal waste for economic development, and they all have a positive influence. Among the factors that influence municipal waste for economic development, 16 to 20 are government regulations (MS =2.79); the cost of waste management operations (MS =2.79); the effective use of safe technology and a human workforce (MS = 2.77); the assessment of the waste recovery rate (MS = 2.60); the existence of market systems relying on recycled-material throughput; the involvement of small businesses, middlemen, and large industries/exporters (MS = 2.59); and the positive influence of these systems.

Furthermore, the assessment of the waste generation rate (MS = 2.48), the composition of the waste stream (MS = 2.47), the presence and effectiveness of private and/or public waste collection (MS = 2.46), and individuals' income influencing waste handling behavior (reuse, recycling, and illegal dumping) (MS = 2.35) ranks 21 to 24, respectively, with a positive influence on waste for economic development. At the bottom of the ranking table, those with a mean score <1 are willing to pay for waste collection/disposal fees (MS = 0.95) and willing to pay for waste collection/disposal fees (MS = 0.67).

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TABLE 2 Challenges posed by waste generated.

Challenges	Not at all		Very Minor		Minor		Moderate		Major		Very major		Total		Mean	SD	Rank
	f	%	f	%	f	%	f	%	f	%	f	%	f	%			
Dust and litter in the surrounding area	14	5.5	33	12.9	12	4.7	28	11.0	57	22.4	111	43.5	255	100	3.62	1.63	1
Clogging drains	27	10.6	18	7.1	23	9.0	19	7.5	41	16.1	127	49.8	255	100	3.61	1.77	2
Stakeholder behavior	15	5.9	17	6.7	27	10.6	59	23.1	51	20.0	86	33.7	255	100	3.46	1.50	3
Diminished tourism	42	16.5	21	8.2	15	5.9	12	4.7	36	14.1	129	50.6	255	100	3.44	1.96	4
The presence of recycling companies	15	5.9	16	6.3	35	13.7	57	22.4	53	20.8	79	31.0	255	100	3.39	1.49	5
Poor waste processes	15	5.9	20	7.8	26	10.2	60	23.5	64	25.1	70	27.5	255	100	3.36	1.47	6
Equipment available to manage waste	18	7.1	16	6.3	32	12.5	54	21.2	64	25.1	71	27.8	255	100	3.35	1.51	7
Awareness programs	20	7.8	29	11.4	23	9.0	48	18.8	47	18.4	88	34.5	255	100	3.32	1.65	8
Household separation	19	7.5	22	8.6	30	11.8	46	18.0	67	26.3	71	27.8	255	100	3.31	1.56	9
Air pollution	13	5.1	11	4.3	44	17.3	75	29.4	56	22.0	56	22.0	255	100	3.25	1.36	10
Contribution to green-house gas emission	20	7.8	10	3.9	41	16.1	63	24.7	70	27.5	51	20.0	255	100	3.20	1.44	11
Transportation mode	19	7.5	26	10.2	30	11.8	59	23.1	60	23.5	61	23.9	255	100	3.17	1.54	12
Surface Water pollution	15	5.9	16	6.3	39	15.3	79	31.0	59	23.1	47	18.4	255	100	3.15	1.37	13
High generation rate	22	8.6	35	13.7	41	16.1	37	14.5	39	15.3	81	31.8	255	100	3.09	1.71	14
Transportation route	33	12.9	29	11.4	32	12.5	44	17.3	43	16.9	74	29.0	255	100	3.01	1.76	15
Culture and tradition	54	21.2	18	7.1	31	12.2	25	9.8	34	13.3	93	36.5	255	100	2.96	1.98	16
Hydrogeology pollution	65	25.5	23	9.0	14	5.5	44	17.3	59	23.1	50	19.6	255	100	2.62	1.90	17
Increasing demand for Landfill use	48	18.8	18	7.1	30	11.8	87	34.1	44	17.3	28	11.0	255	100	2.57	1.59	18
Aquatic biota	74	29.0	14	5.5	25	9.8	51	20.0	44	17.3	47	18.4	255	100	2.46	1.89	19
Site geology	77	30.2	18	7.1	28	11.0	50	19.6	39	15.3	43	16.9	255	100	2.33	1.87	20
Topography	80	31.4	24	9.4	28	11.0	44	17.3	40	15.7	39	15.3	255	100	2.22	1.87	21

4.4 Factors impacting the role of municipal waste in local economic development

Factor analysis procedure is intended to aid in confirming data consistency as well as appraising the same basic paradigm. Initially, the factorability of the 26 items was tested using several well-recognized criteria for the factorability of a correlation, and all had a minimum correlation above 0.3; this signifies reasonable factorability as illustrated in Table 4.

The Kaiser–Meyer–Olkin measure of sampling adequacy was also 0.936, which is above the recommended value of 0.6, and Bartlett's test of sphericity was significant [$\chi^2(325) = 5{,}866.196$, $p < 0.001$]. Finally, the communalities were >0.3, further confirming that each item shared some common variance with the other

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TABLE 3 Ranking of influence of municipal waste on economic development.

Influence	Mean	Median	Standard deviation	Minimum	Maximum	Rank
Use of incentive schemes	3.22	4.00	1.93	−4.00	5.00	1
The extent of knowledge and understanding of waste management methods and health/sanitation/environment within households.	3.20	4.00	1.95	−5.00	5.00	2
Presence and efficiency of formal or informal waste separation.	3.16	4.00	1.85	−3.00	5.00	3
Enforcement of laws	3.11	4.00	2.03	−5.00	5.00	4
The extent of knowledge and understanding of human behavior and waste management methods within households.	3.09	4.00	1.78	−1.00	5.00	5
Presence and effectiveness of private and/or public waste disposal.	3.09	4.00	2.04	−3.00	5.00	6
Presence and efficiency of formal or informal waste collection.	3.09	4.00	1.78	−2.00	5.00	7
Stability/reliability of fund for MSWM	3.04	3.00	1.86	−2.00	5.00	8
Availability of safe technology and human workforce.	2.99	4.00	1.98	−3.00	5.00	9
Presence and effectiveness of an integrated long-term MSWM strategy.	2.98	4.00	2.16	−3.00	5.00	10
The extent of knowledge and understanding of waste handling methods within households.	2.97	4.00	1.93	−4.00	5.00	11
Profitability of market systems relying on recycled-material throughput, involvement of small businesses, middlemen, and large industries/exporters.	2.95	3.00	1.96	−3.00	5.00	12
Land attributes such as terrain, ownership, and development dictate MSWM.	2.87	3.00	1.83	−3.00	5.00	13
Budget allocation to MSWM	2.84	3.00	1.81	−1.00	5.00	14
The extent of trained personnel in MSWM positions.	2.82	4.00	2.02	−3.00	5.00	15
Government regulations	2.79	3.00	2.00	−4.00	5.00	16
Cost of waste management operations	2.79	3.00	2.04	−4.00	5.00	17
Effective use of safe technology and human workforce.	2.77	3.00	1.83	−1.00	5.00	18
Assessment of waste recovery rate	2.60	3.00	1.88	−3.00	5.00	19
Existence of market systems relying on recycled-material throughput, involvement of small businesses, middlemen, and large industries/exporters.	2.59	3.00	1.94	−3.00	5.00	20
Assessment of waste generation rate	2.48	3.00	1.98	−3.00	5.00	21
Composition of the waste stream	2.47	3.00	2.08	−3.00	5.00	22
Presence and effectiveness of private and/or public waste collection.	2.46	3.00	2.52	−5.00	5.00	23
Individuals' income influencing waste handling behavior (reuse, recycling, illegal dumping)	2.35	3.00	2.60	−5.00	5.00	24
Willingness to pay waste collection/disposal fees by residents.	0.95	2.00	3.55	−5.00	5.00	25
Presence of waste collection/disposal fees	0.67	2.00	3.59	−5.00	5.00	26

items. Given these overall indicators, factor analysis was conducted with all 26 questions. Since the primary purpose was to identify and compute composite management factors, principal component analysis (PCA) was used for the underlying factors. The initial eigenvalues indicated that the first factor explained 51.680% of the variance, the second factor explained 8.246% of the variance, and the third and fourth factors explained 7.572% and 4.440%, respectively, of the variance.

Cronbach's alpha was used to determine the internal consistency of each of the scales, and the alphas were above the recommended values of 0.7–0.933 for the Governance of MSWM Factors (11 items), 0.769 for the Social Behavior Factor (3 items), 0.9300 for the Economic Feasibility for MSWM Factors (8 items), and 0.887 for Education/Knowledge Factors (5 items) (see Table 4). No significant increases in alpha could be reached by excluding additional items for any of the scales, and composite scores were generated for each of the four (4) retained factors based on their means, which had their primary loadings on each factor.

TABLE 4 Factor analysis of the influence of municipal waste on local economic development.

Item no.	Factor	Factor loading	Eigenvalue	Variance explained	Cronbach's alpha
Governance of MSWM factors			13.437	51.680	0.933
1	Government regulations	0.887			
2	Enforcement of laws	0.833			
3	Use of incentive schemes	0.740			
4	Cost of waste management operations	0.895			
5	Budget allocation to MSWM	0.746			
6	Stability/reliability of fund for MSWM	0.653			
8	Assessment of waste recovery rate	0.564			
9	Composition of the waste stream	0.600			
11	Presence and efficiency of formal or informal waste separation.	0.432			
15	Individuals' income influencing waste handling behavior (reuse, recycling, illegal dumping)	0.625			
Social behavior factor			2.144	8.246	0.769
7	Assessment of waste generation rate	0.426			
16	Presence of waste collection/disposal fees	0.796			
17	Willingness to pay waste collection/disposal fees by residents.	0.934			
Economic feasibility for MSWM factors			1.969	7.572	0.93
19	Presence and effectiveness of private and/or public waste disposal.	0.405			
20	The extent of trained personnel in MSWM positions.	0.660			
21	Presence and effectiveness of an integrated long-term MSWM strategy.	0.719			
22	Existence of market systems relying on recycled-material throughput, involvement of small businesses, middlemen, and large industries/exporters.	0.749			
23	Profitability of market systems relying on recycled-material throughput, involvement of small businesses, middlemen, and large industries/exporters.	0.711			
24	Availability of safe technology and human workforce.	0.782			
25	Effective use of safe technology and human workforce.	0.767			
26	Land attributes such as terrain, ownership, and development dictate MSWM.	0.819			
Education/knowledge factors			1.154	4.440	0.887
s10	Presence and efficiency of formal or informal waste collection.	0.633			
12	The extent of knowledge and understanding of human behavior and waste management methods within households.	0.526			
13	The extent of knowledge and understanding of waste management methods and health/sanitation/environment within households.	0.554			
14	The extent of knowledge and understanding of waste handling methods within households.	0.439			
18	Presence and effectiveness of private and/or public waste collection.	0.719			

5 Discussion

According to the NMBM IWMP (2016), municipal waste includes recyclable waste, food waste, garden waste, hazardous waste, and other types of waste. Chen et al. (2020) and Katiyar et al. (2013) listed organic, paper, plastic, metal, glass, and other municipal waste types, and Adeniran and Shakantu (2022) added construction and demolition waste and non-recyclable waste to the municipal waste typology. These findings are consistent with the literature.

This study confirmed the findings of Njoku et al. (2019), who noted that one of the main problems with waste generation is how it causes dust, litter, and consequent pollution in the surrounding environment. According to Dumbili and Henderson (2020), cluttering rivers, fouling streets and sewage banks, and blocking drainage systems are further challenges. Stakeholder conduct

was also noted by Guerrero et al. (2013). These stakeholders include people, business organizations, and the government and its agencies. Due to COVID-19, many enterprises have closed, and visitor numbers have decreased in several areas. This has had an influence on waste generation but in a good way because it has freed up resources to concentrate on household waste management (Leal Filho et al., 2021). Paletta et al. (2019) recognized waste processing and recycling firms as difficult, as the procedures followed result in more harm than benefit due to the created waste.

Household separation and waste awareness initiatives are two social variables that Knickmeyer (2020) recognized as difficulties related to the waste created. They said that the absence of this is a problem since it will influence how people see the waste problem. The challenges posed by waste generated have been identified by Yang et al. (2023) as air pollution, contributions to greenhouse gas emissions, and surface water pollution. These issues persist globally despite various programs and policies aimed at curbing them.

The research suggests that transportation methods can potentially hinder waste creation and collection. It also highlights the importance of a new consumption culture and traditions in circularity, which are linked to user groups and communities sharing the use, value, and function of physical objects, in tandem with the findings of Al-Dailami et al. (2022) and Korhonen et al. (2018).

Another problem caused by waste creation is contamination of the environment, which includes marine ecology. Babanyara et al. (2010) noted that pollution is widespread due to the ongoing generation of waste, which creates many additional problems. This research emphasizes the challenges associated with waste creation, including contamination of aquatic biota and hydrogeology.

The cumulative impact of all the above-identified difficulties keeps driving up demand for landfill usage. Ismail and Latifah (2013) state that the problem of how to provide more waste disposal facilities, such as landfills, to handle waste is caused by the increase in waste output in combination with economic and population growth. According to Idowu et al. (2019), ineffective landfilling practices have also led to inadequate sanitation, a lack of clean water, and poor hygiene across Africa. Therefore, the literature supports the results of this study in that there is an issue with the growing demand for landfill usage.

Hina et al. (2022) highlighted incentives as key to implementing a circular economy, ensuring stakeholder alignment and positively impacting municipal waste management; the results of the present study are consistent with the literature.

Informal waste management promotes economic growth by simplifying recycling and reuse, especially when families are involved, as confirmed by Pharino and Pharino (2017) and Oyekale (2018). This study concurs with the related literature in that it states that the existence and effectiveness of official or informal waste separation has a favorable impact on economic development.

People are directed to engage in a circular economy and sustainable waste management practices through the effectiveness of law enforcement (Patel et al., 2021). Therefore, it is appropriate to conclude from this study that the application of legislation has an impact.

Waste generation and disposal are expected to be significantly and unpredictably influenced by consumer behavior (Esmaeilian et al., 2018). Thus, Martucci et al. (2017) believe that understanding and anticipating human behavior play critical roles in determining the success of environmental projects and the circular economy. The study's conclusions indicate that home waste management practices and human behavior knowledge and comprehension levels have an impact on economic growth.

Wilson et al. (2015) noted that the effectiveness of waste management, and by extension, its contribution to the local economy, depends on the existence of effective public or private waste disposal companies with qualified staff and safe technology for official or informal waste collection. This is because they will supply the equipment needed for this procedure. This study also revealed that economic development is influenced by the existence and efficacy of public and/or private waste disposal entities.

According to Maletz (2018), the implementation of the circular economy is hampered by the lack of funding and budgetary allotments for waste service enhancements. Additionally, monitoring budgets are also gradually decreasing as waste management operations become more expensive. This study also revealed that the conversion of waste for financial benefit is influenced by the budgetary allotment and the stability/reliability of funding for solid waste management. The results of this study are consistent with Maletz (2018) additional identification of factors that affect the availability and profitability of market structures based on recycled-material throughput, as well as the involvement of small businesses, intermediates, and large industries/exporters.

The results of this study, which show that the existence and efficacy of an integrated long-term municipal solid waste management strategy influence waste-enhancing economic development, are consistent with the observations of Kurniawan et al. (2021) that long-term strategies for the standardization of solid waste management are essential for achieving a circular economy.

According to Tisserant et al. (2017), the feasibility and, consequently, the use of waste as a resource are influenced by the rate of waste formation, the rate of recovery, and the makeup of the waste stream. There is a tendency for more raw resources to be used when more waste is produced and recycled or reused. The study's findings are consistent with previous research.

According to this study, property features, including ownership, topography, and development, have an impact on how municipal waste is managed; Troschinetz and Mihelcic (2009) corroborate this finding.

Numerous authors, including Guerrero et al. (2013) and Oyekale (2018), have noted that residents, to the extent that this is possible, do not wish to pay for the waste management services they receive. As a result, the municipality bears the entire burden of waste management, which influences the implementation of the circular economy. This study confirms this finding, as the respondents said that households are willing to pay waste collection and disposal fees and that these costs exist as a factor.

Government regulations, law enforcement, incentive programs, the cost of waste management operations, budgetary allocation to MSWM, the stability and reliability of funds for MSWM, the composition of the waste stream, the existence and effectiveness of formal or informal waste separation, and the impact of an individual's income on waste handling behavior (reuse, recycling,

and illegal dumping) are the sub-factors in governance that this study identified, both in terms of private and public domains.

Government restrictions impact the use of municipal waste for local economic development since they provide a barrier to the adoption of a circular economy in developing nations (Gedam et al., 2021). Extension producer responsibility (EPR) (Maitre-Ekern, 2021), waste recycling goals (Aprile and Fiorillo, 2019), and product and eco-design standards are used to encourage the development of more sustainable and circular products (Mendoza et al., 2017), and prioritizing the purchase of environmentally friendly goods and services could all have an impact on how municipal waste is used to create wealth (Lăzăroiu et al., 2002). Furthermore, these regulations may force businesses to adopt circular practices to be granted access to public procurement opportunities.

One aspect that might guarantee waste to wealth is the degree to which pertinent circularity laws are implemented, as indicated by numerous scholars, including Patel et al. (2021) and Murthy and Ramakrishna (2022), who observed that the attainment of circularity is contingent upon the enforcement of laws.

According to Knickmeyer (2020), social conduct has a significant role in waste management and varies widely across various regions. Caferra et al. (2023) further confirmed that to support a sustainable plan, changes in waste management require behavioral changes on the part of all stakeholders. The evaluation of the waste generation rate, the existence of waste collection and disposal costs, and the willingness of people to pay these fees are the social behavior aspects highlighted by this study.

The presence and efficacy of private and/or public waste disposal; the degree to which trained personnel are trained in MSWM positions; the existence and efficacy of an integrated long-term MSWM strategy; the profitability of market systems reliant on recycled material throughput; the involvement of small businesses, middlemen, and large industries/exporters; the availability of safe technology and human workforces; the efficient use of safe technology and human workforces; and land attributes such as terrain, ownership, and development dictating MSWM were the eight factors influencing the economic feasibility of MSWM. A circular economy requires economic viability, as highlighted by Maletz (2018), who also said that economic viability affects the conversion of waste into benefits.

The presence and effectiveness of formal or informal waste collection; the degree of knowledge and understanding of human behavior and waste management techniques within households; the degree of knowledge and understanding of waste management techniques and health, sanitation, and the environment within households; the degree of knowledge and understanding of waste handling techniques within households; and the existence and efficacy of private and/or public waste collection are the five factors that make up the fourth factor, education and knowledge. According to Grodzinska-Jurczak (2003), the establishment of a circular economy—which might support local economic growth—will not be achievable without the effective formal and informal education of society.

6 Proposed framework for a sustainable solid waste management system that promotes economic development in urban areas

Based on the combined outcomes of the comprehensive review of the literature pertaining to theories and practices of solid waste management and key results and findings of this study, a framework is provided to show the interdependence of items necessary for waste-to-wealth and, ultimately, local economic development; this framework is presented in Figure 2.

The framework depicts a three-layer expanding circle, with the outermost circle representing waste in the environment, which can be influenced by the next circle of MSWM governance, social behavior, economic feasibility, and education/knowledge to ensure waste to wealth in the local economy. The central circle, which depicts the identified reasons for which waste management is beneficial, also assists in sustainable management. Furthermore, there must be synergy among all of these components, and none of these components can be separated for successful wealth management for local economic growth.

To effectively implement the framework, it is crucial to take into account all the factors uncovered by this research as dynamic elements essential for transforming waste into a valuable resource and promoting local economic development.

According to the study's findings, one of the major factors in determining how waste management generally influences economic growth is the administration of municipal solid waste management (MSWM). Waste management procedures must be strictly controlled, enforced, and in line with the objectives of economic development to be considered effective. The sub-factors are government regulations, enforcement of laws, use of incentive schemes, cost of waste management operations, budget allocation to MSWM, stability/reliability of funds for MSWM, assessment of waste recovery rate composition of the waste stream, presence and efficiency of formal or informal waste separation and individuals' income influencing waste handling behavior (reuse, recycling, and illegal dumping). To turn waste into wealth and guarantee that solid waste management makes a beneficial contribution to economic growth, a thorough and well-managed governance process that considers the aforementioned sub-factors is necessary. Establishing a waste management ecosystem that is both economically advantageous and sustainable requires cooperation among businesses, government agencies, and the community.

Undoubtedly, the role of solid waste management in economic development is multifaceted, and social behavior plays a crucial role in shaping the success of waste management initiatives. The sub-factors related to this factor include the assessment of the waste generation rate, the presence of waste collection/disposal fees and the willingness to pay for waste collection/disposal fees. This study deduced that social behavior is a crucial component that effective waste-to-wealth frameworks must take into account. Attaining sustainable and economically feasible solid waste management systems requires community engagement, a grasp of people's willingness to pay, and the provision of suitable incentives.

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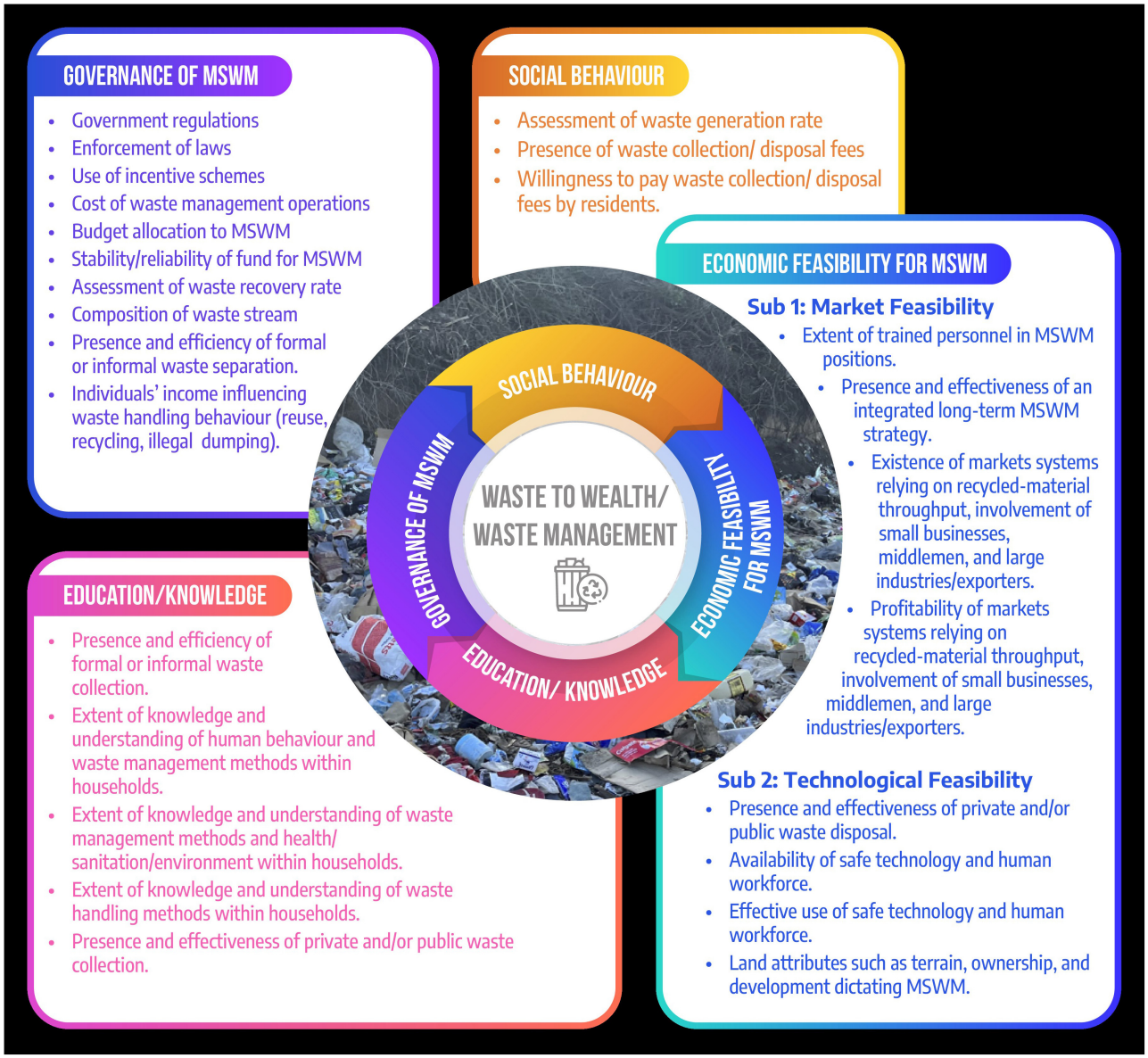

FIGURE 2
Framework for sustainable solid waste management system that promotes economic development in urban areas.

Another factor identified by this research as a critical factor in determining the role of solid waste management in economic development is the economic feasibility of municipal solid waste management (MSWM). The sub-factors identified by this study are the presence and effectiveness of private and/or public waste disposal; the extent of trained personnel in MSWM positions; the presence and effectiveness of an integrated long-term MSWM strategy; the existence of market systems relying on recycled-material throughput; the involvement of small businesses, middlemen, and large industries/exporters; the profitability of market systems relying on recycled-material throughput; the involvement of small businesses, middlemen, and large industries/exporters; the availability of safe technology and human workforce; the effective use of safe technology and human workforce; and land attributes such as terrain, ownership, and development dictate MSWM. While economic feasibility in municipal solid waste management involves a holistic assessment of various factors and sub-factors, communities wishing to harness waste as an economic resource must address these aspects to ensure that waste management contributes positively to economic development while minimizing environmental impact.

The last factor, education and knowledge, plays a crucial role in the successful implementation of solid waste management programs, and they contribute significantly to the economic development associated with waste management. The sub-factors identified by this study are the presence and efficiency of formal or informal waste collection, the extent of knowledge and understanding of human behavior and waste management methods within households, the extent of knowledge and understanding of waste management methods and health/sanitation/environment

within households, the extent of knowledge and understanding of waste handling methods within households and the presence and effectiveness of private and/or public waste collection. As revealed in this study, education is a stimulant that encourages favorable attitudes and practices related to waste management. A better education and involvement of the public in waste management processes can result from successful educational programs that empower both people and communities. This promotes public health, lowers environmental pollution, and opens doors for the resource recovery and recycling sectors, all of which support economic growth.

To ensure sustainable waste-to-wealth, each community should collectively consider these factors by efficiently managing waste.

7 Conclusion

The goal of this research study was to look into how solid waste management can help economic growth in cities by creating a waste management framework that can be used to achieve Integrated Solid Waste Management (ISWM) and help poor urban communities grow their economies.

This research identified various types of waste, assessed challenges, and evaluated waste's potential for resource creation. The study concluded that municipal waste includes organic, paper, plastic, metal, glass, food, garden, hazardous, construction, demolition, and non-recyclable waste. Environmental pollution poses a significant challenge, and 26 factors have been found to positively influence the conversion of waste into wealth. The research also highlighted the importance of land attributes, budget allocation, trained personnel, and government regulations. The proposed framework aims to reduce urban poverty while also preserving the environment and supporting the current urban economy. Finally, the study demonstrates that the transformation of waste into wealth can be achieved through social behavior, education/knowledge, MSWM governance, and economic feasibility for MSWM. Therefore, these factors were incorporated into the proposed waste to wealth framework.

The framework might help to shore up the present urban economy. In this scenario, the fundamental question is whether stakeholders will continue to ignore waste's potential demands and benefits for urban economic growth. The proposed framework is applicable not only to the NMBM but also to South Africa and other developing countries.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Nelson Mandela University_Research Ethics Committee: Human (REC-H). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

SMn: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. SMb: Supervision, Writing – review & editing. AA: Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Abdel-Shafy, H. I., and Mansour, M. S. (2018). Solid waste issue: sources, composition, disposal, recycling, and valorization. *Egypt. J. Petroleum* 27, 1275–1290. doi: 10.1016/j.ejpe.2018.07.003

Abubakar, I. R., Maniruzzaman, K. M., Dano, U. L., AlShihri, F. S., AlShammari, M. S., Ahmed, S. M. S., et al. (2022). Environmental sustainability impacts of solid waste management practices in the global South. *Int. J. Environ. Res. Public Health* 19:12717. doi: 10.3390/ijerph191912717

Adeniran, A., Elegbede, O. T., and Ogundiran, A. A. (2018). Solid waste management and property values: issues and challenges in Old Bodija, Ibadan, Nigeria. *Soc. Sci. Human. Res.* 6, 185–194.

Adeniran, A. A., and Shakantu, W. (2022). The health and environmental impact of plastic waste disposal in South African Townships: a review. *Int. J. Environ. Res. Public Health* 19:779. doi: 10.3390/ijerph19020779

Al-Dailami, A., Ahmad, I., Kamyab, H., Abdullah, N., Koji, I., Ashokkumar, V., et al. (2022). Sustainable solid waste management in Yemen: environmental, social aspects, and challenges. *Biomass Conver. Bioref.* 1–27. doi: 10.1007/s13399-022-02871-w

Al-Dailami, A., Ahmad, I., Kamyab, H., Abdullah, N., Koji, I., Ashokkumar, V., et al. (2022). Sustainable solid waste management in Yemen: environmental, social aspects, and challenges. *Biomass Convers. Bioref.* 1–27. doi: 10.1007/s13399-022-02871-w

Alpizar, F., Carlsson, F., Lanza, G., Carney, B., Daniels, R. C., Jaime, M., et al. (2020). A framework for selecting and designing policies to reduce marine plastic pollution in developing countries. *Environ. Sci. Policy* 109, 25–35. doi: 10.1016/j.envsci.2020.04.007

Ambarwati, D., Safaa'at, R., Hamidah, S., and Sulistyarini, R. (2023). Local economic development concept: a comparison between indonesian village-owned enterprises and chinese township and village enterprises. *Int. J. Soc. Sci. Res. Rev.* 6, 254–270. doi: 10.47814/ijssrr.v6i4.1163

Aprile, M. C., and Fiorillo, D. (2019). Intrinsic incentives in household waste recycling: the case of Italy in the year 1998. *J. Clean. Prod.* 227, 98–110. doi: 10.1016/j.jclepro.2019.04.184

Ara, S., Khatun, R., and Uddin, M. S. (2021). Urbanization challenge: Solid waste management in Sylhet City, Bangladesh. *Int. J. Eng. Appl. Sci. Technol.* 5, 20–28. doi: 10.33564/IJEAST.2021.v05i10.004

Babanyara, Y. Y., Usman, H. A., and Saleh, U. F. (2010). An overview of urban poverty and environmental problems in Nigeria. *J. Hum. Ecol.* 31, 135–143. doi: 10.1080/09709274.2010.11906304

Caferra, R., D'Adamo, I., and Morone, P. (2023). Wasting energy or energizing waste? The public acceptance of waste-to-energy technology. *Energy* 263:126123. doi: 10.1016/j.energy.2022.126123

Chen, D. M. C., Bodirsky, B. L., Krueger, T., Mishra, A., and Popp, A. (2020). The world's growing municipal solid waste: trends and impacts. *Environ. Res. Lett.* 15:074021. doi: 10.1088/1748-9326/ab8659

Cohen, S. (2014). *Understanding Environmental Policy*. New York: Columbia University Press. doi: 10.7312/cohe13536

David, V. E., John, Y., and Hussain, S. (2020). Rethinking sustainability: a review of Liberia's municipal solid waste management systems, status, and challenges. *J. Mater. Cycles Waste Manage.* 22, 1299–1317. doi: 10.1007/s10163-020-01046-x

Department of Environmental Affairs (2018). *South Africa State of Waste Report: First draft report. Pretoria, Republic of South Africa.* Available at: https://soer.environment.gov.za/soer/UploadLibraryImages/UploadDocuments/141119143510_state%20of%20Waste%20Report_2018.pdf (accessed October 20, 2020).

Devlin, J., Hopeward, K., Hopeward, J., and Saint, C. (2023). Leading the circular future: South Australia's potential influence on circular economy development in Asia-Pacific Region. *Sustainability* 15:13756. doi: 10.3390/su151813756

Doe, B., Aboagye, P. D., Osei-Owusu, P. K., Amoah, T., Aidoo, A., and Amponsah, N. Y. (2023). Towards circular economy and local economic development in ghana: insights from the coconut waste value chain. *Circ. Econ. Sustain.* 3, 347–372. doi: 10.1007/s43615-022-00182-w

Drummond, J., Drummond, F., and Rogerson, C. M. (2021). Latent opportunities for heritage tourism in South Africa: evidence from Mahikeng and surrounds. *Afr. J. Hospit. Tour. Leisure* 10, 1591–1609. doi: 10.46222/ajhtl.19770720.181

Dumbili, E., and Henderson, L. (2020). "The challenge of plastic pollution in Nigeria," in *Plastic Waste and Recycling* (Academic Press), 569–583. doi: 10.1016/B978-0-12-817880-5.00022-0

Enaifoghe, A., and Vezi-Magigaba, M. F. (2023). Conceptualizing the role of entrepreneurship and SME in fostering South Africa's local economic development. *Int. J. Res. Bus. Soc. Sci.* 12, 96–105. doi: 10.20525/ijrbs.v12i4.2444

Esmaeilian, B., Wang, B., Lewis, K., Duarte, F., Ratti, C., and Behdad, S. (2018). The future of waste management in smart and sustainable cities: a review and concept paper. *Waste Manage.* 81, 177–195. doi: 10.1016/j.wasman.2018.09.047

Eurostat (2017). *Environmental Protection Expenditure Accounts Handbook 2017 edition*. Luxembourg: Publications Office of the European Union. Available at: http://ec.europa.eu/eurostat/about/policies/copyright (accessed September 4, 2019).

Ferreira, C., Broughton, K., Broadhurst, K., and Ferreira, J. (2023). Collaborative innovation in a local authority–'local economic development-by-project'? *Public Manag. Rev.* 26, 1405–1423. doi: 10.1080/14719037.2023.2185663

Ferronato, N., and Torretta, V. (2019). Waste mismanagement in developing countries: a review of global issues. *Int. J. Environ. Res. Public Health* 16, 1–28. doi: 10.3390/ijerph16061060

Garlapati, V. K. (2016). E-waste in India and developed countries: management, recycling, business and biotechnological initiatives. *Renew. Sustain. Energy Rev.* 54, 874–881. doi: 10.1016/j.rser.2015.10.106

Gedam, V. V., Raut, R. D., de Sousa Jabbour, A. B. L., Tanksale, A. N., and Narkhede, B. E. (2021). Circular economy practices in a developing economy: barriers to be defeated. *J. Clean. Prod.* 311:127670. doi: 10.1016/j.jclepro.2021.127670

Godfrey, L., and Oelofse, S. (2017). Historical review of waste management and recycling in South Africa. *Resources* 6:57. doi: 10.3390/resources6040057

Gough, K. V., Langevang, T., and Namatovu, R. (2013). Researching entrepreneurship in low-income settlements: the strengths and challenges of participatory methods. *Int. Inst. Environ. Dev.* 26, 297–311. doi: 10.1177/0956247813512250

Grodzinska-Jurczak, M. (2003). The relation between education, knowledge and action for better waste management in Poland. *Waste Manag. Res.* 21, 2–18. doi: 10.1177/0734242X0302100102

Guerrero, L. A., Maas, G., and Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Manag.* 33, 220–232. doi: 10.1016/j.wasman.2012.09.008

Gupta, J., and Vegelin, C. (2016). Sustainable development goals and inclusive development. *Int. Environ. Agree.* 16, 433–448. doi: 10.1007/s10784-016-9323-z

Heacock, M., Kelly, C. B., Asante, K. A., Birnbaum, L. S., Bergman, Å. L., Brun,é, M. N., et al. (2016). E-waste and harm to vulnerable populations: a growing global problem. *Environ. Health Perspect.* 124, 550–555. doi: 10.1289/ehp.1509699

Hina, M., Chauhan, C., Kaur, P., Kraus, S., and Dhir, A. (2022). Drivers and barriers of circular economy business models: where we are now, and where we are heading. *J. Clean. Prod.* 333:130049. doi: 10.1016/j.jclepro.2021.130049

Hoang, A. T., Varbanov, P. S., Nizetic, S., Sirohi, R., Pandey, A., Luque, R., et al. (2022). Perspective review on Municipal Solid Waste-to-energy route: Characteristics, management strategy, and role in circular economy. *J. Clean. Prod.* 359:131897. doi: 10.1016/j.jclepro.2022.131897

Ibikunle, R. A., Titiladunayo, I. F., Lukman, A. F., Dahunsi, S. O., and Akeju, E. A. (2020). Municipal solid waste sampling, quantification and seasonal characterization for power evaluation: Energy potential and statistical modelling. *Fuel* 277:118122. doi: 10.1016/j.fuel.2020.118122

Idowu, I. A., Atherton, W., Hashim, K., Kot, P., Alkhaddar, R., Alo, B. I., et al. (2019). An analysis of the status of landfill classification systems in developing countries: Sub-Saharan Africa landfill experiences. *Waste Manag.* 87, 761–771. doi: 10.1016/j.wasman.2019.03.011

Islamovna, U. Z. (2022). Development of tourist and recreational cluster of Samarkand region and its impact on domestic business. *Eur. Multidiscipl. J. Mod. Sci.* 4, 39–44.

Ismail, S. N. S., and Latifah, A. M. (2013). The challenge of future landfill: A case study of Malaysia. *J. Toxicol. Environ. Health Sci.* 5, 2400–2407. doi: 10.5897/JTEHS12.058

Kaletnik, G., and Lutkovska, S. (2020). Innovative environmental strategy for sustainable development. *Eur. J. Sustain. Dev.* 9:89. doi: 10.14207/ejsd.2020.v9n2p89

Kamara, R. D. (2017). Creating enhanced capacity for local economic development (LED) through collaborative governance in South Africa. *SocioEcon. Challenges* 1, 98–115. doi: 10.21272/sec.1(3).98-115.2017

Katiyar, R. B., Suresh, S., and Sharma, A. K. (2013). Characterization of municipal solid waste generated by the City of Bhopal, India. *Int. J. ChemTech Res.* 5, 623–628.

Khan, I., Chowdhury, S., and Techato, K. (2022). Waste to energy in developing countries—a rapid review: opportunities, challenges, and policies in selected countries of sub-Saharan Africa and South Asia towards sustainability. *Sustainability* 14:3740. doi: 10.3390/su14073740

Knickmeyer, D. (2020). Social factors influencing household waste separation: a literature review on good practices to improve the recycling performance of urban areas. *J. Clean. Prod.* 245:118605. doi: 10.1016/j.jclepro.2019.118605

Korhonen, J., Honkasalo, A., and Seppala, J. (2018). Circular economy: the concept and its limitations. *Ecol. Econ.* 143, 37–46. doi: 10.1016/j.ecolecon.2017.06.041

Kuik, S., Kumar, A., Diong, L., and Ban, J. (2023). A systematic literature review on the transition to circular business models for small and medium-sized enterprises (SMEs). *Sustainability* 15:9352. doi: 10.3390/su15129352

Kumar, S. (2016). *Municipal Solid Waste Management in Developing Countries*. Boca Raton: CRC Press. doi: 10.1201/9781315369457

Kurniawan, T. A., Lo, W., Singh, D., Othman, M. H. D., Avtar, R., Hwang, G. H., et al. (2021). A societal transition of MSW management in Xiamen (China) toward a circular economy through integrated waste recycling and technological digitization. *Environ. Pollut.* 277:116741. doi: 10.1016/j.envpol.2021.116741

Lăzăroiu, G., Ionescu, L., Andronie, M., and Dijmărescu, I. (2020). Sustainability management and performance in the urban corporate economy: a systematic literature review. *Sustainability* 12:7705. doi: 10.3390/su12187705

Leal Filho, W., Voronova, V., Kloga, M., Paço, A., Minhas, A., Salvia, A. L., et al. (2021). COVID-19 and waste production in households: a trend analysis. *Sci. Total Environ.* 77:145997. doi: 10.1016/j.scitotenv.2021.145997

Liang, X., Kurniawan, T. A., Goh, H. H., Zhang, D., Dai, W., Liu, H., et al. (2022). Conversion of landfilled waste-to-electricity (WTE) for energy efficiency improvement in Shenzhen (China): a strategy to contribute to resource recovery of unused methane for generating renewable energy on-site. *J. Clean. Prod.* 369:133078. doi: 10.1016/j.jclepro.2022.133078

Madanaguli, A., Kaur, P., Mazzoleni, A., and Dhir, A. (2022). The innovation ecosystem in rural tourism and hospitality–a systematic review of innovation in rural tourism. *J. Knowl. Manag.* 26, 1732–1762 doi: 10.1108/JKM-01-2021-0050

Maitre-Ekern, E. (2021). Rethinking producer responsibility for a sustainable circular economy from extended producer responsibility to premarket producer responsibility. *J. Clean. Prod.* 286:125454. doi: 10.1016/j.jclepro.2020.125454

Makhathini, M. S., Mlambo, V. H., and Mpanza, S. (2020). Infrastructure provision as a catalyst for local economic development in South Africa. *Strat. Rev. Southern Africa* 42:198. doi: 10.35293/srsa.v42i1.198

Maletz, R. (2018). "Success factors for the implementation of separate collection systems," in *Source Separation and Recycling: Implementation and Benefits for a Circular Economy,* 297–297. doi: 10.1007/698_2017_51

Mandpe, A., Paliya, S., Gedam, V. V., Patel, S., Tyagi, L., and Kumar, S. (2023). Circular economy approach for sustainable solid waste management: a developing economy perspective. *Waste Manag. Res.* 41, 499–511. doi: 10.1177/0734242X221126718

Martucci, L. A., Fischer-Hübner, S., Hartswood, M., and Jirotka, M. (2017). "Privacy and social values in smart cities," in *Designing, Developing, and Facilitating Smart Cities: Urban Design to IoT Solutions,* 89–107. doi: 10.1007/978-3-319-44924-1_6

Mathew, A., Isbanner, S., Xi, Y., Rundle-Thiele, S., David, P., Li, G., et al. (2023). A systematic 'literature review of voluntary behaviour change approaches in single-use plastic reduction. *J. Environ. Manage.* 336:117582. doi: 10.1016/j.jenvman.2023.117582

Mendoza, J. M. F., Sharmina, M., Gallego-Schmid, A., Heyes, G., and Azapagic, A. (2017). Integrating backcasting and eco-design for the circular economy: the BECE framework. *J. Industr. Ecol.* 21, 526–544. doi: 10.1111/jiec.12590

Michael, A. O., Kayode, O. L., and Idowu, O. G. (2023). Enhancing public administration for sustainable environmental strategies: a framework for effective implementation in Nigeria. *FUOYE J. Public Admin. Manage.* 1:16.

Mohee, R., Mauthoor, S., Bundhoo, Z. M. A., Somaroo, G., Soobhany, N., and Gunasee, S. (2015). Current status of solid waste management in small island developing states: a review. *Waste Manag.* 43, 539–549. doi: 10.1016/j.wasman.2015.06.012

Mori, J., and Stroud, D. (2021). Skills policy for growth and development: The merits of local approaches in Vietnam. *Int. J. Educ. Dev.* 83:102386. doi: 10.1016/j.ijedudev.2021.102386

Murthy, V., and Ramakrishna, S. (2022). A review on global e-waste management: urban mining towards a sustainable future and circular economy. *Sustainability* 14:647. doi: 10.3390/su14020647

Nel, L. (2019). *Regional and Local Economic Development in South Africa: The Experience of the Eastern Cape*. New York: Routledge Revivals. doi: 10.4324/9780429445224

Njoku, P. O., Edokpayi, J. N., and Odiyo, J. O. (2019). Health and environmental risks of residents living close to a landfill: a case study of Thohoyandou Landfill, Limpopo Province, South Africa. *Int. J. Environ. Res. Public Health* 16:2125. doi: 10.3390/ijerph16122125

NMBM IWMP (2016). *Nelson Mandela Bay Municipality Integrated Waste Management Plan 2016-2020.* Port Elizabeth, South Africa. Available at: https://www.nelsonmandelabay.gov.za/datarepository/documents/iwmp-executive-summary.pdf (accessed July 23, 2023).

Oduro-Appiah, K., Scheinberg, A., Mensah, A., Afful, A., Boadu, H. K., and de Vries, N. (2017). Assessment of the municipal solid waste management system in Accra, Ghana: a "Wasteaware" benchmark indicator approach. *Waste Manag. Res.* 35, 1149–1158. doi: 10.1177/0734242X17727066

Oyekale, A. S. (2018). Determinants of households' involvement in waste separation and collection for recycling in South Africa. *Environ. Dev. Sustain.* 20, 2343–2371. doi: 10.1007/s10668-017-9993-x

Oyekale, A. S. (2018). Determinants of households' involvement in waste separation and collection for recycling in South Africa. *Environ. Dev. Sustain*. 20, 2343–2371. doi: 10.1007/s10668-017-9993-x

Paletta, A., Leal Filho, W., Balogun, A. L., Foschi, E., and Bonoli, A. (2019). Barriers and challenges to plastics valorization in the context of a circular economy: case studies from Italy. *J. Clean. Prod.* 241:118149. doi: 10.1016/j.jclepro.2019.118149

Patel, M., Kumari, S., Kumari, N., and Ghosh, A. (2021). "Understanding circular economy in solid waste management," in *Handbook of Solid Waste Management: Sustainability Through Circular Economy* (Singapore: Springer Singapore), 1–33. doi: 10.1007/978-981-15-7525-9_7-1

Pharino, C., and Pharino, C. (2017). "Waste characteristics and practices," in *Challenges for Sustainable Solid Waste Management: Lessons from Thailand,* 15–28. doi: 10.1007/978-981-10-4631-5_2

Ranjbari, M., Saidani, M., Esfandabadi, Z. S., Peng, W., Lam, S. S., Aghbashlo, M., et al. (2021). Two decades of research on waste management in the circular economy: Insights from bibliometric, text mining, and content analyses. *J. Clean. Prod.* 314:128009. doi: 10.1016/j.jclepro.2021.128009

Rasmeni, Z. Z., and Madyira, D. M. (2019). A review of the current municipal solid waste management practices in Johannesburg City townships. *Procedia Manuf.* 35, 1025–1031. doi: 10.1016/j.promfg.2019.06.052

Rodic, L., and Wilson, D. C. (2017). Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries. *Sustainability* 9:404. doi: 10.3390/su9030404

Roy, S., Rautela, R., and Kumar, S. (2023). Towards a sustainable future: Nexus between the sustainable development goals and waste management in the built environment. *J. Clean. Prod.* 415:137865. doi: 10.1016/j.jclepro.2023.137865

Suryawan, I. W. K., and Lee, C. H. (2023). Citizens' willingness to pay for adaptive municipal solid waste management services in Jakarta, Indonesia. *Sustain. Cities Soc.* 97:104765. doi: 10.1016/j.scs.2023.104765

Tisserant, A., Pauliuk, S., Merciai, S., Schmidt, J., Fry, J., Wood, R., et al. (2017). Solid waste and the circular economy: a global analysis of waste treatment and waste footprints. *J. Industr. Ecol.* 21, 628–640. doi: 10.1111/jiec.12562

Tongco, M. D. C. (2007). *Purposive Sampling as a Tool for Informant Selection.*

Troschinetz, A. M., and Mihelcic, J. R. (2009). Sustainable recycling of municipal solid waste in developing countries. *Waste Manag.* 29, 915–923. doi: 10.1016/j.wasman.2008.04.016

United Nations (2020). *Part I Out of the Waste Crisis. UNESCAP*. Available at: https://www.unescap.org/sites/default/files/PARTIOutoftheWasteCrisis.pdf (accessed July 22, 2020).

Vaish, B., Sharma, B., Srivastava, V., Singh, P., Ibrahim, M. H., and Singh, R. P. (2019). Energy recovery potential and environmental impact of gasification for municipal solid waste. *Biofuels* 10, 87–100. doi: 10.1080/17597269.2017.1368061

Vij, D. (2012). Urbanization and solid waste management in India: present practices and future challenges. *Procedia-Soc. Behav. Sci.* 37, 437–447. doi: 10.1016/j.sbspro.2012.03.309

Weitz, K. A., Thorneloe, S. A., Nishtala, S. R., Yarkosky, S., and Zannes, M. (2002). The impact of municipal solid waste management on greenhouse gas emissions in the United States. *J. Air Waste Manag. Assoc.* 52, 1000–1011. doi: 10.1080/10473289.2002.10470843

Wilson, D. C., Rodic, L., Cowing, M. J., Velis, C. A., Whiteman, A. D., Scheinberg, A., et al. (2015). 'Wasteaware' benchmark indicators for integrated sustainable waste management in cities. *Waste Manag.* 35, 329–342. doi: 10.1016/j.wasman.2014.10.006

Wilson, D. C., Rodic, L., Scheinberg, A., Velis, C. A., and Alabaster, G. (2012). Comparative analysis of solid waste management in 20 cities. *Waste Manag. Res.* 30, 237–254. doi: 10.1177/0734242X12437569

Yang, M., Chen, L., Wang, J., Msigwa, G., Osman, A. I., Fawzy, S., et al. (2023). Circular economy strategies for combating climate change and other environmental issues. *Environ. Chem. Lett.* 21, 55–80. doi: 10.1007/s10311-022-01499-6

Yaska, M., and Nuhu, B. M. (2024). Assessment of measures of central tendency and dispersion using likert-type scale. *Afr. J. Adv. Sci. Technol. Res.* 16, 33–45. doi: 10.62154/ajastr.2024.016.010379

Yukalang, N., Clarke, B., and Ross, K. (2018). Solid waste management solutions for a rapidly urbanizing area in Thailand: recommendations based on stakeholder input. *Int. J. Environ. Res. Public Health* 15, 1302–1325. doi: 10.3390/ijerph15071302