Household adoption of modern waste management technologies in Ilala Municipal Council, Dar es Salaam, Tanzania

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Abstract
The study explored the factors influencing household adoption of Modern Waste Management Technologies (MWMT) in Ilala Municipal Council. The study aimed at examining the factors influencing household adoption of MWMT, the characteristics of households in Ilala Municipal Council, and the challenges they face in adopting MWMT. The study employed a cross-sectional survey design, utilizing both quantitative and qualitative data. A structured questionnaire was administered to a sample of 100 household heads, selected using simple random sampling with the aid of the Yamane formula, in Kivule ward, which was purposefully selected. Logistic regression was used to analyze the factors influencing the adoption of MWMT. The results revealed that age, family size, monthly income, education level (secondary and tertiary), perceived benefits, and economic incentives were statistically significant factors. Challenges to adoption were analyzed descriptively using a five-point Likert scale. The results indicated that informal housing development, irregular waste collection, and lack of education on waste management were the major challenges.

1. Introduction

In the face of rapid urbanization and the ever-growing challenge of managing waste, the adoption of modern waste management technologies at the household level stands as a crucial frontier in creating sustainable and livable urban environments. As the global population congregates in urban centers, the intricate dance between humanity and its waste becomes an increasingly complex choreography (Dragomir et al., 2010). In recent years, research into the question of solid waste management has come to the forefront due to the increasing complexity of this service, caused by the growth of cities and high service costs, among other factors (Bel and Mur, 2009, Benito-López et al., 2011).

In many developing countries, the lack of viable alternatives to handle waste management efficiently and effectively to prevent environmental pollution is still a challenge (Davis, 2014). The main source of pollution includes wastewater from leaking sewage system, heavy smoke and chemicals from agricultural activities, air pollution, vehicle scraps from transportation activities, electronic and non-electronic scraps from market activities, noise and gaseous emissions from industrial activities and leachates from dumpsites (Abarca, 2013). The emission of greenhouse and other toxic gases from treatment and disposal procedures is one of the most common issues with old waste management methods like Open Dumping,Incineration without Energy Recovery, burning, and Uncontrolled Dumping.

New technologies have recently been introduced to combat the severe consequences of poor waste management, which are more efficient and environmentally friendly, for instance; Waste-to-Energy Incineration, Landfill Gas Recovery, Recycling, Composting, Anaerobic Digestion, Mechanical Biological Treatment (MBT), Waste Sorting Technologies, Pyrolysis, Smart Waste Management Systems and Zero Waste Initiatives (Kitole & Sesabo, 2022). Several internationally and locally designed initiatives have been implemented to curb the impact of improper management of solid wastes. One of the Eight Millennium Development Goals (MDGs) outlined in the declaration have waste or resource efficiency implications is to ensure environmental sustainability by integrating the principles of sustainable development into country policies and programs and reverse the loss of environmental resources (Ezeah, 2006; Kitole & Sesabo, 2024). The national solid waste management strategy (2018), The Environment Management Act (EMA) No. 20 of 2004, and the National Environment Management Council (NEMC) Act No. 19 of 1983, is in practice in Tanzania to make sure that environmental conservation and sanitation are maintained. It is in this context that efficient and sustainable waste management systems are required as the country develops into a newly industrialized state by 2025. However, municipal solid waste management has been commonly the largest single budget item for communities, industries, institutions, and business areas such as in markets. In the face of that, approximately more than 10,000 tons of municipal solid wastes are generated per day with a rate ranging from 0.1 to 1.0 kg/cap/day countrywide (Ndum, 2013).

In the national solid waste management strategy (2018), the government had issued a Public Notice to ban the manufacturing, importation, selling, buying, and use of plastic bags under 30 microns (or 0.03 mm) thickness and those with 65 microns (or 0.065 mm) thickness used for water and juice packaging. Also, it surtaxes other types of plastic bags with 30 microns (or 0.03 mm) thickness and above, by more than 100%. Industry owners and investors are encouraged to promote the production of alternative bags in place of plastic bags, such as paper manufactured bags. Moreover, the Dar es Salaam metropolitan development project phase two (DMDP) has also established city wide solid waste management systems and supportive infrastructure and landfill facilities (Makonyo& Msabi, 2022).

Several studies had been conducted to access factors for households' adoption of modern waste management technologies (Muhamad, 2022; Boniface, 2022; Natalia, 2023; Litvinov, 2020; Marcin, 2020), and results of those studies found the factors behind were: Household's income level, education level, Government planning, country's economic situation, priorities, waste type generated, and population size. But none of these studies had looked on the perceived benefits by the household when adopting modern waste management technologies, hence this study aimed to fill the existing gap of knowledge by examining factors for households' adoption of modern waste management technologies in Ilala District, Dar es Salaam, Tanzania.

Despite the increasing awareness of the environmental and health implications of improper waste disposal, there exists a persistent challenge in encouraging households to adopt modern waste management technologies. Ilala district still faces issues related to inadequate waste separation, low participation in recycling programs, and a general reluctance to embrace innovative waste management solutions. Understanding the factors influencing households' decisions in adopting modern waste management technologies is crucial for designing effective interventions and policies to promote sustainable waste management practices. This study seeks to identify and analyze the key determinants that impact the adoption of such technologies at the household level, with the goal of informing targeted strategies to enhance community-wide waste management practices.

Figure 1 Conceptual Framework
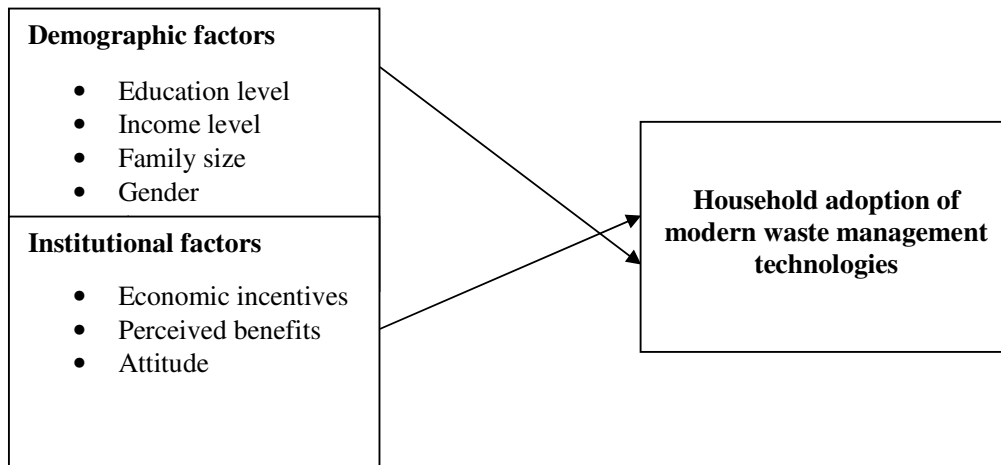
Source: Own Construct, (2024)

2. Data and Method

Study Area, Population, and Sample The study was conducted in the Ilala District, officially known as the Ilala Municipal Council, located in the Dar es Salaam region of Tanzania. The district is bordered by Kinondoni and Ubungo districts to the north and northeast, the Zanzibar Channel to the east, Pwani Region to the west, and Temeke District to the south. Covering an area of 364.9 km² and divided into 36 wards, Ilala experiences temperatures ranging from 26°C in August to 35°C in December and January, with an average monthly rainfall of 150mm to 300mm during the long rainy season (March - May). The district generates 1100 tons of waste per day, of which only 39% is collected. The focus of this study was Kivule ward, situated at latitude -6.9363° south and longitude 39.183° east. According to the 2022 Tanzanian population census, Kivule ward has an estimated population of 88,273 with a density of 4,280 people per km². The sample size for the study was determined using

Yamane's (1967) formula, and both probability (simple random sampling) and non-probability sampling techniques were employed to select participants from the ward.
Research Design, Data Collection, and Instruments This research utilized a cross-sectional design, allowing for the collection of data at a single point in time, which is both time and cost-effective compared to longitudinal studies. The primary data collection technique involved administering structured questionnaires to household heads in Kivule ward. These questionnaires contained closed-ended questions aligned with the study's objectives. The study's unit of analysis was households within the Ilala Municipal Council, specifically targeting household heads to respond to the research questions. By employing a combination of simple random sampling for selecting individual households and purposive selection of Kivule ward, the study ensured a representative sample while maintaining relevance to the specific research area.

3. Econometrics analysis and results

This study employs a Logit model to estimate the determinants of household adoption of modern waste management technologies in Ilala District. The Logit model is particularly suitable for this analysis as it allows for the examination of binary outcomes—whether a household adopts or does not adopt the technology (Theodory & Kitole, 2024; Dimoso & Andrew, 2021; Kitole et al., 2023; Kitole et al., 2024). By analyzing factors such as age, family size, income level, gender, attitude, education level, perceived benefits, and economic incentives, the Logit model provides insights into the likelihood of adoption.

Let; y be the adaptation of the modern waste management technologies

$$y_i = mx + c$$

Whereby y takes a value of 0 or 1 (Unbalanced scale), x ranges from $-\infty$ to ∞ (Balanced scale)

$$P = mx + c$$

Values of odds ratio start from 0 to ∞ (unbalanced scale). Odds ratio is the probability of wining upon the probability of losing.

$$Odds\ ratio = \frac{P}{1-P}$$

Odds ratio has imbalance scale so transform to logarithm function
Since $\log 1 = 0$, $\log \infty = \infty$, $\log 0 = -\infty$, $e \approx 2.71828$ is the base of the natural logarithm

$$\log_e\left(\frac{P}{1-P}\right) = \ln\left(\frac{P}{1-p}\right)$$

$$\ln\left(\frac{P}{1-P}\right) = mx + c$$

Applying exponential function on both side

$$\frac{P}{1-p} = e^{mx+c}$$

$$P = (e^{mx+c})(1-P)$$

$$P = \frac{e^{mx+c}}{1+(e^{mx+c})}$$

The general formula:

$$logit(P) = \ln(\frac{P}{1-P}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k + \mu$$

Where,β_0 is the intercept term, β_0, β_1 …. β_k are the coefficients associated with the predictor variables $X_1, X_2 … X_k$, $\frac{P}{1-P}$ represents the odds of event to occur, $logit(P)$ represents natural logarithm of the odds ratio, and μ represents error term

4. Results and discussion

The characteristics of the respondents in this study are summarized in Table 1, which provides insights into their age, income level, and family size. The sample consists of 100 respondents, offering a diverse representation of the population within Kivule ward.

Table 1 Summary of respondents' characteristics

Variables	Observation	Mean	Std. Dev	Min	Max
Age	100	34.5	13.27982	14	69
Income Level	100	86630	68409.73	21,000	420,000
Family Size	100	2.58	1.401154	1	7

Source: Field data, 2024

The age of respondents ranges from a minimum of 14 years to a maximum of 69 years, with a mean age of 34.5 years and a standard deviation of 13.28. This indicates a relatively young population with a wide age range, suggesting that the survey captured perspectives from both younger and older individuals. The variability in age reflects the inclusive nature of the study, encompassing different age groups and potentially varied life experiences and perspectives. Regarding the income level, the mean income of the respondents is 86,630 Tanzanian Shillings, with a substantial standard deviation of 68,409.73. The income levels span from a minimum of 21,000 to a maximum of 420,000 Tanzanian Shillings. This high variability in income suggests significant economic diversity among the respondents. The broad range of income levels indicates the presence of both low-income and higher-income households within the sample, providing a comprehensive view of the economic conditions in Kivule ward. The family size of the respondents averages 2.58 members per household, with a standard deviation of 1.40. The family sizes range from a single-member household to a maximum of seven members. This variation in family size highlights the different household structures within the community. The relatively low average family size may reflect modern urban family dynamics, where smaller families are becoming more common.

Table 2 Description for socioeconomic characteristicsof respondents

Variables	Categories	Frequency	Percent
Adoption	If Adopt	53	53
	If Not Adopt	47	47
Attitude	Positive attitude	56	56
	Negative attitude	44	44
Perceived Benefit	If Gain Perceived Benefits	53	53
	If Not Gain Perceived Benefit	47	47
Economic Incentives	If Gets Economic Incentives	59	59
	If Not Get Economic Incentives	41	41
Gender	Female	56	56
	Male	44	44
Education level	Non-formal education	31	31
	Primary education	32	32
	Secondary education	29	29
	Tertiary education	8	8

Source: Field data, 2024

The socioeconomic characteristics of the respondents are summarized in Table 2, which categorizes various attributes such as adoption of practices, attitude, perceived benefits, economic incentives, gender, and education level. This detailed breakdown provides a comprehensive view of the social and economic diversity within the sampled population.

Regarding adoption, the sample is almost evenly split, with 53% of respondents adopting the practice or technology in question and 47% not adopting it. This near balance suggests a moderate level of acceptance and integration within the community, with potential for increased adoption through targeted interventions and education.

The attitude towards the practice or technology also shows a slight majority with a positive outlook, as 56% of respondents have a positive attitude, while 44% hold a negative attitude. This indicates a generally favorable perception, although there remains a significant portion of the population that may need further convincing or support to change their view. Moreover, the Perceived benefits align closely with adoption and attitude, with 53% of respondents perceiving benefits from the practice or technology, and 47% not perceiving such benefits. This correlation suggests that those who adopt and have a positive attitude are likely to perceive benefits, highlighting the importance of demonstrating tangible advantages to encourage wider acceptance.

Economic incentives appear to be a significant motivator, with 59% of respondents receiving economic incentives and 41% not receiving them. The higher percentage of respondents receiving incentives indicates that financial support or rewards play a crucial role in encouraging adoption and positive attitudes towards new practices or technologies. In terms of gender, the sample is slightly skewed towards females, with 56% female and 44% male respondents. This gender distribution may reflect the demographic characteristics of the area or the specific focus of the survey, and it highlights the importance of considering gender dynamics in socioeconomic studies.

Education level among respondents varies, with 31% having non-formal education, 32% having primary education, 29% having secondary education, and 8% having tertiary education. This distribution shows a broad range of educational backgrounds, which can influence attitudes, adoption rates, and perceived benefits. The relatively low percentage of respondents with tertiary education suggests potential areas for educational improvement and capacity building. In summary, the socioeconomic characteristics of the respondents reveal a diverse population with varying levels of adoption, attitudes, perceived benefits, economic incentives, gender representation, and educational attainment. Understanding these factors is crucial for designing effective interventions and policies that address the specific needs and challenges of the community.

4.1 Determinants of household to adopt modern waste management technologies
The logistic regression model presented in Table 3 examines the determinants of households' adoption of modern waste management technologies. The results highlight various factors influencing adoption, with the logit model coefficients and marginal effects providing insights into the strength and direction of these relationships. Age of the household head is positively associated with the adoption of modern waste management technologies, with a logit coefficient of .0636323 ($p<0.05$) and a marginal effect of .0158731 ($p<0.01$). This suggests that as the age of the household head increases, the likelihood of adopting modern waste management technologies also increases, although the effect size is relatively small.

Family size has a significant negative impact on adoption, indicated by a logit coefficient of -1.080757 ($p<0.001$) and a marginal effect of -.2695955 ($p<0.001$). Larger families are less likely to adopt modern waste management technologies, potentially due to increased household demands or financial constraints that make it more challenging to implement new practices. Moreover, Income level is a strong positive determinant of adoption, with a logit

coefficient of 1.904722 (p<0.001) and a marginal effect of .475134 (p<0.01). Higher-income households are significantly more likely to adopt modern waste management technologies, reflecting the role of financial capacity in facilitating access to and implementation of these technologies.

Gender shows no significant effect on adoption, with the logit coefficient for females being -.2375165 (not statistically significant). This indicates that gender does not play a decisive role in the adoption of waste management technologies in this context. Also, Education level significantly influences adoption. Households with secondary education have a logit coefficient of 2.31138 (p<0.01) and a marginal effect of .4902944 (p<0.001), indicating a substantial positive impact on adoption. Those with tertiary education also show a positive relationship, with a logit coefficient of 2.297994 (not statistically significant) and a marginal effect of .4234516 (p<0.01). This underscores the importance of education in understanding and implementing modern waste management practices.

Table 3 Logistic regression model on determinants of household to adopt modern waste management technologies

Variable	Logit model	Marginal effect
Age	.0636323*	.0158731**
	(.0319498)	(.00797)
Family size	-1.080757***	-.2695955***
	(.3056454)	(.07707)
Income level	1.904722***	.475134**
	(.6145893)	(.15332)
Gender		
Female	-.2375165	-.0591372
	(.7239274)	(.17977)
Attitude`		
Positive attitude	.6039366	.1497258
	(.7202529)	(.17623)
Education level		
Primary level	1.076622	.2578405
	(.8579116)	(.19205)
Secondary level	2.31138**	.4902944***
	(.9234547)	(.15157)
Tertiary level	2.297994	.4234516**
	(1.553326)	(.16633)
Perceived benefits		
Gain perceived benefits	1.457474**	.3488638**
	(.7386606)	(.16245)
Economic incentives		
Get economic incentives	1.240751	.3005862*
	(.7610486)	(.17281)
Model strength	Number of observations= 100 LR chi2(10) = 76.26 Prob > chi2 = 0.0000 Log likelihood = -31.0032 Pseudo R^2 = 0.5516	

Standard errors in parenthesis,***P<0.01, **P<0.05, *P<0.1
Source: Field data, 2024

Perceived benefits are a significant positive determinant, with a logit coefficient of 1.457474 (p<0.01) and a marginal effect of .3488638 (p<0.01). Households that perceive benefits from modern waste management technologies are more likely to adopt them, highlighting the importance of demonstrating the advantages of these technologies. Additionally, economic incentives also positively influence adoption, with a logit coefficient of 1.240751 (not statistically significant) and a marginal effect of .3005862 (p<0.05). Providing economic incentives can enhance the likelihood of households adopting modern waste management technologies, although the statistical significance is weaker compared to other factors.

The model's overall strength is robust, with an LR chi2 value of 76.26 (p<0.0000), indicating that the predictors collectively explain a significant portion of the variance in adoption. The Pseudo R2 value of 0.5516 suggests that the model accounts for approximately 55.16% of the variability in the likelihood of adopting modern waste management technologies.In summary, age, income level, family size, education level, perceived benefits, and economic incentives are key determinants of the adoption of modern waste management technologies. Higher income, better education, perceived benefits, and economic incentives positively influence adoption, while larger family size negatively impacts it. Gender appears to have no significant effect. These insights can guide policymakers and practitioners in designing targeted interventions to promote the adoption of modern waste management practices.

4.2 Challenges of households to adopt modern municipal waste management technologies In Ilala district

Table 4 provides a detailed breakdown of the challenges faced by households in adopting modern waste management technologies in Ilala District. The data is categorized into five levels of agreement: strongly agree, agree, neutral, disagree, and strongly disagree. This comprehensive analysis sheds light on the predominant obstacles that hinder effective waste management practices. Financial challenges are a significant barrier, with 2% of respondents strongly agreeing and 24% agreeing that financial constraints impede the adoption of modern waste management technologies. A substantial 44% remain neutral, suggesting that while financial issues are a concern, they may not be the primary challenge for many households. However, the combined 26% who either disagree or strongly disagree indicates that some households do not perceive financial limitations as a major obstacle.

Table 4 Challenges for household adoption of modern waste management in Ilala district

Challenges	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
Financial challenges to adopt modern waste management technologies.	2%	24%	44%	20%	10%	100%
Informal housing development	50%	38%	10%	0%	2%	100%
Lack public participation and cooperation in waste management.	1%	26%	49%	16%	8%	100%
Lack of education on waste management to the public.	51%	30%	17%	2%	0%	100%
Shortage of dustbins to store waste temporary.	23%	25%	37%	11%	4%	100%
Scarcity and distance to dumpsites.	43%	34%	17%	3%	3%	100%

| Irregular waste collection | 51% | 32% | 15% | 2% | 0% | 100% |

Source: Field data, 2024

Informal housing development emerges as a major issue, with 50% strongly agreeing and 38% agreeing. This overwhelming consensus (88%) underscores the impact of unplanned settlements on the adoption of modern waste management practices. The minimal disagreement (2% strongly disagree) further emphasizes the pervasive nature of this challenge in the district.

Lack of public participation and cooperation in waste management is another significant challenge, with 1% strongly agreeing and 26% agreeing, while a notable 49% are neutral. This neutrality might reflect a sense of apathy or lack of awareness among the public. However, the combined 24% who disagree or strongly disagree points to a segment of the population that perceives adequate public cooperation. Additionally, lack of education on waste management is critically highlighted, with 51% strongly agreeing and 30% agreeing that this is a significant barrier. This 81% consensus points to the urgent need for educational initiatives to improve waste management practices. Only 2% disagree, indicating widespread recognition of this issue.

Additionally, the shortage of dustbins to store waste temporarily is noted, with 23% strongly agreeing and 25% agreeing. However, a significant 37% remain neutral, suggesting mixed experiences regarding dustbin availability. The disagreement (15%) indicates that some areas may have sufficient dustbin provision. Also, scarcity and distance to dumpsites is a pronounced challenge, with 43% strongly agreeing and 34% agreeing. This 77% agreement highlights logistical issues in waste disposal. The minimal disagreement (6%) suggests that for most households, proximity to dumpsites is a significant concern.

Lastly, irregular waste collection is a critical issue, with 51% strongly agreeing and 32% agreeing. This high consensus (83%) underscores the inconsistency in waste collection services as a major barrier to effective waste management. Only 2% disagree, indicating near-universal acknowledgment of this problem. In summary, the primary challenges to adopting modern waste management technologies in Ilala District include informal housing development, lack of education on waste management, and irregular waste collection. Financial constraints, public participation, and the availability of dustbins also play significant roles. Addressing these issues through targeted educational programs, improved waste collection services, and better infrastructure could enhance waste management practices in the district.

Table 5: Summary of challenges with mean ranking according to a Five Likert scale

Challenges	N	Mean	Ranking according to order of Likert scale
Informal housing development	100	1.66	1st
Irregular waste collection	100	1.68	2nd
Lack of waste management education	100	1.70	3rd
Scarcity and distance to dumpsites	100	1.89	4th
Lack of dustbins to store waste	100	2.48	5th
Lack of public participation	100	3.04	6th
Financial challenges	100	3.12	7th
Valid N (listwise)	**100**		

Source: Field data, 2024

Table 5 presents a summary of the challenges faced by households in adopting modern waste management technologies in Ilala District, ranked according to their mean scores on a five-point Likert scale. The mean rankings provide a clear picture of the relative severity of each challenge as perceived by the respondents. Informal housing development is identified as the most significant challenge, with a mean score of 1.66. This ranking indicates a strong consensus among respondents that unplanned settlements severely hinder the implementation of modern waste management practices. The prevalence of informal housing likely complicates waste management infrastructure and service delivery.

Irregular waste collection follows closely as the second most pressing issue, with a mean score of 1.68. The high ranking of this challenge underscores the critical impact of inconsistent waste collection services on the community's ability to manage waste effectively. Regular and reliable waste collection is essential for maintaining cleanliness and public health. Also, the lack of waste management education ranks third, with a mean score of 1.70. This finding highlights the urgent need for educational programs to raise awareness and impart knowledge about effective waste management practices. Education can play a pivotal role in changing behaviors and encouraging the adoption of sustainable waste management technologies.

Scarcity and distance to dumpsites is the fourth major challenge, with a mean score of 1.89. The geographical and logistical difficulties in accessing dumpsites present a significant barrier to proper waste disposal. This issue emphasizes the need for more accessible and strategically located waste disposal facilities. Moreover, the lack of dustbins to store waste is ranked fifth, with a mean score of 2.48. Although not as critical as the top four challenges, the inadequate provision of dustbins still poses a substantial problem, hindering households' ability to temporarily store waste before disposal.

Lack of public participation is identified as the sixth challenge, with a mean score of 3.04. While it ranks lower than the previously mentioned challenges, improving public participation and cooperation is still essential for successful waste management initiatives. Engaging the community can lead to more effective and sustainable waste management practices.Lastly, financial challenges rank seventh, with a mean score of 3.12. This ranking suggests that while financial constraints are a barrier, they are perceived as less critical compared to other challenges. Nonetheless, addressing financial barriers can still play an important role in facilitating the adoption of modern waste management technologies.

Additionally, the most significant challenges to adopting modern waste management technologies in Ilala District are informal housing development, irregular waste collection, and lack of waste management education. Addressing these top-ranked challenges through targeted interventions can significantly improve waste management practices. Enhancing education, improving waste collection services, and providing better infrastructure will be key steps in overcoming these obstacles.

5. Discussion and recommendation
The results of this study highlight several significant challenges to the adoption of modern waste management technologies in Ilala District, Tanzania. The primary issues identified include informal housing development, irregular waste collection, and a lack of waste management education. These findings align with existing literature and provide critical insights for policymakers and practitioners aiming to improve waste management systems.

Informal housing development emerged as the most significant barrier, with the lowest mean score of 1.66. This finding is consistent with previous studies that have identified informal settlements as major impediments to effective waste management due to the lack of infrastructure and planning (Abarca-Guerrero et al., 2015). Informal settlements often lack proper waste collection systems, making it difficult to implement modern waste management technologies. Addressing this issue requires integrated urban planning and the formalization of informal settlements, which can provide the necessary infrastructure to support efficient waste management practices.

The second major challenge, irregular waste collection, with a mean score of 1.68, underscores the critical need for consistent and reliable waste collection services. Irregular collection not only leads to the accumulation of waste but also poses significant health risks to the community (Abaset al., 2022). This finding supports the work of Abdel-Shafy and Mansour(2018), who argue that improving the frequency and reliability of waste collection services is essential for effective waste management. Implementing regular collection schedules and investing in adequate waste collection infrastructure can mitigate this challenge and enhance overall waste management efficiency.

Additionally, lack of waste management education, ranking third with a mean score of 1.70, highlights the importance of educating the public about proper waste management practices. Education plays a crucial role in changing public attitudes and behaviors towards waste management (Amasuomo & Baird, 2016; Utouh & Kitole, 2024). The study's findings align with those of Bhat(2022), who emphasizes that raising awareness and providing education on waste management can significantly increase community participation and support for waste management initiatives. Developing comprehensive educational programs and campaigns can foster a culture of responsible waste disposal and recycling.

The challenge of scarcity and distance to dumpsites (mean score of 1.89) points to logistical barriers in waste disposal. Similar challenges have been documented in other studies, where the lack of accessible waste disposal sites hinders effective waste management (Richard et al., 2015; Kitole & Genda, 2024; Barton et al., 2011). Addressing this issue requires the strategic placement of dumpsites and the development of transfer stations to facilitate easier waste disposal (Davidet al., 2020; Diaz, 2017). This can reduce the burden on households and improve overall waste management outcomes. The issue of lack of dustbins to store waste temporarily, with a mean score of 2.48, is a significant but secondary concern. Previous research has shown that providing adequate waste storage facilities is fundamental to effective waste management (Goodman-Smith et al., 2020; Kitole & Utouh, 2023). Ensuring that households have access to sufficient dustbins can prevent the accumulation of waste and facilitate more efficient collection processes.

Lack of public participation in waste management (mean score of 3.04) and financial challenges (mean score of 3.12) are also notable barriers, though they rank lower than the aforementioned issues. Public participation is essential for the success of waste management programs, as community involvement can enhance compliance and support for waste management policies (Lai,2017; Lema et al., 2019). Encouraging community engagement through participatory approaches and local initiatives can address this challenge. Financial constraints, while significant, may be mitigated through innovative financing mechanisms and partnerships with private sector stakeholders (Abarca-Guerrero et al., 2015; Özbay, 2015).

Furthermore, the study identifies informal housing development, irregular waste collection, and lack of education as the primary challenges to adopting modern waste management technologies in Ilala District. Addressing these issues requires a multifaceted approach involving urban planning, infrastructure investment, education, and community engagement. The findings are supported by existing literature and provide a comprehensive understanding of the barriers to effective waste management in the context of Ilala District. Future interventions should focus on these key areas to improve waste management practices and enhance the quality of life for residents.

6. Conclusion

The study reveals that the primary challenges hindering the adoption of modern waste management technologies in Ilala District are informal housing development, irregular waste collection, and a lack of waste management education. These findings underscore the complex interplay of infrastructure, service delivery, and public awareness in achieving effective waste management. Addressing these issues is crucial for enhancing the overall waste management system, which in turn can improve public health and environmental sustainability in the district.

To overcome these challenges, it is recommended that integrated urban planning and formalization of informal settlements be prioritized to provide the necessary infrastructure for waste management. Additionally, improving the reliability and frequency of waste collection services through adequate investment in waste collection infrastructure is essential. Implementing comprehensive educational programs to raise awareness about proper waste management practices can foster community participation and support. Furthermore, strategic placement of dumpsites and provision of adequate dustbins should be ensured to facilitate efficient waste disposal. Finally, encouraging public participation and exploring innovative financing mechanisms can enhance the overall effectiveness of waste management initiatives in Ilala District. These targeted interventions can collectively address the identified challenges and promote sustainable waste management practices.

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