

THE EFFECTIVENESS OF FINANCIAL GOVERNANCE PRACTICES ON THE ENVIRONMENTAL PERFORMANCE OF THE MUNICIPALITIES IN DEVELOPING COUNTRIES

Silas Mukwarami *

* Faculty of Commerce and Administration, Department of Accounting, Walter Sisulu University, Mthatha, South Africa
Contact details: Faculty of Commerce and Administration, Department of Accounting, Walter Sisulu University, Nelson Mandela Drive, Mthatha 5100, Eastern Cape, South Africa



Abstract

How to cite this paper: Mukwarami, S. (2026). The effectiveness of financial governance practices on the environmental performance of the municipalities in developing countries. *Journal of Governance and Regulation*, 15(2), 69–81. <https://doi.org/10.22495/jgrv15i2art6>

Copyright © 2026 The Author

This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0). <https://creativecommons.org/licenses/by/4.0/>

ISSN Print: 2220-9352
ISSN Online: 2306-6784

Received: 30.04.2025
Revised: 12.08.2025; 30.01.2026
Accepted: 02.03.2026

JEL Classification: G13, Q51, Q53, Q54, Q56
DOI: 10.22495/jgrv15i2art6

The paper examines the relationship between municipal financial management practices (MFMPs) and environmental performance (EP) in South African municipalities (SAMs). The need for study is driven by prevailing EP challenges, as exhibited by poor waste management practices in the local municipalities (Bikam & Chakwizira, 2021). To achieve this objective, the study employed robust standard errors to analyse panel data collected by quantitative content analysis from online sources regarding thirty SAMs during the period spanning 2014 and 2023. The study found a positive, insignificant relationship between MFMPs and EP. The study's findings have crucial implications for many stakeholders, including policymakers, the national government, and local municipalities, as the need to review and enforce compliance with the existing financial management framework remains pertinent to addressing environmental challenges. The study's findings influence decisions on MFMPs, as a commitment to managing the ecological environment, which presents an additional dimension of addressing waste management challenges. Therefore, future research must aim to broaden this agenda, which remains imperative to promoting sustainable environmental management practices (EMPs) from a financial management perspective.

Keywords: Environmental Performance, Financial Management Practices, Municipalities, Service Delivery, Waste Management

Author's individual contribution: The Author is responsible for all the contributions to the paper according to CRediT (Contributor Roles Taxonomy) standards.

Declaration of conflicting interests: The Author declares that there is no conflict of interest.

1. INTRODUCTION

Globally, the need to manage waste sustainably continues to drive local government entities to implement proactive environmental management strategies to achieve a seamless service delivery system (Mukwarami & van der Poll, 2024). Municipalities have responsibilities to manage solid waste and wastewater, and protect the ecological

environment by enforcing bylaws and national regulations. This ensures that adequate resources are available for improving environmental performance (EP) (Nzama, 2022). The increasing impacts of climate change on service delivery (Mukwarami & van der Poll, 2024), a lack of funding (Bikam & Chakwizira, 2021), overpopulation in the cities (Terrance & Oupa, 2023; Murwirapachena, 2022), poor governance, corruption, and political

interferences perpetually compromise the local municipalities' efforts to provide quality service delivery (Ngumbela, 2021). Above all, the majority of South African municipalities (SAMs) are in financial distress, mainly due to poor corporate governance practices. This has continued to affect most municipalities' capacity building for managing the ecological environment (Tsagae, 2023). Given the extent of financial management malpractices in local municipalities, against repressed fiscal space (Nzama, 2022), this, however, suggests that the capacity to address service delivery challenges remains constrained, let alone extended environmental responsibilities. These factors have contributed to large quantities of unmanaged municipal waste, presenting challenges to the current waste management system that result in detrimental effects on human health and the environment (Adeleke et al., 2021). Therefore, this calls for examining the impacts of decisions regarding financial management practices on the environment for improved approaches to achieving sustainable development goals.

Financial governance encompasses municipal financial management practices (MFMPs), which are provided for by a legislative framework composed of the Municipal Finance Management Act (MFMA) (2003), Municipal Fiscal Powers and Functions Act (2007), Municipal Systems Act (2000), Municipal Structures Act (1998), and Municipal Property Rates Act (2004). The inception of the King IV report on corporate governance provided a clear framework for how local municipalities practice ethical leadership to build good corporate governance (Nzama, 2022). Notwithstanding the contribution of the existing legal framework, poor MFMPs continue to contribute to financial distress in local municipalities (Glasser & Wright, 2020), thus making it extremely difficult to cope with good environmental management practices (EMPs) that lead to reduced water, air, and land pollution (Mukwarami et al., 2023). Failure to implement sustainable financial management practices across the SAMs continues to worsen funding challenges as sustainable water infrastructure investment problems continue to characterise municipalities' fiscal space (Ruiters & Amadi-Echendu, 2022b, 2022c; Enwereji & Uwizeyimana, 2021), resulting in a further impact on the waste management system. Therefore, without understanding how financial management decisions influence EP, seeking solutions to waste management challenges is a pipe dream in the local municipalities.

Despite remarkable progress in improving service delivery (Murwirapachena, 2022), evidence of poor waste management practices continues to impede endeavours towards promoting good EP (Mukwarami & van der Poll, 2024). This is against the backdrop of failure to comply with the existing MFMPs in the local municipalities, as evidenced by retarded EP progress in big cities. Studies have proved that decisions on financial management practices relating to asset management (Bikam & Chakwizira, 2021; Murwirapachena, 2022), budget implementation (Agbenyo et al., 2018; Oupa, 2023), financial performance (FP) (Mukwarami, 2021), and investment decisions (Enwereji & Uwizeyimana, 2021; Antunes & Martins, 2020) are considered

integral in promoting sustainable service delivery and, to a certain extent, better EP. Without strict adherence to prescribed MFMPs, municipalities face difficulties in raising adequate revenue through investments and collections from service users (Ruiters & Amadi-Echendu, 2022a). While the essence of financial management practices in promoting sustainable EP is widely confirmed in several studies (Rashied et al., 2024; Jovanović & Vašiček, 2021), the South African context has not received adequate attention, as there is a lack of further evidence to suggest the existence of such studies. This, however, presents a critical research gap in the South African context and requires attention to address the main question regarding whether MFMPs influence EP as represented by waste management expenditure. The specific questions that require answers to achieve the research objective are as follows:

RQ1: Do asset management practices significantly improve EP measured through waste management in SAMs?

RQ2: Is budget implementation significantly improving EP measured through waste management in SAMs?

RQ3: Do investment decisions significantly improve EP measured through waste management in the SAMs?

Therefore, the aim of addressing the research questions through examining the relationship between MFMPs and EP in SAMs is driven by the need to ensure that MFMPs relating to asset management, investment, and budgeting align with environmental sustainability efforts that foster water, energy, and waste management. SAMs face a problem of corruption and financial mismanagement (Mbalaka, 2023; Nzama, 2022; Everatt & Pieterse, 2022). This study influences local government entities to pay proportionate attention to EP challenges. Thirdly, municipalities are facing funding challenges (Ruiters & Amadi-Echendu, 2022a), and therefore, the study presents an opportunity to make informed decisions on MFMPs that help promote environmental sustainability performance without compromising quality service delivery.

Therefore, to achieve the research objective, the study employs robust standard errors to analyse panel data (2014–2023) relating to budgeting, asset management, investment decisions, and waste management in the SAMs. The study makes meaningful contributions to the body of knowledge on municipal efforts to address environmental sustainability challenges through the efficient allocation of resources. Firstly, the study represents pioneering efforts in addressing environmental challenges through promoting sustainable MFMPs in the SAMs. Secondly, the study unveils insights into how effective municipal decisions on MFMPs can add value to the sustainability efforts within the realm of South African local governments. This has an impact on the other private businesses that deal with municipalities to provide services to the communities. Lastly, the study encourages local municipalities to review MFMPs and make necessary adjustments to ensure adequate resources are made available to improve EP.

The structure of the paper is as follows. Section 2 discusses the review of the literature and

the development of hypotheses related to MFMPs and EP. Section 3 describes the research methodology and data collection. Sections 4 and 5 present the study's findings and the discussion, respectively. Section 6 includes the conclusion.

2. LITERATURE REVIEW

2.1. Financial management in South African municipalities

A sound financial management system forms the basis for strategic management, transparency, and accountability in all entities of the public sector, such as municipalities (Enwereji & Uwizeyimana, 2021; Terrance & Oupa, 2023). Municipal financial management involves a portfolio of financial activities, including asset management, cash and expenditure management, reporting and oversight, procurement and planning, and budgeting (Republic of South Africa Department of National Treasury, 2018). In the context of SAMs, the financial management system was modernised after the introduction of the MFMA in 2003. The goal of modernising the financial management framework was to ensure a sound financial base is in place to accelerate the achievement of service delivery goals (Mulenga, 2017). Apart from the MFMA (2003), the broader context of the legal framework for MFMPs works in conjunction with various legislation, including the Municipal Systems Act (2000), Municipal Structures Act (1998), Municipal Fiscal Powers and Functions Act (2007), and Municipal Property Rates Act (2004) that set the basis for accountability, transparency, governance, operation, budgeting, and planning.

According to Krishnan and Subban (2022), the Municipal Public Account Committee (MPAC), alongside the Executive Committee, the Audit Committee, the Management Structure, the Internal Audit, and the External Audit Committee, oversees financial governance in local government entities. While MPAC facilitates oversight of the financial report presented by the councils, the audit committee provides a view of the financial situation of municipal entities based on examination of the financial statements and responds to municipal councils on issues raised by the Auditor General. In addition, the Auditor General's objective is to express an audit opinion on whether the financial statements fairly present the financial position of audited municipalities at the financial year-end. The Auditor General checks compliance with the National Treasury circulars, audits municipalities' financial statements, and monitors the performance of audit committees (Krishnan & Subban, 2022).

Despite the existing coherent framework to guide municipalities on matters related to financial management, financial distress continues to affect service delivery, with other municipalities on the verge of collapse (Glasser & Wright, 2020). Evidence suggests that a low level of compliance with prescribed MFMPs in local municipalities has led to many problems such as service delivery supply chain management inefficiencies (Mukwarami, 2021), poor service delivery (Krishnan & Subban, 2022), corruption (Ngumbela, 2021),

underutilisation of assets, budget implementation challenges (Oupa, 2023), and lack of water sector investments (Ruch & Geyer, 2017). Therefore, a quest for how MFMPs determine EP in local municipalities remains relevant to addressing waste management challenges.

2.2. Related literature and hypotheses development

Understanding the relationship between asset management and EP to advance the sustainable infrastructure narrative across the municipalities is crucial in achieving sustainable development. Evidence suggests that the management of assets directly influences service delivery (Mbalaka, 2023), and, therefore, it is critical to ensure that municipal infrastructure elements are effectively managed. Patience's (2015) study suggests that poor infrastructure management practices in the Ekurhuleni Metropolitan municipality have hurt service delivery. This is due to challenges such as ineffective budgeting and planning, and a lack of technical expertise to manage infrastructure. Likewise, poor asset management can lead to deteriorating infrastructure, irregular maintenance schedules, a lack of leak monitoring and detection instruments (Enwereji & Uwizeyimana, 2021), resulting in costly service delivery (Mukwarami, 2021). Consequently, a surge in wastewater leakages could result in contamination of drinking water sources (Mukwarami, 2021). This could potentially make water sources unsafe for human consumption, leading to the spread of waterborne diseases (Tsagae, 2023; Adeleke et al., 2021).

Moreover, Ndolomingu et al. (2023) evaluated asset management in a waste treatment environment. The study confirmed that a lack of synergies in the waste treatment environment due to limited diligence in the application of maintenance strategies in the waste treatment works, gross environmental equipment failures in the waste treatment process, led to challenges in managing the environment. The management of the assets is affected by many factors, as confirmed by Fernando (2019) in the study on implementation analysis of the solid waste management of local government in the Western province of Sri Lanka. Despite the study's results highlighting human resource challenges, a lack of business and community cooperation, and administrative inefficiencies, a lack of modern technology contributed significantly to the failure in managing a sustainable solid waste management system. Also, effective utilisation of assets in the local municipalities often resulted in positive financial and EP. This is evidenced in a study by Bartolacci et al. (2018) that examined the relationship between good EMPs and FP in the municipal-owned Italian waste management companies. The results reveal a strong correlation between return on assets and EP measured by waste collection rates per capita.

The introduction of technology-based assets continues to receive recognition in dealing with the management of environmental challenges. Kurniawan et al. (2022) evaluated the transformation of solid waste management based on a digitalisation-based circular economy in China. The study findings

acknowledge that digitalisation is a driving force for China towards developing carbon management strategies. Moreover, digitalisation significantly led to improvements in EP through waste reduction, recycling, and reuse of waste, and conservation of resources. Bikam and Chakwizira (2021) examined municipal asset operations and maintenance performance of infrastructure in metropolitan and rural municipalities in South Africa. The study highlights that a lack of funding and limited fiscal space continue to negatively affect the renewal of municipal assets and the provision of vital services to vulnerable communities. Therefore, it may be imperative to increase capital spending to ensure the replacement and maintenance of all outdated and malfunctioning infrastructure. To confirm the effect of capital expenditure on service delivery, Murwirapachena (2022) evaluated the impact of capital expenditure and population growth on access to water services in 52 SAMs. From the analysis of the fixed effects model (FEM) and random effects model (REM) results, capital expenditure influenced water access rate and population growth, hurting municipal efforts to address service delivery challenges. Therefore, it is imperative to accept that asset management practices influence EP, and as such, the following hypothesis is proposed.

H1: Asset management practices significantly improve EP measured through waste management in SAMs.

Budgeting, as a component of financial management, outlines a financial management planning strategy that an organisation can utilise to achieve desired goals (Jovanović & Vašiček, 2021; Agbenyo et al., 2018). Therefore, the budget is a vital mechanism for tracking expenditure and revenue in local municipalities, starting at the national and local government levels (Kumasi, 2019). A budget can be a benchmarking tool for service delivery performance management in local municipalities. Oupa (2023) explored the effects of performance management on service delivery in the Greater Tzaneen municipality. The results suggest that poor performance management in the local municipality has affected the quality-of-service delivery. This is due to targeting unrealistic performance goals that are not achievable within the budget period. Hence, waste management is one of the performance indicators used to assess the performance of municipalities; therefore, this suggests that budgeting should be inclusive and representative of all the key performance areas.

Considering the surge in environmental catastrophes, local municipalities continue to search for survival strategies that ensure decisions on cost allocation models integrate the environmental management approaches (Mukwarami & van der Poll, 2024). Kotnik et al. (2017) evaluated the performance budgeting model for addressing waste pollution problems by investigating the interaction between environmental taxes, environmental expenditures, and environmental impacts. The study confirms that performance budgeting can only be effective when all three aspects are considered. Additionally, the direct and indirect influence of taxes on environmental management to reduce waste pollution was confirmed. To ensure an effective

waste management system in local municipalities, it is crucial to ensure that the budget is well-funded. Troschinetz and Mihelcic (2009) analysed the sustainable recycling of municipal solid waste in developing countries by conducting a qualitative analysis of all 23 case studies. The major barriers to full implementation of recycling projects include the availability of government funding, relating to municipal solid waste management capacity challenges, and the unavailability of land, human resources, and new technology. Rashied et al. (2024) evaluated the impact of financial management reforms on budget efficiency, transparency, and wastage reduction across diverse regions. The study employed a mixed-method approach, and the findings from regression analysis, interviews, and thematic analysis suggest that improved budget efficiency and transparency significantly reduced waste in key sectors such as health and infrastructure, particularly in South Asia and sub-Saharan Africa. Overall, financial management reforms can lead to better fiscal performance, reduce wastage inefficiencies, and increase transparency. Therefore, budgeting remains effective in ensuring that correct cost allocation models consider the infrastructure required for municipal solid waste management.

In the context of the local government sphere, Cabannes (2015) evaluated the impact of participatory budgeting on service delivery: municipal practices and evidence from the field. The study acknowledged that participatory budgeting contributes significantly to improving service delivery. Similarly, Gonçalves (2014) examined the effects of participatory budgeting on municipal expenditure and infant mortality in Brazil. The results suggest that municipalities using participatory budgeting allocated funds to meet public expenses, according to popular preferences, and a substantial fraction of their budgets was allocated to investments in sanitation and health services. Budget, as a performance management tool is instrumental to managing water service delivery expenditure through by tracking and monitoring expenses incurred within the service provision supply chain. Kumasi's (2019) study examined the link between district water budgets and expenditure tracking for sustainable rural service delivery in Ghana. The results from the quantitative research suggest a positive relationship between capital expenditure and the water access rate. However, the budget can only be effective as a performance management tool if it reflects the service delivery priorities, with realistic service delivery targets complemented by the availability of resources (Nkadimeng, 2019). Enwereji and Uwizeyimana's (2021) study focused on local municipalities in the North-West province, South Africa. According to the study findings, local municipalities struggled to provide adequate water and sanitation services to residents due to ineffective budget implementation plans, poor implementation of legislative frameworks, and financial management issues. Therefore, it can be hypothesised that:

H2: Budget implementation significantly improves EP measured through waste management in SAMs.

Investment is creating a portfolio of productive service infrastructure assets to yield direct and indirect income (Mukwarami, 2021). This implies that infrastructure investment decisions are imperative to improving service delivery and EP (Mukwarami & van der Poll, 2024). However, when making investment decisions, it is vital to consider factors such as inadequate budget, poor FP, and underpricing of municipal services (Ruiters & Amadi-Echendu, 2022a). Mukwarami (2021) examined the relationship between sustainable water infrastructure factors and investment in water management in South African metropolitan municipalities. The feasible generalised least squares results suggest that FP measured through net operating surplus margin and non-revenue water affected total investment in water management positively and negatively, respectively. Do et al. (2024) investigated the determinants of financing decisions for renewable energy projects, and the findings suggest many factors influence investment decisions, including institutional influence from legal obligations and normative sources, prior beliefs, and knowledge of the renewable energy operational context. The results emphasise the role of *a priori* beliefs in ensuring technological adequacy to make renewable energy effective and successful. Therefore, this suggests that investment decisions influence efforts to promote renewable energy projects, which are necessary for enhancing EP. In a study, Dlamini et al. (2019) looked at municipal solid waste management in South Africa from the perspective of energy recovery through waste-to-energy technologies. The findings from reviewing literature on waste-to-energy technologies suggest that with the right technologies and investment changes, waste can potentially become a resource that contributes to the socio-economic development of cities. In conclusion, the paper suggests that waste-to-energy technologies have the potential to contribute to ecological and environmental well-being and sustainable waste management.

Antunes and Martins (2020) examined the determinants of an improved water service delivery system, and the results concluded that investment in physical infrastructures, particularly in urban areas, tends to improve access to improved water sources. Likewise, Antunes and Martins (2020) identified the determinants of access to improved water sources in line with the Millennium Development Goals. The findings suggest that increasing investment in physical infrastructure, education, and gender power improved the provision of water services. Consistent with these scholarly views, Kumasi et al. (2022) looked at universal water service delivery in Ghana, and the results of the study point out that the provision of sustainable water service requires large capital injection, with many complementary factors such as improved monitoring and evaluation, committed leadership, institutional power, and a skilled workforce. Hence,

considering water infrastructure underinvestment problems, it is essential to make wise investment decisions to contribute towards an integrated waste delivery system. However, the debate about waste management strategies relevant for addressing waste service delivery challenges, particularly in South Africa, where the government continues to increase investment with little progress (Mukwarami, 2021). Therefore, waste management investment decisions are integral in developing a sustainable waste management chain across municipalities. As such, the proposed hypothesis is as follows.

H3: Investment decisions significantly improve EP measured through waste management in the SAMs.

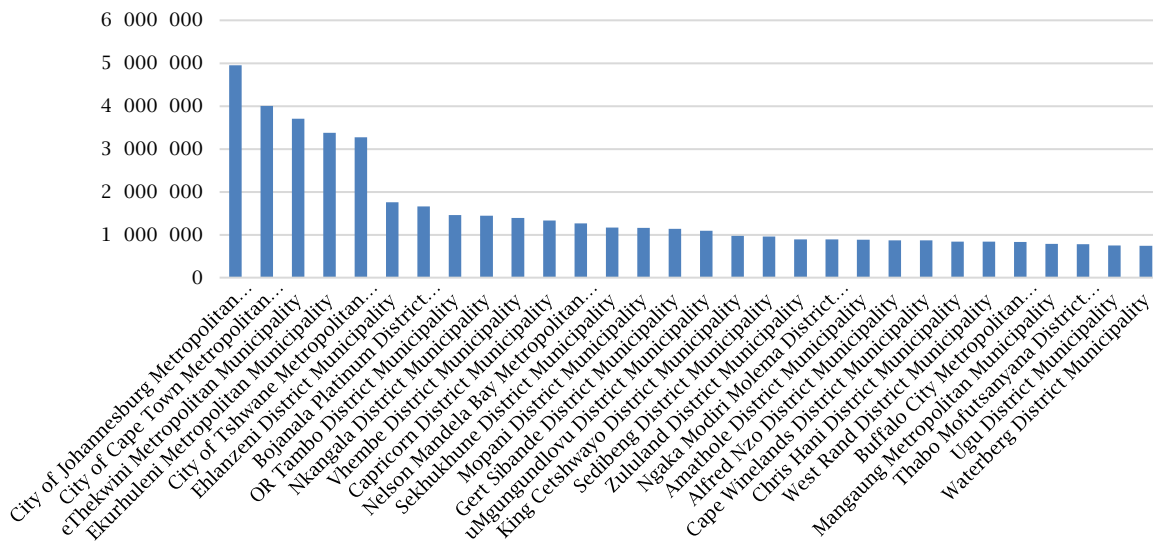
3. RESEARCH METHODOLOGY

3.1. Research design and data

The study aimed to establish the effects of MFMPs on EP measured through expenditure in waste management. The study employed an explanatory research design, explained by Saunders et al. (2016) as the best research design for understanding ideas by establishing the causal relationship between variables. Additionally, the research design aligns with the chosen positivist philosophy and deductive approach. This ensures that objectivism takes precedence over subjectivism and testing of the existing theories, respectively (Ngulube et al., 2015). Given the nature of the research inquiry, the study used a quantitative method known to be associated with objective numerical data collected (2014–2023) from various online sources, mainly accessed on <https://municipaldata.treasury.gov.za/> and <https://municipalities.co.za/>. Furthermore, the study considered backup data sources, including PDF-copies of audited financial statements, service delivery budget implementation plans, municipal infrastructure expenditure reports, annual integrated reports, and Statistics South Africa survey reports.

The study's total population is composed of 257 SAMs, which are in three categories, namely, eight metropolises (Category A), 44 districts (Category B), and 205 local municipalities (Category C). The study purposively drew a sample of the 30 biggest municipalities based on two criteria: population size, resulting in eight and 22 local municipalities from categories A and B, respectively (as shown in Figure 1). The MFMA (2003) governs financial management practices in South Africa, and the Act requires all municipalities to follow guidelines on reporting, budgeting, and asset management. This is critical to promote transparency and accountability relating to all local government activities. The MPAC must oversee financial governance, including reporting across all SAMs (Krishnan & Subban, 2022), and, therefore, gives credibility to data and its sources.

Figure 1. Population distribution by municipality



3.2. Data analysis

Considering the relationship between MFMPs and EP, a regression analysis approach is used to understand and quantify the relationship between the concerned variables. Regression analysis is the most common approach to investigating the relationship between the variables (Breit et al., 2023). The use of the regression analysis in the study is mostly informed by its application in several correlational studies (Murwirapachena, 2022; Bartolacci et al., 2018).

The study employed commonly used regression panel data estimators, namely FEM and REM. Consistent with other empirical studies, the study tests the data to check for violations of regression assumptions for improved and more accurate statistical results (Murwirapachena, 2022). The panel

data model for examining the relationship between MFMPs and EP in the SAMs is as follows:

$$Y_{it} = \alpha_i + \beta X_{it1} + V_i + \varepsilon_{it} \tag{1}$$

where, Y_{it} represents the dependent variable for entity i in period t , β represents the coefficients for the independent variables, X represents the independent variables, α is the intercept for each entity, V_i is the specific error term for each entity, which differs between entities but has a constant value for any particular entity, ε_{it} is the “common” error term with the usual properties (i.e., mean 0, uncorrelated with itself, uncorrelated with X , uncorrelated with V_i and homoscedastic). The expanded model gives a full empirical model as follows:

$$EWMAG_{it} = \alpha_i + \beta CETER_{it1} + \beta CAPEX_{it2} + \beta CEBII_{it3} + \beta POPSZ_{it4} + V_i + \varepsilon_{it} \tag{2}$$

where, $EWMAG_{it}$ is the expenditure in waste management, a measure of EP for municipality i in year t ; $CETER_{it1}$ is the capital expenditure to total expenditure ratio for municipality i in year t ; $CAPEX_{it2}$ is the cash changes due to additions and decreases in fixed assets, receivables and investments represents water investing decisions for municipality i in year t ; $CEBII_{it3}$ stands for capital expenditure budget implementation which is an indicator that measures the extent of budget implementation for municipality i in year t ; $POPSZ_{it4}$ is the population size, control variable for municipality i in year t .

3.3. Explanation of variables

The dataset comprises one dependent variable, three independent variables, and a control variable, explained as follows.

The dependent variable is EP, which is measured through waste management expenditure. As millions of tonnes of waste are generated, pressure is mounting on various municipalities to provide sustainable solid waste management

services, taking into account the functionality of the natural environment (Kalina & Schenck, 2024). In recent years, local municipalities have increased their expenditure on waste management to contain the amount of waste generated in the cities.

Independent variables: MFMPs are measured through asset management, budget implementation, and investment decisions. MFMPs are guided by Section 216 (1)(c) of the Constitution and Section 2 of the MFMA, which empowers the National Treasury to provide circulars that set ratio norms and interpretation standards and cover various aspects regarding municipal finances, such as FP and position, and budget implementation.

Capital expenditure to total expenditure ratio ($CETER$) is the level of capital expenditure to total expenditure, which indicates the prioritisation of expenditure toward current operations versus future capacity in terms of municipal services (Mabelane et al., 2023).

The capital expenditure budget implementation indicator ($CEBII$) measures the municipality’s ability to implement capital projects and monitor risks associated with non-implementation (Mabelane et al., 2023; Jorge et al., 2023).

$$CEBII = \frac{\text{Actual capital expenditure}}{\text{Budget capital expenditure}} \times 100$$

Total investment in infrastructure (CAPEX) is calculated based on the amount spent on investing in capital projects. According to the Global Sustainable Investment Alliance’s (2022) study on mapping the state of sustainable investment in major global financial markets, there is a shift towards environmentally conscious investment strategies. Therefore, for this study, it is crucial to evaluate whether investment decisions of local municipalities are better positioned to deal with surging environmental challenges.

Population size (POPSZ) refers to the total number of people living in a municipal area. The POPSZ is a control variable because the National Treasury’s allocation of funds is based on

$$lgEWMAG_{it} = \alpha_i + \beta lgCETER_{it1} + \beta lgCAPEX_{it2} + \beta lgCEBII_{it3} + \beta lgPOPSZ_{it4} + V_i + \varepsilon_{it} \tag{3}$$

where, $lgEWMAG_{it}$ is the expenditure in waste management, a measure of EP, $lgCETER_{it1}$ is the logarithm of CETER; $lgCAPEX_{it2}$ is calculated based on the cash changes due to additions and decreases in fixed assets, receivables, and investments; $lgCEBII_{it4}$ is the logarithm of a CEBII; $lgPOPSZ_{it4}$ is the logarithm of POPSZ.

3.4. Panel data estimators

The study adopted FEM and REM to examine the relationship between MFMPs and EP in the SAMs. The FEM accounts for specific factors that are constant across the observations. In this regard, it is crucial to accept that MFMA guides municipalities on financial management matters in all municipalities in South Africa. Therefore, compliance with MFMA is expected to have the same fixed effect on MFMPs in all local government entities. The FEM eliminates bias from unobservables that are not consistent over time but static over entities. Therefore, the use of FEM helps to avoid omitted variables (Ruch & Geyer, 2017).

The REM considers variability and differences across the entities and assumes that the outcomes depend on variations characterising the observations. For the study, it can be viewed that MFMPs are homogeneous across municipalities; there are individual factors, such as level of compliance, enforcement, and sustainability strategies, that affect the outcomes. The REM controls for unobserved heterogeneity when the heterogeneity is static over time and is uncorrelated with independent variables (Ruch & Geyer, 2017).

Considering the strengths and weaknesses of these two models, the study conducted Hausman tests to decide which model is suitable for producing reliable results. Before estimation,

the population in each municipality, with the biggest municipalities receiving substantial amounts (Mukwarami, 2021; Murwirapachena, 2022).

The municipalities that form part of the sample are operating under a single governance system, and the same metrics, such as population size, water supply capacity, municipal infrastructure grants received from the National Treasury, and revenue-generating capacity, are used in assessing the condition of the municipalities. Therefore, the panel data generated by content analysis using different sources is complex and presents challenges in analysing it in its natural form. The study adopted a process that involves transforming data into natural logarithms consistent with previous studies (Murwirapachena, 2022). The revised regression equation showing transformed data in natural logarithms is as follows.

the study performed diagnostic tests to detect multicollinearity and heteroskedasticity. The presence of heteroskedasticity in the panel data results in heterogeneity problems that lead to biased results characterised by imprecision (Adeboye & Agunbiade, 2017).

The presence of multicollinearity implies that the dependent variables are highly correlated and can affect the statistical power of the regression model and the precision of the results (García et al., 2015). If the panel data violate any of the two mentioned regression assumptions, particularly heteroscedasticity, both feasible generalised least squares and standard errors for robust estimators are considered options because of their strength to suppress heteroscedasticity. The former is regarded as the best when the data has heteroskedasticity. However, it works better and provides reliable results when the period time (T) is greater than the number of observations (N) (Bai et al., 2021). The latter is known to suppress heteroscedasticity when N is greater than T . Therefore, depending on the results of diagnostic tests, the researcher takes the necessary action to ensure that the adopted model produces reliable results free of bias.

4. FINDINGS

4.1. Descriptive statistics

According to information in Table 1, data on expenditure on waste management (EWMAG) showed a mean value of 255 million and a standard deviation of 295 million. The standard deviation is higher than the mean value, implying that the data are not clustered around the mean. However, this suggests that progress in waste management was heterogeneous across the SAMs because of differences in municipal sizes.

Table 1. Descriptive statistics

Variable	Mean	Std. dev.	Min	Max
EWMAG (ZAR)	255 million	295 million	25 million	5.1 billion
CAPEX (ZAR)	118 million	85 million	19 million	9.4 billion
CETER (%)	13.8352	17.47688	23.50161	80.71374
CEBII (%)	54.6008	25.55796	30.12478	95.4897
POPSZ	1.5 million	1.6 million	0.7 million	4.9 million

Source: Author’s elaboration.

The CAPEX standard deviation is below the mean, and huge variations explain the homogeneity in waste management that varies with the size of the municipalities. The normal range for CETER is between 10% and 20%, but according to the results, the mean is 13.83, which is within the range. However, the higher standard deviation suggests existing wide variation across the SAMs, implying the data values are spread. Regarding CEBII, the normal range is between 95% and 100%, the mean is 56.6008, and the standard deviation value is 25.55796, implying that most data points are clustered around the mean. Lastly, the POPSZ has a mean of 1.5 million and is lower than the standard deviation of 1.6 million. This suggests that the data values are spread as explained by the size of the municipalities.

4.2 Diagnostic test

Following ordinary least squares, the study conducted multicollinearity and heteroskedasticity to ensure that the regression models used in analysing panel data pass the adequacy tests.

4.2.1. Multicollinearity

Multicollinearity exists when there is a strong correlation between independent variables. Testing for multicollinearity among independent variables is vital to avert associated adverse effects that could be pitfalls in regression analysis (Singh & Kumar, 2021). The results shown in Table 2 are for the multicollinearity tests performed.

Table 2. Multicollinearity

Variable	VIF	1/VIF
CEBII	2.04	0.490525
CETER	1.91	0.522923
CAPEX	1.81	0.246579
POPS	1.48	0.676665
Mean VIF	1.69	

Source: Author's elaboration.

The multicollinearity tests conducted through the variance inflation factor (VIF) analysis produced a VIF mean of 1.64, as displayed in Table 2. According to the literature, a VIF below 5 is within the suitable range (Osborne & Waters, 2002), implying that the data were free from the problem of multicollinearity and posed no threat to the regression analysis results.

4.2.2. Heteroscedasticity

Heteroskedasticity exists when the standard deviations of a dependent variable, observed over different values of predictor variables, are not constant (Osborne & Waters, 2002). The study conducted Breusch-Pagan tests to detect the presence of heteroskedasticity in the panel data, as shown in Table 3.

Table 3. Heteroskedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity Null assumption: Constant variance Variables: fitted values of <i>lgEWMAG</i> chi ² (1) = 103.22 Prob > chi ² = 0.0000
--

Source: Author's elaboration.

Based on the results, as shown in Table 3, the dataset is heteroskedastic, as evidenced by the p-value of 0.000, below the 0.05 confidence interval. This means that the precision of the FEM and REM results was compromised. Therefore, the study considered alternative estimators that suppress heteroskedasticity.

4.3. Regression estimators' results

The results from FEM and REM were used to test the impact of MFMPs on EP (which are shown in Table 4). Following the results from the FEM and REM, as shown in Table 4, the approach to conducting Hausman tests (results shown in Table 5) to choose the best estimator between models is in line with previous research (Murwirapachena, 2022).

Table 4. The results of panel data estimators

Independent variables	LogEWMAG FEM	LogEWMAG REM	LogEWMAG Robust standard errors
LogCAPEX	0.00271	0.00736*	0.00268
	-0.78	-2.09	-0.97
LogCETER	-0.0287**	-0.0432***	0.0384*
	(-2.61)	(-3.75)	-2.38
LogCEBII	0.0174*	0.0152	0.015
	-2.32	-1.85	-0.88
LogPOPSZ	0.312***	0.205***	0.0388***
	-17.75	-13.99	-6.01
_cons	0.908***	2.056***	3.696***
	-4.46	-11.7	-37.09
N	240	240	240

Note: Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

Source: Author's elaboration.

The Hausman test is a statistical method used to determine whether to use REM or FEM in panel data analysis. The alternative assumption, which supports the FEM, assumes that unobserved differences are correlated with the independent

variables. The null assumption, which assumes that REM is acceptable, posits that the unobserved differences are not correlated with the independent variable.

Table 5. Hausman test

Independent variables	(b)	(B)	(b - B)	Sqrt (diag(V_b - V_B))
	FEM	REM	Difference	S.E.
LogCAPEX	627108.25	7.3636	-4.6528	6.23894
LogCETER	-49100.54	-49451.96	351.4166	4486.662
LogCEBII	-12805.24	-14024.65	1219.409	328.66
LogPOPSZ	7.646635	2.356979	5.289655	5.015254

b = consistent under null assumption and alternative assumption; obtained from xtreg
B = inconsistent under alternative assumption, efficient under null assumption; obtained from xtreg
Test: null assumption: difference in coefficients not systematic
Prob > chi² = 0.6202 (REM is appropriate)

Source: Author's elaboration.

In this context, as shown in Table 5, the Hausman test indicates a significance level of 0.05; any p-value below this threshold supports the alternative assumption. Based on the results, the p-value is 0.6202, which exceeds the 0.05 threshold. Therefore, the null assumption is acceptable, implying that REM is more appropriate than FEM.

According to the results presented in Table 5, FEM (b) is inconsistent with the null assumption, implying that REM is efficient under the null assumption. Also, the p-value is greater than 0.05, thus confirming the suitability of the REM. However, the presence of heteroskedasticity in the data raised questions about relying on REM results. From the two alternative regression estimators proposed above, the study did not consider feasible generalized least squares because N is more than T . This left the researcher with no option except to resort to robust standard errors. Robust standard errors for robust estimators present many advantages, including improved efficiency, consistent inference, and robustness to misspecification when the data have heteroscedasticity (Bai et al., 2021). Ultimately, the study considered statistical results based on robust standard errors, accurate and correct (shown in Table 4).

The total investment in infrastructure (CAPEX) has a positive influence on EP, but the relationship is insignificant. While asset management, as measured by CETER, proved to have a negative and significant relationship with EP, the relationship turned out to be positive and weak, considering the robust standard errors results. Lastly, the finding suggests that budgeting, as proxied by the CEBII, shows a positive and insignificant relationship with EP. Overall, the aggregated results support that MFMPs in the SAMs positively influenced performance in environmental, and this calls for acknowledging the sustainability efforts.

5. DISCUSSION OF THE MAIN RESULTS

The study aims to examine the relationship between MFMPs and EP, as measured through expenditure on waste management. As shown in Table 4, the confirmation of hypotheses is determined by the results of robust standard errors, which are considered unbiased and precise. The summary of results in Table 6 confirms the rejection and acceptance of the hypotheses.

Table 6. Hypotheses tests summary table: Cluster robust results

Hypothesis	Regression coefficient (Significance)	Accept/reject
H1	0.0384*	Accept
H2	0.015	Reject
H3	0.00268	Reject

Note: * weak relationship, ** strong relationship, *** very strong relationship.

Source: Author's elaboration.

As shown in Table 6, the relationship between asset management practices (CETER) and environmental performance (EP) was confirmed to be significant and positive (0.0384). The positive and significant relationship suggests that asset management practices have had the desired effects on the provision of EP, and therefore, H1 is accepted. This implies that local municipalities are moving in a positive direction towards embracing the concepts of sustainability planning in their asset management and strategic planning. The confirmation of results is backed by research that confirms that a strong correlation exists between sustainable asset management and EP. (Bartolacci et al., 2018). Moreover, increasing expenditure on sustainable infrastructure was confirmed to have a positive impact on service delivery and wastewater management in the literature (Murwirapachena, 2022; Bikam & Chakwizira, 2021). The outcomes are proof of continued efforts by local municipalities' bodies of management practices towards improving the infrastructure's value chain and formulation of operational and strategic decisions for improved EP. Also, this suggests that implementing asset management policies to improve service delivery by addressing dysfunctional infrastructure was effective (Bouleonovar & Gibson, 2015).

The results could be due to the existing municipal financial management framework, as guided by the MFMA (2003), which provides direction on financial management practices. Additionally, the influence of the Auditor General on the areas of asset management utilisation in the local government is vital to promote best practices (Auditor General South Africa, 2023). Despite the positive influence of MFMPs on EP, the weak relationship further suggests that not many efforts have been made to ensure that assets are effectively used for improving EP. The weak and positive linkage might be attributed to a lack of funding to finance maintenance projects. Consistently, Bikam and Chakwizira (2021) pointed out that funding challenges negatively impact the renewal of

municipal assets and the provision of crucial services to vulnerable communities. Surge of water and wastewater leakages in and around the industrial areas, resulting in polluting water sources and environmental catastrophes (Adeleke et al., 2021). Moreover, a lack of visible progress in transforming waste management through digitalisation might continue to influence sustainability efforts. As such, it is crucial to ensure that waste management operations are well-resourced through acquiring cutting-edge technology for full digitalisation, as confirmed in the literature (Kurniawan et al., 2022). On the other hand, researchers suggest that compliance with the financial management system is essential for improving the efficient and effective use of assets within the value chain of the water supply. As such, it is pertinent for municipalities to continue reviewing the asset management framework to improve EP.

The robust standard error results confirm a positive and insignificant relationship between budget implementation (*CEBII*) and *EP*. Therefore, *H2* cannot be accepted as the insignificant relationship existed. Although local municipalities' efforts on *EP* have had an insignificant relationship, the positive dimension of the linkage further suggests a positive attitude in managing the environment embedded in budget planning and implementation. The results are consistent with many previous studies, with Oupa (2023) confirming that realistic budgets are effective in managing service delivery. This follows Kumasi's (2019) research on district water budgets and expenditures that have had a positive influence on service delivery. Contradictorily, Enwereji and Uwizeyimana (2021) blame poor budget implementation as one of the reasons why municipalities find it difficult to provide proper water and sanitation services in South Africa.

However, the existence of an insignificant relationship suggests underutilisation of funds allocated to municipalities meant to improve water infrastructure capacity (Jorge et al., 2023; Ruiters & Amadi-Echendu, 2022a). *CEBII* also assesses municipalities' ability to effectively control expenditures incurred in line with the approved budget (Republic of South Africa Department of National Treasury, 2018). The results further confirm that the weaknesses in monitoring and evaluating capital budget implementation strategies in local municipalities failed to influence water service provisioning efforts in a positive direction. Additionally, the relationship could be due to poor budgeting of revenue amounts that proved impossible to collect. This is consistent with Patience's (2015) study, which confirmed that ineffective budgeting has continued to widen the sustainable infrastructure gap. Moreover, a lack of inclusive budgeting might have influenced the relationship. Gonçalves (2014) suggests that participatory budgeting influences priorities, which are meant to promote service delivery. According to Mukwarami (2021), the failure to collect revenue in local municipalities derailed budget implementation and service delivery efforts, resulting in poor *EP* (Agbenyo et al., 2018). However, Rashied et al. (2024) stress that the implementation of financial management reforms that could impact budgeting relies on political will and institutional power to

influence capacity building. Therefore, efforts to improve budget implementation remain relevant in achieving an integrated waste management system in SAMs.

As shown in Table 6, a positive and insignificant relationship (0.00268) existed between investment decisions (*CAPEX*) and *EP* in SAMs, implying that *H3* is confirmed and supported by the results. The positive relationship between investment decisions and *EP* suggests a proactive decision environmental management strategy embedded in municipal infrastructure investment decisions. Moreover, the results are consistently in line with the findings of previous studies, which found a positive relationship between water investments and water service delivery (Antunes & Martins, 2020; Kumasi et al., 2022). The positive and insignificant relationship could be due to factors that influence the demand and supply sides of investments in infrastructure management. Murwirapachena's (2022) study suggests that investing in water projects through capital expenditure improved the delivery of water services in local municipalities, but population growth is undoing municipal efforts. The accountability of population size has become a challenge due to uncontrolled immigration (Mukwarami, 2021).

Additionally, several municipalities have come under the spotlight due to corruption (Ngumbela, 2021), a lack of human resources to manage infrastructure investments, a lack of accountability and transparency in the utilisation of funds, and low-rate investment return (Ruch & Geyer, 2017; Ruiters & Amadi-Echendu, 2022a; Terrance & Oupa, 2023). Therefore, local governments can hardly attract private-sector investment because of the aforementioned challenges (Ruiters & Amadi-Echendu, 2022c). Thus, decisions on investing in waste management should be informed by understanding its determinants, followed by approaches to developing a sustainable service delivery infrastructure value chain that contributes to increasing internal investments arising from ploughing back surplus generated from recycling projects.

6. CONCLUSION

Waste management responsibilities continue to drive local municipalities in South Africa to improve MFMPs. This is crucial to make sustainable municipal infrastructure available to promote the functionality of the natural environment. Sustainable financial management practices in local municipalities remain a significant determinant in achieving better environmental and service delivery performance. However, the dimension of promoting sustainable *EP* by implementing sustainable financial management decisions remains overlooked in this field of research. However, this is against the backdrop of inadequate infrastructure funding, which should be utilised optimally to cater for service delivery and environmental responsibilities. Therefore, insignificant attention to this area of study continues to underestimate how sustainable financial management practices could potentially contribute to the effectiveness of managing waste, leading to better *EP*. Therefore, this article's approach is centred on accepting that most

municipalities in South Africa face financial challenges that are partly exacerbated by corruption, poor financial management decisions, and noncompliance with the financial management framework. Considering the financial distress challenges faced by local municipalities, it is crucial to implement MFMPs to promote allocative efficiency of financial resources. Therefore, the article examines the relationship between MFMPs as measured through asset management, investment decisions, and budgeting, and EP-proxied expenditure on waste management.

The panel data set, composed of data involving the largest SAMs, was used, and the heteroskedasticity robust standard errors approach was utilised in the analysis. The panel data estimator produced a positive and weak relationship between MFMPs and EP in the SAMs. However, only asset management has had a significant influence, with budget implementation and investing decisions proving to have insignificant effects on EP. Despite the positive results, local municipalities showed little commitment towards improving budget implementation and making sustainable investment decisions. These results provide valuable information concerning the existing financial management framework's potential to influence efforts on addressing poor EMPs in SAMs.

The results' implications for waste management teams, policymakers, municipal managers, national governments, and communities are far-reaching. The national government should collaborate with policymakers to align the waste management practices of the MFMPs. Similarly, municipal managers and chief financial officers are at the centre of implementing MFMPs and are accountable to communities for failing to manage available financial resources to promote

environmental responsibility. Additionally, the results signify a stepping stone towards reviewing the MFMPs to align with the efforts to achieve sustainable EP. This also calls for reflection on conformity and compliance with the MFMPs, ensuring resource allocative efficiency is achieved to provide balanced priority to triple bottom issues.

Notwithstanding positive efforts towards achieving sustainable development, encouraging adherence to financial management practices as stressed by the Republic of South Africa Department of National Treasury remains a priority. Similarly, a surge in non-compliance with MFMPs should be met with a proportionate response that ensures that municipal officials failing to comply are banned from holding public offices and their professional membership is withdrawn until they receive further training. The continuous process of reviewing the existing financial management framework and making necessary adjustments to ensure that all loopholes are closed for improved environmental transparency and accountability. Further recommendations suggest that digitalising waste management operations can go a long way in capacity building to ensure recycling, reduction, and reuse of waste activities are fully transformed.

Despite using a small sample composed of a few municipalities drawn from categories A and B, the results potentially represent the general situation in South Africa, as municipalities are geographically spread across the country. Additionally, the level of compliance with prescribed MFMPs across municipalities in South Africa could have potentially influenced the outcomes of the results. Therefore, future research should focus on gaining a broad insight into how MFMPs influence environmental efforts in SAMs by studying a large sample.

REFERENCES

- Adeboye, N. O., & Agunbiade, D. A. (2017). Estimating the heterogeneity effects in a panel data regression model. *Annals. Computer Science Series*, 15(1), 149–158. <https://eprints.federalpolyilaro.edu.ng/1002/1/ROMANIA%20JOURNAL%20PUBLICATION.pdf>
- Adeleke, O., Akinlabi, S., Jen, T.-C., & Dunmade, I. (2021). Towards sustainability in municipal solid waste management in South Africa: A survey of challenges and prospects. *Transactions of the Royal Society of South Africa*, 76(1), 53–66. <https://doi.org/10.1080/0035919X.2020.1858366>
- Agbenyo, W., Danquah, F. O., & Shuangshuang, W. (2018). Budgeting and its effect on the FP of listed manufacturing firms: Evidence from manufacturing firms listed on Ghana Stock Exchange. *Research Journal of Finance and Accounting*, 9(8), 12–22. <https://www.iiste.org/Journals/index.php/RJFA/article/view/42008>
- Antunes, M., & Martins, R. (2020). Determinants of access to improved water sources: Meeting the MDGs. *Utility Policy*, 63, Article 101019. <https://doi.org/10.1016/j.jup.2020.101019>
- Auditor General South Africa. (2023). *Local government 2021–22 audit outcomes: Audit outcomes for the financial year ended 30 June 2022. Status of material irregularities as of 15 February 2023*. <https://www.agsa.co.za/Portals/0/Reports/MFMA/2021-22/2021-22%20MFMA%20-%20Tabling%20presentation%20-%2031%20May%202023.pdf?ver=2023-05-31-093622-627>
- Bai, J., Choi, S. H., & Liao, Y. (2021). Feasible generalised least squares for panel data with cross-sectional and serial correlations. *Empirical Economics*, 60, 309–326. <https://doi.org/10.1007/s00181-020-01977-2>
- Bartolacci, F., Paolini, A., Quaranta, A. G., & Soverchia, M. (2018). The relationship between good environmental practices and financial performance: Evidence from Italian waste management companies. *Sustainable Production and Consumption*, 14, 129–135. <https://doi.org/10.1016/j.spc.2018.02.002>
- Bikam, P., & Chakwizira, J. (2021). Municipal asset operations and maintenance performance in metropolitan and rural municipalities in Gauteng province and Vhembe district local municipalities, South Africa. *Cogent Engineering*, 8(1), Article 1935409. <https://doi.org/10.1080/23311916.2021.1935409>
- Bouleonov, J., & Gibson, J. (2015). *Asset management in rural areas: A case of Amatole and Chris Hani District municipalities*. IRC. <https://www.ircwash.org/sites/default/files/7608997e8e21c38049364586a0b01fb1.pdf>
- Breit, M., Preuß, J., Scherrer, V., & Preckel, F. (2023). Why the use of segmented regression analysis to explore change in relations between variables is problematic: A simulation study. *Psychological Methods*, 30(3), 622–635. <https://doi.org/10.1037/met0000576>
- Cabannes, Y. (2015). The impact of participatory budgeting on basic services: Municipal practices and evidence from the field. *Environment and Urbanisation*, 27(1), 257–284. <https://doi.org/10.1177/0956247815572297>

- Dlamini, S., Simatele, M. D., & Serge Kubanza, N. (2019). Municipal solid waste management in South Africa: From waste to energy recovery through waste-to-energy technologies in Johannesburg. *Local Environment*, 24(3), 249–257. <https://doi.org/10.1080/13549839.2018.1561656>
- Do, T. T. T., Tran, T. M., Le, H. D., Tran, L. P., & Cao, G. T. (2024). Determinants of financing decisions for renewable energy projects: A case study. *Risk Governance and Control: Financial Markets & Institutions*, 14(4), 29–40. <https://doi.org/10.22495/rgcv14i4p3>
- Enwereji, P. C., & Uwizeyimana, D. E. (2021). Gender perspectives of measures to improve water and sanitation delivery in South African local municipalities. *Gender and Behaviour*, 19(1). https://hdl.handle.net/10520/ejc-genbeh_v19_n1_a29
- Everatt, D., & Pieterse, M. (2022). Outsourcing governance: Local government and the future of democracy in South Africa. *Journal of Southern African Studies*, 48(5), 787–804. <https://doi.org/10.1080/03057070.2022.2119749>
- Fernando, R. L. S. (2019). Solid waste management of local governments in the Western province of Sri Lanka: An implementation analysis. *Waste Management*, 84, 194–203. <https://doi.org/10.1016/j.wasman.2018.11.030>
- García, C. B., García, J., López Martín, M. M., & Salmerón, R. (2015). Collinearity: Revisiting the variance inflation factor in ridge regression. *Journal of Applied Statistics*, 42(3), 648–661. <https://doi.org/10.1080/02664763.2014.980789>
- Glasser, M. D., & Wright, J. (2020). South African municipalities in financial distress: What can be done? *Law, Democracy & Development*, 24(1). <https://doi.org/10.17159/2077-4907/2020/1dd.v24.17>
- Global Sustainable Investment Alliance (2022). *Global sustainable investment review 2022*. <https://www.gsi-alliance.org/wp-content/uploads/2023/12/GSIA-Report-2022.pdf>
- Gonçalves, S. (2014). The effects of participatory budgeting on municipal expenditures and infant mortality in Brazil. *World Development*, 53, 94–110. <https://doi.org/10.1016/j.worlddev.2013.01.009>
- Jorge, S., Cerqueira, P., & Furtado, S. (2023). Municipal revenue over-budgeting: A dynamic analysis of its determinants. *Local Government Studies*, 49(3), 644–675. <https://doi.org/10.1080/03003930.2021.2025359>
- Jovanović, T., & Vašiček, V. (2021). The role and application of accounting and budgeting information in the government financial management process — A qualitative study in Slovenia. *Public Money & Management*, 41(2), 99–106. <https://doi.org/10.1080/09540962.2020.1724405>
- Kalina, M., & Schenck, C. (2024). What a mess: Rethinking municipal waste management 30 years into South African democracy. *South Africa Journal of Science*, 120(11–12), Article 18995. <https://doi.org/10.17159/sajs.2024/18995>
- Kotnik, Ž., Klun, M., & Škulj, D. (2017). Performance budgeting model in the environmental perspective: Tackling waste pollution. *Administrativna in Management Public*, 29, 141–150. <https://www.ceeol.com/search/article-detail?id=728401>
- Krishnan, H. B., & Subban, M. (2022). Local financial governance and accountability through audit committees in local government: A normative framework for self-evaluation of audit committees. *Administratio Publica*, 30(4), 142–164. https://journals.co.za/doi/pdf/10.10520/ejc-adminpub_v30_n4_a8
- Kumasi, T. C. (2019). District water budgets and expenditure tracking for sustainable rural service delivery in Ghana. *Sustainable Water Resources Management*, 5, 1057–1071. <https://doi.org/10.1007/s40899-018-0278-9>
- Kumasi, T. C., Nyarko, K. B., & Antwi-Agyei, P. (2022). Universal water service delivery: Insights on what it takes from Ghana. *World Water Policy*, 8(1), 9–30. <https://doi.org/10.1002/www2.12072>
- Kurniawan, T. A., Liang, X., O'Callaghan, E., Goh, H., Othman, M. H. D., Avtar, R., & Kusworo, T. D. (2022). Transformation of solid waste management in China: Moving towards sustainability through digitalisation-based circular economy. *Sustainability*, 14(4), Article 2374. <https://doi.org/10.3390/su14042374>
- Mabelane, K., Mongwe, W. T., Mbuvha, R., & Marwala, T. (2023). An analysis of local government financial statement audit outcomes in a developing economy using machine learning. *Sustainability*, 15(1), Article 12. <https://doi.org/10.3390/su15010012>
- Mbalaka, B. J. (2023). *Combating corruption in municipal procurement: An exploratory study of blockchain integration in the city of Tshwane metropolitan municipality* [Master's thesis, University of Johannesburg]. University of Johannesburg Institutional Repository. <https://ujcontent.uj.ac.za/esploro/outputs/graduate/Combating-corruption-in-Municipal-Procurement/9931808407691>
- Mukwarami, S. (2021). *Sustainable cities, water investment and management for improved water service delivery: A case study of South African metropolitan municipalities* [Doctoral dissertation, University of Limpopo]. University of Limpopo Institutional Repository http://ulspace.ul.ac.za/bitstream/handle/10386/3831/mukwarami_s_2021.pdf?sequence=1&isAllowed=y
- Mukwarami, S., & van der Poll, H. M. (2024). Critical environmental management accounting practices influencing service delivery of growing cities in a developing economy: A review and conceptual framework. *Environment Systems and Decisions*, 44(3), 710–739. <https://doi.org/10.1007/s10669-023-09960-9>
- Mukwarami, S., Nkwaira, C., & van der Poll, H. M. (2023). Environmental management accounting implementation challenges and supply chain management in emerging economies' manufacturing sector. *Sustainability*, 15(2), Article 1061. <https://doi.org/10.3390/su15021061>
- Mulenga, K. (2017). *Challenges of water management at the local government municipal level in the Eastern Cape of South Africa* [Doctoral dissertation, University of the Witwatersrand]. Wits Institutional Repository. <https://wiredspace.wits.ac.za/items/f8a5121d-c9b3-42b4-9bff-f0b3ec159f27>
- Murwirapachena, G. (2022). Capital expenditure, population growth and access to water services in South Africa. *Sustainable Water Resources Management*, 8(5), Article 131. <https://doi.org/10.1007/s40899-022-00729-7>
- Ndolomingu, N. N., Ohe, K. N., & Lubbe, S. (2023). Asset management in the waste treatment environment. *HOLISTICA — Journal of Business and Public Administration*, 14(1), 133–161. <https://doi.org/10.2478/hjbpa-2023-0008>
- Ngulube, P., Mathipa, E. R., & Gumbo, M. T. (2015). Theoretical and conceptual framework in the social sciences. In E. R. Mathipa & M. T. Gumbo (Eds.), *Addressing research challenges: Making headway in developing researchers* (pp. 43–66). Mosala-MASEDI Publishers & Booksellers CC.

- Ngumbela, X. (2021). Is South Africa building a capable state through developmental local government? *The Strategic Review for Southern Africa*, 43(2), 83–102. <https://doi.org/10.35293/srsa.v43i2.872>
- Nkadimeng, M. N. (2019). *The role of management control on service delivery in local government: A case study of a South African municipality* [Doctoral dissertation, University of South Africa]. University of South Africa. <https://ir.unisa.ac.za/handle/10500/25606>
- Nzama, L. (2022). *A governance framework for non-performing municipalities in South Africa* [Doctoral dissertation, University of Johannesburg]. University of Johannesburg Institutional Repository. <https://ujcontent.uj.ac.za/esploro/outputs/doctoral/A-governance-framework-for-non-performing-municipalities/9928508907691>
- Osborne, J. W., & Waters, E. (2002). Four assumptions of multiple regression that researchers should always test. *Practical Assessment, Research and Evaluation*, 8(1), Article 2. <https://doi.org/10.7275/r222-hv23>
- Oupa, H. (2023). Exploring the effects of performance management on service delivery in Greater Tzaneen municipality. *International Journal of Social Science Research and Review*, 6(6), 354–364. <https://doi.org/10.47814/ijssrr.v6i6.1374>
- Patience, J. J. (2015). *Infrastructure management challenges in Ekurhuleni Metropolitan municipality* [Master's dissertation, University of Johannesburg]. University of Johannesburg Institutional Repository. <https://ujcontent.uj.ac.za/esploro/outputs/graduate/Infrastructure-management-challenges-in-Ekurhuleni-Metropolitan/9913646607691#file-0>
- Rashied, A. S., Chyad, A. K., Qasem, W., & Abbas, N. H. (2024). The impact of financial management reforms on budget efficiency, transparency, and wastage reduction across diverse regions. *Journal of Ecohumanism*, 3(5), 743–762. <https://doi.org/10.62754/joe.v3i5.3935>
- Republic of South Africa Department of National Treasury. (2018). *State of local government finances* (Report as at 30 June 2018 and Section 71 quarter 4 local government results as at 30 June 2019). https://static.pmg.org.za/191015NT_State_of_LG.pdf
- Ruch, W., & Geyer, H. S., Jr. (2017). Public capital investment, economic growth and poverty reduction in South African municipalities. *Regional Science Policy & Practice*, 9(4), 269–285. <https://doi.org/10.1111/rsp3.12104>
- Ruiters, C., & Amadi-Echendu, J. (2022a). Economic costs and investment challenges of water infrastructure in South Africa. *Infrastructure Asset Management*, 9(4), 194–206. <https://doi.org/10.1680/jinam.21.00014>
- Ruiters, C., & Amadi-Echendu, J. (2022b). Investment models for the water infrastructure value chain in South Africa: Investment measures, needs and priorities. *Water SA*, 48(4), 429–440. <https://doi.org/10.17159/wsa/2022.v48.i4.3852>
- Ruiters, C., & Amadi-Echendu, J. (2022c). Public-private partnerships as investment models for water infrastructure in South Africa. *Infrastructure Asset Management*, 9(4), 180–193. <https://doi.org/10.1680/jinam.21.00013>
- Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research methods for business students* (7th ed.). Pearson Education.
- Singh, S. G., & Kumar, S. V. (2021). Dealing with the multicollinearity problem in the analysis of side friction characteristics under urban heterogeneous traffic conditions. *Arabian Journal for Science and Engineering*, 46, 10739–10755. <https://doi.org/10.1007/s13369-020-05213-y>
- South African Government. (1998). *Municipal Structures Act No. 117 of 1998*. <https://www.gov.za/documents/local-government-municipal-structures-act>
- South African Government. (1999). *Public Finance Management Act No. 29 of 1999 (as amended)*. <https://www.gov.za/documents/public-finance-management-amendment-act>
- South African Government. (2000). *Municipal Systems Act No. 32 of 2000*. <https://www.gov.za/documents/local-government-municipal-systems-act>
- South African Government. (2003). *Municipal Finance Management Act 56 of 2003*. <https://www.gov.za/documents/local-government-municipal-finance-management-act-0>
- South African Government. (2004). *Municipal Property Rates Act No. 6 of 2004*. <https://www.gov.za/documents/local-government-municipal-property-rates-act-0>
- South African Government. (2007). *Municipal Fiscal Powers and Functions Act No. 12 of 2007*. <https://www.gov.za/documents/municipal-fiscal-powers-and-functions-act>
- Terrance, M. T., & Oupa, H. (2023). Public accountability mechanisms, a panacea to improve policy in South African municipalities: Navigating through the new public management to create public value and effective service delivery. *Journal of Nation-Building and Policy Studies*, 7(3). <https://doi.org/10.31920/2516-3132/2023/v7n3a3>
- Troschinetz, A. M., & Mihelcic, J. R. (2009). Sustainable recycling of municipal solid waste in developing countries. *Waste Management*, 29(2), 915–923. <https://doi.org/10.1016/j.wasman.2008.04.016>
- Tsagae, N. (2023). Political instability: An impediment to good governance in local government — The case of selected municipalities in South Africa. *Journal of Public Administration*, 58(2). <https://doi.org/10.53973/jopa.2023.58.2.a14>