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Determinants of financial sustainability in private solid waste management firms: Evidence from Dar es Salaam, Tanzania using System GMM

Augustine J.M Kajembe[1]
Lucas Mataba[2]
Goodluck A. Mmari[3]
William B. Warsanga[4]

[1]*augustinemayk@gmail.com

[1*]College of Business Education (CBE) , [2.,3,4]Moshi Co-operative University (MoCU),[1,2,3,4]Tanzania

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ABSTRACT

Financial sustainability is fundamental to the survival and continuity of private solid waste management (SWM) firms, yet evidence on its determinants remains limited, particularly in developing countries such as Tanzania. This study examines the determinants of financial sustainability among private SWM firms in Dar es Salaam using an unbalanced panel dataset of 36 firms collected via census sampling, covering the period from 2016 to 2023. Guided by Contingency Theory and Sustainability Finance Theory the study employed a longitudinal panel research design. Financial sustainability was measured using the Financial Self-Sufficiency (FSS) ratio, while the two-step System Generalised Method of Moments (System GMM) estimator was employed to analyse its determinants. The results reveal that financial sustainability is persistent over time ($\beta = 0.572$, $p < 0.01$) and is positively influenced by firm age, firm size, adoption of new technology, waste collection frequency, container collection, customers served, and operation in planned areas. Conversely, training, mixed technology adoption, distance to the dumpsite and contract duration negatively affect financial sustainability. In contrast, mixed collection methods and operation in mixed areas were insignificant. The study concludes that both firm-specific and external factors influence financial sustainability, although their effects vary. Accordingly, municipal authorities should consider restructuring service contracts, while firm managers should invest in new technology to enhance financial sustainability.

Keywords: Financial Sustainability; Financial Self-Sufficiency, Private Firms; System GMM; Solid Waste Management

I. INTRODUCTION

Financial sustainability remains a critical challenge for firms delivering essential public services in developing nations (Ozili & Iorember, 2024; Hoang & Fogarassy, 2020). Increasing municipal solid waste volumes have substantially increased collection costs, placing considerable pressure on the financial sustainability of private solid waste management (SWM). This trend emphasises the urgency of adopting sustainable SWM practices and indicates that delayed action may intensify both environmental pollution and financial strain on firms (Hoang & Fogarassy, 2020). Accordingly, ensuring consistent service delivery and financial sustainability requires continuous investment in infrastructure and technological innovation (Ozili & Iorember, 2024). From the perspective of Contingency Theory, organisational performance depends on both internal capabilities and external conditions. In the context of private SWM firms, this suggests that financial sustainability is likely to be influenced by both firm-specific characteristics and external operating conditions. Therefore, understanding the determinants of financial sustainability is essential for ensuring the long-term sustainability of private SWM firms.

The increasing reliance on private firms to deliver municipal solid waste management (MSWM) has shifted attention from service provision alone to firms' financial capacity to sustain those services over time (Biswas & Singh, 2021; Bartolacci et al., 2018). However, sustaining these services remains challenging for many private SWM firms, as rising operational costs and inadequate revenue generation increasingly constrain their financial sustainability (Mpuya & Munishi, 2024). These financial constraints are particularly noticeable in developing countries, where weak institutional support, limited access to finance, and rapidly growing urban populations further constrain the financial sustainability of private firms. (Ezeudu & Bristow, 2025). (Otundo, 2024) (Lissah *et al.*, 2021). Noufal *et al.*, 2020). In contrast, developed countries have advanced strategies emphasising circular economy models, eco-efficiency, and waste diversion (Moshkal *et al.*, 2024; Hemidat *et al.*, 2022; Abdeljaber *et al.*, 2022). Even within well-developed waste management systems, private SWM companies in developed countries remain vulnerable to rising operational costs,

volatile revenue streams, and increasingly stringent environmental regulations, which continue to threaten their financial sustainability (István Szűcsp & Gáthy, 2024; Mim *et al.*, 2025; Gradus *et al.*, 2019). These challenges show that financial sustainability remains a concern for private SWM firms in both developing and developed countries.

Tanzania is no exception to these challenges, though the government has strengthened private-sector participation in SWM. The efforts have been accompanied by policy and institutional reforms to improve SWM and create a more supportive environment for private service provision. These include the Environmental Management Act of 2004, the National Solid Waste Management Strategy of 2018, and the National Environmental Policy of 2021. Moreover, at the local government level, municipalities have introduced by-laws and enforcement measures, including fines and restrictions on access to selected municipal services for non-compliant service users, to strengthen compliance with waste collection services, including refuse collection fee payment (Harfadli *et al.*, 2024; Biswas & Singh, 2021; Kirama & Mayo, 2016). Nevertheless, these efforts have not fully addressed the financial challenges facing private SWM firms, as difficulties in cost recovery and rising operational costs continue to constrain their financial sustainability.

Existing empirical studies have primarily examined waste financing strategies, cost recovery mechanisms, circular economic initiatives, and the evolution of SWM (Ezeudu & Bristow, 2025; Mim *et al.*, 2025; Ceraso & Cesaro, 2024; Sondh *et al.*, 2024). Only a few studies have explicitly examined the determinants of financial sustainability among waste management companies (Bartolacci *et al.*, 2018). In Tanzania, studies on SWM have mainly examined participation, operational challenges, and the performance of solid waste management in the private sector (Mpuya & Munishi, 2024; Kirama & Mayo, 2016). Although studies from other sectors have investigated the determinants of financial sustainability (Marwa *et al.*, 2026; Rwekaza *et al.*, 2025; Njiku, 2019), comparable evidence from the private SWM sector remains limited. Consequently, the determinants of financial sustainability among private SWM firms have received little empirical attention, particularly in the Tanzanian context. From a methodological perspective, existing studies have largely employed cross-sectional, case study approaches, providing limited evidence on the dynamic nature of financial sustainability. This study overcomes these limitations by applying the Two-Step System GMM estimator. This study addresses these empirical, contextual, and methodological limitations by applying the Two-Step System GMM estimator to identify the firm-specific and external determinants of financial sustainability among private SWM firms in Dar es Salaam, Tanzania, while accounting for persistence and potential endogeneity.

The findings are expected to help private SWM firms identify areas for improving their operational efficiency and financial sustainability, while informing local government authorities in creating an enabling business environment for these firms. The study also aligns with the United Nations' Sustainable Development Goal 11 on sustainable cities and Tanzania's Vision 2050, which emphasises high-quality living environments.

1.2 Research Objective

This study examines the determinants of financial sustainability among private SWM firms in Dar es Salaam

II. LITERATURE REVIEW

2.1 Theoretical Review

This study used Contingency Theory (CT), developed by Woodward, Lawrence and Lorsch, and Fiedler, which states that organisational effectiveness depends on both organisational structure and environment. But this study adopts Lex Donaldson's 2001 view that performance is determined by both internal characteristics (e.g., size, technology) and external contingencies. In the context of private SWM firms in Dar es Salaam, these contingencies include firm-specific factors such as age, size, and technology, as well as external factors such as contract duration and customers served. The degree to which firms depend on internal and external factors influences their operational effectiveness and financial sustainability, as hypothesised. The relevance and applicability of CT is supported by empirical studies showing that contingency factors and environmental conditions significantly influence firm performance (Olarewaju & Msomi, 2021). As Contingency Theory does not directly address financial outcomes, this study complements it with Sustainability Finance Theory, which provides the financial metric Financial Self-Sufficiency (FSS) to measure financial sustainability.

2.1.2 Sustainability Finance Theory

The Sustainable Finance Theory, as conceptualised by Ozili and Iorember (2024), is adopted as a supplementary theoretical lens to explain the dependent variable, financial sustainability measured by FSS. This framework emphasises building a financial system that enhances social welfare, environmental sustainability, and financial stability while ensuring long-term resilience. This theory is particularly relevant, as financial sustainability in SWM depends on the firm's capacity to generate consistent revenue through efficient operations, thereby covering expenses (Dutra & Siman, 2024; Bartolacci *et al.*, 2018). By integrating CT with Sustainability Finance Theory, the study can provide a

comprehensive analysis of how firm-specific and external factors interact to influence financial sustainability in the SWM sector.

2.2 Empirical Review

Studies on financial sustainability across various sectors have drawn considerable interest in recent years. Within this broader discourse, the existing study focuses on the firm-specific and external factors influencing the financial sustainability of SWM service providers in Dar es Salaam City. Financial sustainability in this context refers to a firm's ability to generate sufficient revenue to cover operational costs, invest in service improvements, and maintain long-term sustainability without reliance on external subsidies.

Furthermore, firm-specific factors represent internal characteristics that may shape organisational performance and sustainability. Empirical evidence suggests that firm-specific factors influence financial sustainability. Studies (Fadilah *et al.*, 2022; Isik & Ersoy, 2022) found positive effects of firm age and size on financial sustainability; the former used pooled OLS, random-effects, and fixed-effects models, while the latter used regression analysis. In this view, these findings indicate that older and large firms are better positioned to strengthen their financial sustainability over time. However, Felipe *et al.* (2021) found that firm age negatively affects financial sustainability and employed a fixed-effects model, thereby reinforcing that large firms do not always benefit; sometimes they may suffer from rigidity or higher costs, which can undermine performance. These mixed results strengthen the argument that age and size do not have a uniform influence on financial sustainability.

According to Sult et al. (2024), Hamdan Al-Abbadi (2021), Olarewaju and Msomi (2021), and Jafar et al. (2021), training enhances financial sustainability and firm performance. They employed different methodological approaches: descriptive analysis, multivariate regression analysis, and structural equation modelling. In contrast, Higuchi *et al.* (2018) found that training could not impact business performance in terms of sales revenue and profit. The studies provide an appropriate foundation for this study despite being conducted in other sectors, as their findings are relevant to the context of financial sustainability. Technology adoption has been shown to significantly enhance firm sustainability, as evidenced by Abdinazar and Hairong (2025), Aragonés-Beltrán et al. (2023), and Abas et al. (2022). Conversely, Sait *et al.* (2018) reported that technology may yield either positive or negative impacts, reflecting that technology may be either positive or negative, indicating that its effect on sustainability is context-dependent and not universal. These studies provide a relevant basis, given the limited research attention to the determinants of financial sustainability, especially for private SWM firms.

Firm-specific factors: firm age (H1), firm size (H2), training (H3), and technology adoption (H4) each significantly influence financial sustainability.

In addition to firm-specific attributes, external factors also play a critical role in shaping financial sustainability, even though they are largely outside firms' direct control. Among these, the customers served may influence financial sustainability. Using a panel regression model, Bartolacci et al. (2018) found that serving more customers through territorial expansion negatively influences financial sustainability. The finding suggests that serving more customers does not always improve firms' financial sustainability, as it can increase operational expenses. While Jin et al. (2022) employed a panel analysis, they found that a strong customer base can boost revenue collection and operational stability, thereby enhancing financial sustainability. The evidence indicates that private SWM firms with a large customer base and consistent payments are more likely to maintain stable revenue and enhance financial sustainability. Collection methods significantly influence financial sustainability. Studies by Hess et al. (2024), Laurieri et al. (2020), Carlos et al. (2019) showed that variations in collection systems, door-to-door models, and bin design positively affect municipal solid waste management. Employed different methodological approaches, including systematic literature review, case study and quantitative case study, respectively. These findings reveal that the choice of collection method plays a critical role in shaping service efficiency and overall financial sustainability of the firms.

Contract duration is also considered a factor that improves financial sustainability. Omar and Bullu (2022) employed a mixed-methods descriptive design and found that shorter contracts given to SWM firms negatively affect their financial sustainability. Whereas contract duration has a positive effect on innovation, leading to higher investment and, hence, financial performance. In the context of Dar es Salaam, these findings imply that well-structured contracts are likely to influence the financial sustainability of SWM firms. Collection frequency is also an important factor linked to financial sustainability in private SWM firms. Consequently, Donkor *et al.* (2020) used descriptive and inferential analyses to argue that a higher collection frequency may increase operating costs and negatively affect financial sustainability. In contrast, El-adawy et al. (2025) emphasised that an optimisation framework, when supported by well-designed collection systems, can reduce unnecessary collection frequency, thereby minimising operational costs while maintaining service efficiency and financial sustainability. Methodologically, a quantitative modelling approach was employed using a mixed integer linear programming framework. These findings suggest that waste collection frequency has a dual effect on financial sustainability in SWM firms. This evidence implies that, to strike a balance between service quality and cost-effectiveness, an optimal rather than excessive collection frequency may be required.

Distance to landfill may also affect financial sustainability. Sulemana *et al.* (2019) employed a paired test; the study found that optimal routing, which reduces travel distance, travel time, and fuel consumption, significantly lowers operating costs and enhances overall financial sustainability. While Gull *et al.* (2022), through a cross-country firm-level study, found that inefficient waste handling, such as extended transport distances, undermines financial performance by raising operating costs and lowering ESG ratings, Fang et al. (2023) reported that logistics optimisation reduced costs, hence enhancing financial sustainability. Generally, evidence suggests that long distances increase organisational costs; thus, optimal routing is essential to lower costs and enhance financial sustainability. On the other hand, the nature of served areas may influence financial sustainability; empirical studies by Mapunda *et al.* (2023) and Owusu-Ansah *et al.* (2021) found that planned areas tend to enhance financial performance by reducing operating costs. Similarly, Guo (2025) reported that unplanned areas increase expenses, regulatory risks, and weaken profitability and financial sustainability. Employed descriptive and inferential analysis and econometric regression, respectively. Therefore, these studies' results imply that organised areas tend to improve firms' financial sustainability by lowering costs relative to unplanned areas.

Although substantial evidence exists across other sectors, limited and often conflicting research has examined how external factors affect financial sustainability in SWM firms. This gap is important, as the sector's unique operational context may shape financial sustainability in ways that differ from other industries. Thus, the following hypotheses were developed.

External factors: waste collection methods (H5), Nature of area (H6), distance to dumpsite (H7), contract duration (H8), customers served (H9), collection frequency (H10), significantly influence financial sustainability.

III. METHODOLOGY

3.1 Study, Philosophy, Design and Approach

The study is guided by a positivist research philosophy, which emphasises objective measurement and statistical analysis of observable phenomena. Accordingly, a quantitative research approach was adopted to measure the study variables numerically, test their relationships, and draw empirical conclusions. A longitudinal panel research design was employed to capture variations across private SWM firms and changes over time, making it appropriate for examining the determinants of financial sustainability using dynamic panel estimation techniques.

3.2 Area of Study

Dar es Salaam was selected as the study area because it generates the largest volume of municipal solid waste in Tanzania, estimated at 4,161 tonnes daily, posing immense challenges in waste collection (Biswas & Singh, 2021). The city also has substantial private firms' participation in SWM, reflecting a growing shift from centralised Municipal provision to decentralisation (Kasala, 2014). These aspects make Dar es Salaam a suitable area, both for its operational relevance in waste service delivery and for the practical access to data.

3.3 Sampling and Data Collection

A census approach was employed to encompass all private SWM firms operating in Dar es Salaam between 2016 and 2023. This sampling technique was appropriate given the limited population of service providers in Dar es Salaam. Additionally, 2016 was chosen as the base year, following the administrative reorganisation that established Kigamboni and Ubungo Municipalities, an Institutional shift that significantly changed governance structures. A total of 40 firms were identified from municipalities' SWM departments; 36 were retained for analysis, as they met the minimum 3-year operational requirement for GMM estimation, which relies on lagged observations to capture persistence effects. Although the study included 36 firms, the panel structure ($N = 36$, $T \leq 8$) was suitable for System GMM estimation (Ally *et al.*, 2025). The four excluded firms: two had been in operation for less than 6 months because they were newly established, while two lacked key information.

Data were extracted from human resource records, operational records, and audited financial statements of the private SWM firms. The contractual turnover and sector dynamism naturally resulted in missing observations across the study period. Consequently, an unbalanced panel was constructed using available annual observations for each firm, as contractual turnover and sector dynamics resulted in some missing firm-year observations. However, survivorship bias may arise in longitudinal firm studies; its effect is minimised in this study through the use of an unbalanced panel that captures both firm entry and exit between 2016 and 2023 (De Massis *et al.*, 2024). Moreover, the study acknowledges the challenges posed by COVID-19. However, SWM services in Tanzania remained essential, supported by contingency measures to ensure safe and continuous service provision during disease outbreaks (Aikaeli *et al.*, 2021; Tanzania Urban Resilience Program Annual Report [TURP], 2020).

3.4 Measurement and operationalisation of research variables.

The study variables, their measurements, initial signs, expected signs, descriptions, and references are presented in Table 1.

Table 1

Operationalisation of key research variables

Variable	Definition and measurement	Expected sign	Initials	Reference
Firm specific factors Firm Size	Measured by number of employees.	+	SIZE	(Njiku, 2019)
Technology adopted	Categorical variable: 2 = New, 3 = Both 1=Old (Reference group)	+	TECH	(Singh *et al.*, 2024)
Training	Measured by the number of staff training sessions conducted per annum.	+	TRAIN	(Khan and Abdullah, 2019)
Firm Age	Measured by the number of years since its establishment.	+	AGE	(Lyimo and Walter, 2023)**;** (Bogetić and Olusi, 2013)
External factors Customers served	Measured by the number of distinct service units served annually.	+	CUSTO_SERV	(Sriningsih et al., 2024)
Distance to dumpsite	Measured by the total number of kilometres covered annually.	–	DIST_LF	(Kinobe *et al.*, 2015)
Method of waste collection	Categorical variable: 2 = Communal container, 3 = Both 1= Door to Door (Reference group)	+	COLL_METH	(Guillon, 2020)
Frequency Collection	Measured by the total number of trips undertaken annually.	+	FREQ	(Chamwali *et al.*, 2022)
Nature of area served	Categorical variable:2 = planned 3 = Both 1=Unplanned (Reference group)	+	NATU_AREA	(Kosoe *et al.*, 2025)
Contract duration	Measured by the number of years stated in the service contract offered.	+	CONT_DUR	(Lim and Mali, 2023)
Dependent variable Financial sustainability	Measured using FSS ratio (revenue/expenses)	+	FS	(Zhao *et al.*, 2022)

3.5 Measurement of Financial Sustainability Using Financial Self-Sufficiency

Financial Sustainability was estimated using the Financial Self-Sufficiency (FSS) ratio, commonly used in other studies (Yasmin *et al.*, 2024; Maeenuddin *et al.*, 2024; Njiku, 2019). FSS was preferred over Operational Self-Sufficiency (OSS) because it offers a broader, more robust measure of long-term financial sustainability, aligns with the study's objective, and enables consistent tracking of firm-level sustainability over time (Dao *et al.*, 2019). While OSS focuses only on operating revenue and costs over a limited short time period and is useful for snapshots, it is narrower in scope (Hadžiahmetović, 2021). The FSS ratio was calculated as follows:

$FSS_{it} = Revenue_{it} / Expenses_{it}$

The FSS ratio is appropriate given that the firms operate largely on a cash basis, collecting service fees directly from customers and settling most operating expenses contemporaneously, resulting in minor or no adjustments to either revenue or expenses (Marwa & Aziakpono, 2015).FSS ratio >1 denotes financial sustainability, while a ratio <1 denotes financial unsustainability. As the first step, the FSS ratio was calculated to assess each firm's financial sustainability

over the study period. The resulting FSS values were subsequently used as dependent variables to estimate the firm-specific and external determinants of financial sustainability.

3.6 Model Specification

To analyse the determinants of financial sustainability among private SWM firms in Dar es Salaam, this study employs the two-step System Generalised Method of Moments (GMM) estimator following using STATA version 17. System GMM was considered appropriate for the dynamic panel of 36 firms observed from 2016-2023, allowing the lagged dependent variable to capture persistence in financial sustainability. The estimator controls for unobserved firm-specific heterogeneity through transformation and addresses potential endogeneity arising from simultaneity and reverse causality by using internal instruments (Mmbaga *et al.*, 2023; Di Ubaldo & Siedschlag, 2021).

Financial sustainability, measured by FSS, was specified as the dependent variable, while firm-specific and external factors were included as explanatory variables. Continuous variables with highly skewed distributions were transformed into natural logarithms where appropriate, while categorical variables were represented using dummy variables with clearly defined reference categories. The lagged value of FSS was included to capture the dynamic adjustment of financial sustainability, recognising that firms' current financial positions may partly depend on their previous financial performance.

The lagged FSS and regressors treated as endogenous or predetermined were instrumented using appropriate lagged levels in the differenced equations and lagged differences in the level equations. In contrast, strictly exogenous regressors were entered as standard instruments. To limit instrument proliferation, the instrument matrix was collapsed and the lag structure restricted, ensuring that the number of instruments remained below 36 firms. The adequacy of the System GMM specification was assessed using the Arellano–Bond tests for first- and second-order serial correlation AR(1) and AR(2) and the Hansen and Sargan tests of overidentifying restrictions were used to assess the validity of the instruments.

For benchmarking purposes, Pooled Ordinary Least Squares (OLS) and Fixed Effects (FE) estimators were also estimated. However, these estimators were not relied upon for final inference because they do not adequately address the dynamic structure and potential endogeneity associated with the inclusion of the lagged dependent variable (Sheraz *et al.*, 2022). In addition, Two-Step Difference GMM estimates were reported to provide a comparison with the preferred System GMM results. The panel structure, with the cross-sectional dimension (N = 36) exceeding the maximum time dimension (T = 8), was also consistent with the application of dynamic panel GMM. At the same time, the instrument count was deliberately restricted below the number of firms (Ally *et al.*, 2025). Thus, in the second stage of the empirical analysis, the calculated FSS values were used as the dependent variable to estimate the firm-specific and external determinants of financial sustainability. The dynamic panel model was specified in linear form as follows:

$$FSS_{it} = \propto + FSS_{t-1} + + \beta_1 SIZE_{it} + \beta_2 AGE_{it} + \beta_3 TRAIN_{it} + \beta_4 TECH_{it} + \beta_5 COLL\_METH_{it} + \beta_6 NATU\_AREA_{it} + \beta_7 lnDIST\_LF_{it} + \beta_8 CONT\_DUR_{it} + \beta_9 lnCUSTO\_SERV_{it} + \beta_{10} lnFREQ_{it} + \mu_i + \varepsilon_{it}$$

Where: All variables as described in Table 1, and ε_{it} is the error term.

3.7 Diagnostic Tests

The following diagnostic tests were performed to check the model fit before analysing the determinants of financial sustainability.

3.7.1 Pairwise Correlations Matrix and Variance Inflation Factor

Table 2 shows that the pairwise correlations indicate low to moderate relationships among variables, with all coefficients below 0.80, indicating no serious multicollinearity problem. Additionally, the Variance Inflation Factor values range from 1.13 to 4.73, with a mean VIF of 2.42, which is below the acceptable threshold of 10. These results indicate that multicollinearity is not a serious concern among the explanatory variables.

Table 2

Pairwise correlations matrix and Variance Inflation Factor

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) FinancialSS	1.000										
(2) Firm age	0.060	1.000									
(3) Firm_size	0.002	0.197[a]	1.000								
(4) Training	-0.012	-0.038	0.169[a]	1.000							
(5) Technology adopted	-0.012	0.112[c]	0.704[a]	0.265[a]	1.000						
(6) Method of waste collection	-0.001	0.130[b]	0.171[a]	0.367[a]	0.439[a]	1.000					
(7) Nature of area served	0.018	-0.055	0.522[a]	0.288[a]	0.669[a]	0.335[a]	1.000				
(8) Contract duration	0.031	-0.009	0.162[b]	0.171[a]	0.077	-0.055	0.157[b]	1.000			
(9) ln distance to dumpsite	0.057	0.034	0.411[a]	0.166[b]	0.372[a]	0.080	0.477[a]	0.216[a]	1.000		
(10) ln customer served	0.023	0.456[a]	0.497[a]	0.185[a]	0.484[a]	0.355[a]	0.274[a]	0.028	0.257[a]	1.000	
(11) ln frequency collection	0.047	0.201[a]	0.368[a]	0.091	0.327[a]	0.206[a]	0.351[a]	0.084	0.749[a]	0.355[a]	1.000
VIF		1.40	2.44	1.29	3.17	1.70	2.23	1.13	4.20	1.87	4.73
1/VIF		0.713	0.410	0.778	0.315	0.589	0.449	0.883	0.238	0.535	0.211
Mean VIF											2.42

Source Note:Significance level: [a] *p<0.01*, [b] *p<0.05*, [c] *p<0.1*

3.7.2 Panel Unit Root For Stationarity

Fisher-type panel unit root test was conducted to determine the stationarity and order of integration of the study variables before model estimation. Table 3 shows that FinancialSS, training, and ln customers served were stationary at level (I(0), while the remaining variables became stationary after first differencing (I(1). Thus, none of the variables was integrated of order two, I(2). The choice of System GMM was based on the model's dynamic nature, particularly the inclusion of lagged financial sustainability, and the need to address firm-specific effects and potential endogeneity.

Table 3

Fisher-type unit-root test

	Level constant and trend				**First difference Constant trend**				
Variables	Inverse chi-	Inverse normal	Inverse logit	Modified inv.	Inverse chi-	Inverse normal	Inverse logit	Modified inv.	Order of Integrati
FinancialSS	437.806***	-12.955***	-19.787***	30.484***					I (0)
Firm age	4.1982	2.2598	2.3247	-5.6502	71.0392	-6.1051**	-8.0245**	0.0878	I (1)
Firm size	15.274	4.920	4.741	-4.727	126.222***	-5.148***	-5.330***	4.752***	I (1)
Training	112.716**	-1.946**	-4.618***	3.393**					I (0)
Technology adopted	9.765	-0.104	-0.114	-5.186	58.316	-4.126***	-6.992***	-0.988	I (1)
Method of collection	4.956	-1.379	-1.409	-5.587	9.430	-2.367**	-2.774**	-5.119	I (1)
Nature of area served	1.783	1.1567	1.071	-5.851	11.501	-1.810**	-1.723*	-4.944	I (1)
Ln distance dumpsite	64.491	0.286	-0.945	-0.626	107.918**	-4.733***	-5.922***	3.205***	I (1)
Contract duration	8.0069	4.02	3.727	-5.3328	67.550	-4.102***	-3.802***	-0.207	I (1)
Ln customers served	235.921***	-3.690***	-7.313***	13.660***					I (0)
Ln frequency collection	23.156	0.994	0.773	-4.070	78.794	-4.558***	-5.091***	0.743	I (1)

*Source Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1*

3.9.5 Arellano Bond and Hansen and Sargan Test

Table 7 presents the diagnostic tests conducted to assess serial correlation, instrument validity, and instrument proliferation. The Arellano–Bond test shows significant AR(1) (p = 0.001) but no AR(2) (p = 0.092), supporting the model specification. The Hansen (p = 0.222) and Sargan (p = 0.972) tests support instrument validity, while the 31 instruments remained below the 36 firms, indicating no instrument proliferation. Overall, the diagnostic results support the validity of the System GMM model.

IV. FINDINGS & DISCUSSION

4.1 Descriptive Statistics

Table 6 presents the descriptive statistics, highlighting important preliminary insights into the Nature of the data used in this study. FS has a mean of 0.894 with low variation, indicating that most firms operate below the financial sustainability threshold, with only a few performing better financially. Whereas firm-specific factors, firm size ($\bar{x}$ =48.361, SD 49.824) and training ($\bar{x}$ =1.558, SD = 2.387), reveal substantial dispersion, indicating differences in workforce size and staff training, respectively, across firms. Firm age ($\bar{x}$ =5.455, SD 3.716) suggests heterogeneity in firms' operational maturity. Consequently, technology adopted ($\bar{x}$ =1.429, SD 0.785) indicates that most SWM firms predominantly used old technology, although some adopted new or mixed technologies. In addition, external factors show that the average value for the collection method ($\bar{x}$ = 1.094, SD = 0.382) and nature of service area ($\bar{x}$ = 1.609, SD = 0.894) shows that most firms rely on door-to-door collection methods and operate mainly in unplanned areas. Contract duration ($\bar{x}$ = 2.039, SD = 1.001) indicates that most firms operate under medium-length contracts across firms. Ln of distance to dumpsite ($\bar{x}$ = 9.056, SD = 0.448), ln of customers served ($\bar{x}$ = 7.958, SD = 0.694). Ln of collection frequency ($\bar{x}$ = 5.579, SD = 0.348) indicates variation across firms, with relatively higher dispersion in the number of customers served than in distance to the dumpsite and collection frequency. Overall, the descriptive evidence supports the regression findings, showing that firm characteristics and external conditions play a key role in determining financial sustainability.

Table 4

Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FSS	233	0.894	0.12	0.53	1.17
Firm age	233	5.455	3.716	1	19
Firm size	233	48.361	49.824	10	337
Training	233	1.558	2.387	0	12
Technology adopted	233	1.429	0.785	1	3
Method of waste collection	233	1.094	0.382	1	3
Nature of area served	233	1.609	0.894	1	3
Contract duration	233	2.039	1.001	1	3
ln distance to dumpsite	233	9.056	0.448	7.763	9.688
ln customers served	233	7.958	0.694	6.109	9.324
ln Collection frequency	233	5.579	0.348	4.564	5.9

4.2 System GMM results

4.2.1 Influence of Firm-Specific Factors And Environmental Factors on Financial Sustainability

Table 7 presents the dynamic panel regression results based on the two-step System GMM to examine the determinants of Financial sustainability among private SWM firms in Dar es Salaam. The coefficient on the lagged dependent variable is positive and significant ($\beta = 0.572$, $p < 0.01$), confirming persistence in financial sustainability and suggesting that firms that performed well previously tend to perform well in the current period. Thus, private SWM firms in Dar es Salaam that manage costs efficiently and collect fees effectively tend to perform better over time. The results are consistent with those of Boonyanet et al. (2024), who found that the dependent variable's past values significantly affect its current results. This result implies that consistently maintaining sound financial practices can generate lasting benefits for firms' financial sustainability.

Regarding firm-specific factors, firm age exhibits a positive and statistically significant effect on financial sustainability ($\beta = 0.045$, $p < 0.01$), supporting hypothesis (H_1). The results complement those of Fadilah et al. (2022) and Işik and Ersoy (2022), who found that age significantly influences firm sustainability and financial performance, respectively. This finding suggests that older firms benefit from accumulated experience, established customer relationships, and greater operational stability, which strengthen their ability to sustain financial viability over time. This result implies that younger firms may strengthen their financial sustainability by adopting operational and financial practices developed by more experienced firms. Similarly, firm size is significantly influenced by financial sustainability (0.003, $p < 0.10$), supporting hypothesis (H_2), indicating that each additional employee increases financial sustainability by 0.003. This finding aligns with Njiku and Nyamsogoro (2019), who reported a significant association between firm size and the financial sustainability of sunflower processing firms. This finding suggests that larger workforces enable firms to cope effectively with the labour-intensive nature of waste collection in Dar es Salaam's unplanned areas, where narrow and inaccessible roads limit mechanised operations.

In contrast, training (-0.030, $p < 0.05$) has a negative, significant effect on financial sustainability; thus, it does not support hypothesis (H_3). However, training improves skills (Sult et al., 2024). However, this is not always the case, as training may not necessarily improve financial performance, as Higuchi et al. (2018) found. The difference may be attributed to sectoral variations and firm-specific priorities. In private SWM firms, the difference may be attributed to sectoral variations and firm-specific priorities. In private SWM firms, this implies that training requires adequate resources and equipment to improve financial sustainability. Technology adoption shows mixed effects: new technology improves financial sustainability compared to old technology ($\beta = 4.818$, $p < 0.05$), while the combined use of both technologies shows no clear advantage ($\beta = -0.138$, $p > 0.1$); hence, hypothesis (H_4) is partially supported. Sait *et al.* (2018) support the finding that technology can have either a positive or a negative effect on financial performance. Therefore, the findings suggest that the benefits of technology depend on firms' capacity to invest in costly modern technologies, which many private SWM firms in Dar es Salaam cannot readily afford, underscoring the need for affordable financing to facilitate technology adoption.

External factors play a substantial role in shaping financial sustainability. Waste collection methods show mixed outcomes: container-based collection performs better than door-to-door collection ($\beta = 1.448$, $p < 0.1$), while mixed methods show no significant advantage ($\beta = -0.238$, $p > 0.1$). Hence, hypothesis (H_5) is partially supported. These findings are consistent with Bø and Flygansvær (2025), who found that shared household container systems reduce collection costs, thereby improving financial sustainability. Contrary to Pietro *et al.* (2024), who reported that fully door-to-door systems outperform mixed systems in operational effectiveness. Thus, the mixed findings suggest that the financial benefits of collection methods vary, implying that firms should adopt methods that best support their financial sustainability (Hess *et al.*, 2024; Laurieri *et al.*, 2020; Carlos *et al.*, 2019). Moreover, the Nature of the area served

shows mixed effects: planned areas positively influence financial sustainability compared to unplanned areas ($\beta = 2.264$, $p < 0.05$), while serving both areas shows no significant effect ($\beta = -0.189$, $p > 0.1$); hence, hypothesis (H_6) is partially supported. The results align with those of Owusu-Ansah et al. (2021), who emphasise that poor spatial planning increases operational costs, while mixed coverage mitigates these challenges. The results indicate better road access and easier waste collection in planned areas such as Oysterbay, Masaki, and Mikocheni, suggesting that improved accessibility enhances financial sustainability.

Distance to the dumpsite negatively affects financial sustainability ($\beta = -1.994$, $p < 0.05$), which does not support hypothesis (H7), reflecting higher transport costs for firms located far from disposal sites such as Pugu Kinyamwezi in Dar es Salaam. This finding is reinforced by evidence from Fang *et al* (2023), who show that logistics optimisation can substantially reduce transport distances and improve financial outcomes. This evidence implies that reducing disposal distance could lower operating costs and enhance the financial sustainability of private SWM firms. However, contract duration negatively affects financial sustainability ($\beta = -0.036$, $p < 0.05$), thereby not supporting hypothesis (H_8). This finding may be because waste collection contracts are too short and operate under fixed-fee arrangements, limiting firms' ability to adjust revenues in response to rising operational costs. This finding is consistent with Omar and Bullu (2022), who revealed that shorter contract duration reduces financial sustainability. Liem and Khuong (2020) found that longer contracts may support innovation and financial resilience. These results suggest that contract flexibility is essential for sustaining the financial performance of private SWM firms, as it allows firms to adjust service charges and operating arrangements in response to changing costs.

The number of customers served significantly affects financial sustainability ($\beta = 0.187$, $p < 0.05$), supporting hypothesis (H_9). This finding aligns with Bartolacci et al. (2018), who showed that serving more customers increases financial sustainability by stabilising revenues and building resilience. Therefore, it calls for stronger collaboration between firms and municipalities to expand customer coverage, as customers are fundamental to financial sustainability. Moreover, waste collection frequency positively affects financial sustainability ($\beta = 3.000$, $p < 0.05$), supporting hypothesis (H10), as it improves service reliability and payment compliance, particularly in high waste-generating areas such as Kariakoo. Thus, firms maintaining consistent schedules may improve their financial sustainability. The finding complements the study by Donkor *et al.* (2020), who emphasised customer satisfaction as key to profitability, since frequent collections may please clients, underscoring the need to balance efficiency with service quality for sustainability. The finding suggests that collection frequency is not merely an operational decision but also a financial strategy, as reliable collection can strengthen customers' willingness to pay and stabilise firms' revenue flows.

Table 5

Panel regression results

	(1)	(2)	(3)	(4)
VARIABLES	Pooled OLS	FE	2Step Diff GMM	2Step Syst GMM
L.FinancialSS	0.883***	0.211***	0.233***	0.572***
	(0.258)	(0.078)	(0.085)	(0.158)
Firm age	-0.003	-0.009	0.029***	0.045***
	(0.003)	(0.007)	(0.005)	(0.017)
Firm size	-0.000	0.000	-0.001	0.003*
	(0.000)	(0.001)	(0.001)	(0.002)
Training	-0.004	-0.006	-0.023***	-0.030**
	(0.004)	(0.007)	(0.008)	(0.014)
2. New adopted	-0.019			4.818**
	(0.055)			(1.927)
3. Mixed adopted	0.047	-0.006	-0.095**	-0.138
	(0.036)	(0.054)	(0.045)	(0.157)
2.Container_collection	-0.028			1.448*
	(0.053)			(0.922)
3.Mixed_collection	0.011	-0.148	-0.087	-0.238
	(0.057)	(0.124)	(0.161)	(0.153)
2.Planned_area served	-0.070	-0.122	-0.068	2.264**
	(0.059)	(0.135)	(0.224)	(1.151)
3.Mixed_area served	-0.007	-0.067	-0.200	-0.189
	(0.026)	(0.108)	(0.171)	(0.268)
Contract duration	-0.009	-0.000	-0.036**	-0.036**
	(0.008)	(0.015)	(0.017)	(0.030)
ln_distance_to_dumpsite	0.032	0.043	1.547***	-1.994**

	(0.040)	(0.188)	(0.466)	(0.852)
ln_customers served	0.003	-0.022	0.058	0.187**
	(0.016)	(0.030)	(0.053)	(0.073)
ln_ frequency_collection	-0.032	0.047	-0.616	3.000**
	(0.050)	(0.198)	(0.472)	(1.165)
Constant	1.000***	0.724		4.319
	(0.214)	(0.760)		(4.953)
Observations	197	197	161	197
R-squared	0.103	0.124		
Number of firms		36	36	36
AR(1)			0.023	0.023
AR(2)			0.818	0.597
Hansen			0.792	0.684
Sargen			0.559	0.986
Number of Instruments			32.000	32.000

*Source Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1*

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

Overall, the descriptive evidence supports the regression findings, showing that firm characteristics and external conditions play a key role in determining financial sustainability.The study concludes that both firm-specific and external factors influence financial sustainability, although their effects vary.

5.2 Recommendations

Private SWM firms should prioritise investment in new waste collection technology by developing annual equipment replacement plans and tracking the proportion of vehicles and equipment upgraded each year. Firms should expand their customer base by setting annual customer acquisition targets and monitoring changes in the number of active fee-paying customers. Collection frequency should align with customer demand and contractual requirements, and firms should monitor the proportion of scheduled collections completed each month. Employee training should be reviewed by assessing its costs against measurable outcomes such as employee productivity, collection volumes, and operating costs before additional training expenditure is approved.

Moreover, Municipal authorities should periodically review contract duration and terms to ensure they remain consistent with changing service costs and operating conditions, and contract performance should be assessed at least annually. Given the negative effect of distance to the dumpsite, municipalities should establish additional dumpsite facilities closer to service areas and promote recycling to reduce waste transported over long distances. Municipalities should also strengthen refuse-fee compliance by maintaining updated registers of service users and monitoring monthly collection rates against amounts billed. In planned service areas, where financial sustainability was stronger, municipalities should identify operational features that support service delivery and establish measurable improvement targets for accessibility and collection arrangements in less favourable service areas.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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REFERENCES

Abas, M. A., Hassin, N. H., & Najihah, A. (2022). Technology adoption for municipal solid waste management (MSWM) in Malaysia. In *AIP Conference Proceedings* (Vol. 1, Article 050018). https://doi.org/10.1063/5.0078466

Abdeljaber, A., Zannerni, R., Masoud, W., Abdallah, M., & Rocha-Meneses, L. (2022). Eco-efficiency analysis of integrated waste management strategies based on gasification and mechanical biological treatment. *Sustainability, 14*(7), 3899. https://doi.org/10.3390/su14073899

Abdinazar, K., & Hairong, C. (2025). Impact of technology adoption on financial services performance. *Finance and Accounting Research Journal, 7*(2), 50–63. https://doi.org/10.51594/farj.v7i2.1820

Aikaeli, J., Garcés-Urzainqui, D., & Mdadila, K. (2021). Understanding poverty dynamics and vulnerability in Tanzania: 2012–2018. *Review of Development Economics, 25*(4), 1869–1894. https://doi.org/10.1111/rode.12829

Ally, O. J., Kulindwa, Y., & Mataba, L. (2025). Bank efficiency in the digital age: The role of financial technology in Tanzanian banks. *Modern Finance, 3*(1), 1–24. https://doi.org/10.61351/mf.v3i1.218

Aragonés-Beltrán, P., Angel, M.-, & Aragon, P. (2023). Sustainable selection of waste collection trucks considering feasible future scenarios by applying the stratified best and worst method. *Heliyon*. https://doi.org/10.1016/j.heliyon.2023.e15481

Bartolacci, F., Paolini, A., Quaranta, A. G., & Soverchia, M. (2018). Assessing factors that influence the financial sustainability of waste management. *Waste Management, 79*, 571–579. https://doi.org/10.1016/j.wasman.2018.07.050

Biswas, A., & Singh, S. G. (2021). *Tanzania: An assessment of the solid-waste-management ecosystem*. Centre for Science and Environment.

Bø, E., & Flygansvær, B. (2025). A triple-bottom-line evaluation of municipal solid waste collection. *Sustainable Futures, 10*, 100914. https://doi.org/10.1016/j.sftr.2025.100914

Bogetić, Ž., & Olusi, O. (2013). *Drivers of firm-level productivity in Russia's manufacturing sector* (Policy Research Working Paper No. 6572). World Bank.

Boonyanet, W., Jangphanish, K., & Tongkong, S. (2024). Panel regression of industrial sustainability indicators: Two-step system GMM to robust estimation. *Journal of Infrastructure, Policy and Development, 8*(15), 9035. https://doi.org/10.24294/jipd9035

Carlos, M., Gallardo, A., Edo-Alcón, N., & Abaso, J. R. (2019). Influence of the municipal solid waste collection system on the time spent at a collection point: A case study. *Sustainability, 11*(22), 6481. https://doi.org/10.3390/su11226481

Ceraso, A., & Cesaro, A. (2024). Life cycle sustainability assessment of municipal solid waste management systems: A review. *Journal of Environmental Management, 368*, 122143. https://doi.org/10.1016/j.jenvman.2024.122143

Chamwali, L., Mzava, A., & Watundu, S. (2022). Determinants of technical inefficiency in solid waste collection service. *International Journal of Human Capital in Urban Management, 7*(4), 0–2. https://doi.org/10.22034/IJHCUM.2022.04.0

Dao, H. T. T., Dung, D. T., & Hai, T. N. M. (2019). Financial sustainability of microfinance institutions in Viet Nam. *Asian Journal for Poverty Studies, 5*(2), 1–69.

De Massis, A., Muñoz-Bullón, F., Sanchez-Bueno, M. J., Velasco, P., & Vismara, S. (2024). Executive gender and firm leverage decisions: The role of firm ownership and governance. *Journal of Business Research, 179*, 114700. https://doi.org/10.1016/j.jbusres.2024.114700

Di Ubaldo, M., & Siedschlag, I. (2021). Investment in knowledge-based capital and productivity: Firm-level evidence from a small open economy. *Review of Income and Wealth, 67*(2), 363–393. https://doi.org/10.1111/roiw.12464

Donkor, E. A., Alhassan Sulemana, K. S., Boateng, K. S., & Rockson, G. N. (2020). Customer satisfaction of solid waste collection services: A measure towards effective waste management. *Solid Waste Technology and Management*.

Dutra, R. M. de S., & Siman, R. R. (2024). Strategies for financial sustainability of municipal solid waste management systems. *Revista de Gestão Social e Ambiental, 18*(4), 1–17. https://doi.org/10.24857/rgsa.v18n4-047

El-Adawy, M., Ismael, M. A., & Nemitallah, M. A. (2025). [Article title unavailable in the supplied reference]. *Case Studies in Thermal Engineering*, 107287. https://doi.org/10.1016/j.csite.2025.107287

Ezeudu, O. B., & Bristow, D. (2025). Financing methods for solid waste management: A review of typology, classifications, and circular economy implications. *Sustainable Development, 33*(2), 3062–3085. https://doi.org/10.1002/sd.3256

Fadilah, F., Uzliawati, L., & Mulyasari, W. (2022). The effect of firm size and firm age on sustainability reporting and the impact on earnings management. *Jurnal Riset Akuntansi Terpadu, 15*(1), 84. https://doi.org/10.35448/jrat.v15i1.14510

Fang, B., Yu, J., Chen, Z., Osman, A. I., Farghali, M., Ihara, I., Hamza, E. H., Rooney, D. W., & Yap, P. S. (2023). Artificial intelligence for waste management in smart cities: A review. *Environmental Chemistry Letters, 21*(4). https://doi.org/10.1007/s10311-023-01604-3

Felipe, L., Reynoso, L., Vela-Beltrán-del-Río, C., Martínez-Berrones, J. L., Abdelrazaq, H., Aljaffal, T., Daruwalla, P., & Wardle, K. (2021). Firm size, firm age, and firm profitability: Evidence from China. *Journal of Accounting, Business and Management, 28*, 100–115.

Gradus, R., Homsy, G. C., Liao, L., & Warner, M. E. (2019). Which US municipalities adopt pay-as-you-throw and curbside recycling? *Resources, Conservation and Recycling, 143*, 178–183. https://doi.org/10.1016/j.resconrec.2018.12.012

Guillon, O. (2020). Special section: Institute of Energy and Climate Research at Forschungszentrum Jülich. *Advanced Engineering Materials, 22*(6). https://doi.org/10.1002/adem.202000286

Gull, A. A., Ahsan, T., Derouiche, I., & Atif, M. (2022). Does waste management affect firm performance? International evidence. *Economic Modelling, 114*, 105932. https://doi.org/10.1016/j.econmod.2022.105932

Guo, Q. (2025). Waste management systems in urban planning for a sustainable future. *Journal of Lifestyle and SDG's Review, 5*, 1–17. https://doi.org/10.47172/2965-730X.SDGsReview.v5.n05.pe06595

Hadžiahmetović, N. (2021). Factors determining the operational self-sufficiency of microfinance institutions. *Croatian Review of Economic, Business and Social Statistics, 7*(2), 1–13. https://doi.org/10.2478/crebss-2021-0006

Hamdan Al-Abbadi, L. (2021). The effect of employee sustainable training on sustainable performance. *Journal of Management Information and Decision Sciences, 24*(6), 1–12.

Harfadli, M. M., Ramadan, B. S., Rachman, I., & Matsumoto, T. (2024). Challenges and characteristics of the informal waste sector in developing countries: An overview. *Journal of Material Cycles and Waste Management, 26*(3), 1294–1309. https://doi.org/10.1007/s10163-024-01929-3

Hemidat, S., Achouri, O., Fels, L. El, Elagroudy, S., Hafidi, M., Chaouki, B., Ahmed, M., Hodgkinson, I., & Guo, J. (2022). Solid waste management in the context of a circular economy in the MENA region. *Sustainability, 14*(1), 480. https://doi.org/10.3390/su14010480

Hess, C., Dragomir, A. G., Doerner, K. F., & Vigo, D. (2024). Waste collection routing: A survey on problems and methods. *Central European Journal of Operations Research, 32*(2). https://doi.org/10.1007/s10100-023-00892-y

Higuchi, Y., Mhede, E. P., & Sonobe, T. (2018). Short- and medium-run impacts of management training: An experiment in Tanzania. *World Development, 114*, 220–236. https://doi.org/10.1016/j.worlddev.2018.10.002

Hoang, N. H., & Fogarassy, C. (2020). Sustainability evaluation of the municipal solid waste management system in Hanoi (Vietnam): Why choose the "waste-to-energy" concept. *Sustainability, 12*(3), 1085. https://doi.org/10.3390/su12031085

Isik, Ö., & Ersoy, E. (2022). Bank age and financial performance: Is the relationship linear or nonlinear? Evidence from listed and unlisted commercial banks in China. *Finans Ekonomi ve Sosyal Araştırmalar Dergisi, 7*(4), 893–906. https://doi.org/10.29106/fesa.1217119

István Szűcsp, A. V., & Gáthy, A. B. (2024). Waste management and plastic waste recycling in Japan, China, Singapore and South Korea: What trends can be observed under different regulations? *International Review of Applied Sciences and Engineering*. https://doi.org/10.1556/1848.2024.00841

Jafar, S., Zubair, S. S., & Khan, M. A. (2021). Employee training and financial performance: Mediating effects of perceived service quality and customer satisfaction. *Pacific Business Review International, 14*(5), 68–81.

Jin, G., Jiang, Q., & Liu, X. (2022). Customer concentration, managerial ability, and corporate performance. *Frontiers in Psychology, 12*, 814646. https://doi.org/10.3389/fpsyg.2021.814646

Kasala, S. E. (2014). Critical analysis of the challenges of solid waste management initiatives in Keko Machungwa informal settlement, Dar es Salaam. *Journal of Environmental Protection, 5*(12), 1064–1074. https://doi.org/10.4236/jep.2014.512105

Khan, S. I., & Abdullah, N. N. (2019). The impact of staff training and development on teachers' productivity. *Economics, Management and Sustainability, 4*(1), 37–45. https://doi.org/10.14254/jems.2019.4-1.4

Kinobe, J. R., Bosona, T., Gebresenbet, G., Niwagaba, C. B., & Vinnerås, B. (2015). Optimisation of waste collection and disposal in Kampala city. *Habitat International, 49*, 126–137. https://doi.org/10.1016/j.habitatint.2015.05.025

Kirama, A., & Mayo, A. W. (2016). Challenges and prospects of private sector participation in solid waste management in Dar es Salaam City, Tanzania. *Habitat International, 53*, 195–205. https://doi.org/10.1016/j.habitatint.2015.11.014

Kosoe, E. A., Ogwu, M. C., Sanyare, F. N., & Awontiirim, A. D. (2025). Assessing transportation route efficiency in solid waste collection: A mixed-methods study from Wa Municipality, Ghana. *City and Built Environment, 3*(1). https://doi.org/10.1007/s44213-025-00062-7

Laurieri, N., Lucchese, A., Marino, A., & Digiesi, S. (2020). A door-to-door waste collection system case study: A survey on its sustainability and effectiveness. *Sustainability, 12*(14), 5520. https://doi.org/10.3390/su12145520

Liem, N. T., & Khuong, N. V. (2020). Buyer–supplier contract length and the innovation of supplier firms. *Journal of Open Innovation: Technology, Market, and Complexity, 6*(3), 52.

Lim, H. J., & Mali, D. (2023). An analysis of the effect of temporary/permanent contracts on firm efficiency performance: Evidence from South Korea. *Journal of Applied Accounting Research, 24*(1), 149–169. https://doi.org/10.1108/JAAR-08-2021-0227

Lissah, S. Y., Ayanore, M. A., Krugu, J. K., Aberese-Ako, M., & Ruiter, R. A. C. (2021). Managing urban solid waste in Ghana: Perspectives and experiences of municipal waste company managers and supervisors in an urban municipality. *PLOS ONE, 16*(3), e0248392. https://doi.org/10.1371/journal.pone.0248392

Lyimo, G. D., & Walter, G. (2023). Firm-specific determinants of profitability of listed commercial services companies in Kenya and Tanzania. *Pan-African Journal of Business Management, 7*(1), 144–165. https://doi.org/10.61538/pajbm.v7i1.1289

Maeenuddin, H. S. A., Nassir, A. M. D., Fahlevi, M., Aljuaid, M., & Jermsittiparsert, K. (2024). Measuring the financial sustainability and its influential factors in the microfinance sector of Pakistan. *SAGE Open, 14*(3), 1–18. https://doi.org/10.1177/21582440241259288

Mapunda, A. S., Joseph, K. R., & Kasuwi, S. (2023). Impact of population dynamics on solid waste generation trends in Dar es Salaam metropolitan. *International Journal of Advanced Research, 6*(1), 75–87. https://doi.org/10.37284/ijar.6.1.1190

Marwa, N., & Aziakpono, M. (2015). Financial sustainability of Tanzanian saving and credit cooperatives. *International Journal of Social Economics, 42*(10), 870–887. https://doi.org/10.1108/IJSE-06-2014-0127

Marwa, N. K., Makuya, V., & Makona, A. (2026). Revenue diversification, capital budgeting practices and financial sustainability: The moderating role of sustainability audits. *SEISENSE Journal of Management, 9*(1), 40–69. https://doi.org/10.33215/3pr8k418

Mim, S. J., Tasnim, A., Chowdhury, R., Ng, K. T. W., & Richter, A. (2025). Evolution of financial sustainability in Canadian waste management industries across the government and private sectors. *Cleaner Environmental Systems*, 100298. https://doi.org/10.1016/j.cesys.2025.100298

Mmbaga, N., Kulindwa, Y., & Kazungu, I. (2023). Energy consumption and economic growth nexus in East African sub-region: Interactive dynamics of human capital. *[Journal title unavailable in the supplied reference], 11*(5), 50–69.

Moshkal, M., Akhapov, Y., & Ogihara, A. (2024). Sustainable waste management in Japan: Challenges, achievements, and future prospects: A review. *Sustainability, 16*(17), 7347. https://doi.org/10.3390/su16177347

Mpuya, G. J., & Munishi, E. (2024). Private sector challenges in sustainable solid waste management, Dar es Salaam City, Tanzania. *International Journal of Management, Accounting & Economics, 11*(6), 758–781.

Njiku, A. (2019). Determinants of financial sustainability of small scale sunflower oil processing firms in Tanzania. *International Journal of Business and Economics Research, 8*(3), 125–132. https://doi.org/10.11648/j.ijber.20190803.16

Njiku, A. R., & Nyamsogoro, G. D. (2019). Nexus between technical efficiency and financial sustainability: Evidence from small scale sunflower oil processing firms in Tanzania. *Asian Journal of Economics, Business and Accounting, 12*(3), 1–11. https://doi.org/10.9734/ajeba/2019/v12i330150

Noufal, M. J., Maalla, Z. A., & Adipah, S. (2020). Challenges and opportunities of municipal solid waste management system in Homs city, Syria. *Proceedings of the Institution of Civil Engineers: Waste and Resource Management, 173*(2), 40–53. https://doi.org/10.1680/jwarm.19.00020

Olarewaju, O., & Msomi, T. (2021). Factors affecting the financial sustainability of small and medium enterprises in South Africa. *African Journal of Inter/Multidisciplinary Studies, 3*(1), 103–117. https://doi.org/10.51415/ajims.v3i1.893

Omar, H. M., & Bullu, S. L. (2022). Assessment of solid waste management practices in Tanzania's cities. *Global Journal of Engineering and Technology Advances, 13*(1), 108–119. https://doi.org/10.30574/gjeta.2022.13.1.0180

Otundo, R. M. (2024). Innovative approaches to solid waste management in Kenya's urban areas: A case study of Mombasa County in advancing Sustainable Development Goals. *SSRN Electronic Journal*, 4937595. https://doi.org/10.2139/ssrn.4937595

Owusu-Ansah, P., Woangbah, S. K., Anim, B., & Azabu, F. (2021). Solid waste disposal management practices in Ghana: A case study of Subin Metropolis. *Environmental Management and Sustainable Development, 10*(4), 1. https://doi.org/10.5296/emsd.v10i4.18773

Ozili, P. K., & Iorember, P. T. (2024). Financial stability and sustainable development. *International Journal of Finance and Economics, 29*(3), 2620–2646. https://doi.org/10.1002/ijfe.2803

Pietro, A., Baltrocchi, D., Maggi, L., Miino, M. C., Rada, E. C., & Torretta, V. (2024). Comparison of mixed and door-to-door systems for urban waste collection in terms of effectiveness and greenhouse gas emissions: A case study from two mountainous Italian valleys. *Resources*, *13*(1), 17. https://doi.org/10.3390/resources13010017

Rwekaza, G. C., Chikoyo, R. A., & Swai, A. O. (2025). Determinants of financial sustainability in saving and credit [incomplete title]. *[Publication information unavailable in the supplied reference]*, 238–252.

Sait, S. S., Muharam, F. M., & Chin, T. A. (2018). Impacts of technology assessments on firm performance. In *AIP Conference Proceedings*, *2044*(1), Article 020009. https://doi.org/10.1063/1.5080062

Sheraz, M., Deyi, X., Mumtaz, M. Z., & Ullah, A. (2022). Exploring the dynamic relationship between financial development, renewable energy, and carbon emissions: New evidence from Belt and Road countries. *Environmental Science and Pollution Research*, *29*(10), 14930–14947. https://doi.org/10.1007/s11356-021-16641-0

Singh, D., Dikshit, A. K., & Kumar, S. (2024). Smart technological options in collection and transportation of municipal solid waste in urban areas: A mini review. *Waste Management & Research*, *42*(1), 3–15. https://doi.org/10.1177/0734242X231175816

Sondh, S., Upadhyay, D. S., Patel, S., & Patel, R. N. (2024). Strategic approach towards sustainability by promoting circular economy-based municipal solid waste management system: A review. *Sustainable Chemistry and Pharmacy*, *37*, 101337. https://doi.org/10.1016/j.scp.2023.101337

Sriningsih, S., Haryanto, T., Solihin, A., & Program, D. (2024). Determinants of spending efficiency for education and health functions. *Jejak*, *17*(1), 27–41. https://doi.org/10.15294/jejak.v17i1.5620

Sulemana, A., Donkor, E. A., Forkuo, E. K., & Oduro-Kwarteng, S. (2019). Effect of optimal routing on travel distance, travel time and fuel consumption of waste collection trucks. *Management of Environmental Quality: An International Journal*, *30*(4), 803–832. https://doi.org/10.1108/MEQ-07-2018-0134

Sult, A., Wobst, J., & Lueg, R. (2024). The role of training in implementing corporate sustainability: A systematic literature review. *Corporate Social Responsibility and Environmental Management*, *31*(1), 1–30. https://doi.org/10.1002/csr.2560

Tanzania Urban Resilience Program. (2020). *Tanzania Urban Resilience Program annual report 2020*.

Yasmin, F., Sumi, M. S. S., Rabeta, M., & Ima, U. M. (2024). Defining factors behind the financial sustainability of microfinance institutions (MFIs) of Bangladesh. *International Journal of Economics and Financial Issues*, *14*(6), 310–319. https://doi.org/10.32479/ijefi.16966

Zhao, L., Liu, Z., Vuong, T. H. G., Nguyen, H. M., Radu, F., Tăbîrcă, A. I., & Wu, Y. C. (2022). Determinants of financial sustainability in Chinese firms: A quantile regression approach. *Sustainability*, *14*(3), 1555. https://doi.org/10.3390/su14031555