

Strategic Management of Toll Fee Revenue in Zambia: Efficiency, Governance, and Infrastructure Outcomes

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Abstract

This study investigates the strategic management of toll fees in Zambia, focusing on revenue collection efficiency, governance of public-private partnerships (PPPs), and the allocation of toll revenues for road infrastructure development. While toll fees serve as a key financing mechanism in developing economies, concerns about transparency, efficiency, and equitable distribution raise sustainability issues. A mixed-methods approach was employed, combining survey data from 106 respondents with analysis of policy documents and literature. Quantitative data were analyzed using descriptive statistics, while qualitative data were examined through thematic analysis. Findings reveal that although toll fees are widely recognized as essential for infrastructure financing, operational inefficiencies and transparency challenges persist. About 36.8% of respondents viewed the system as necessary but in need of improvement, while 34% reported traffic delays despite electronic tolling systems. Concerns over accountability and uneven revenue allocation were also evident. The study further highlights limitations in PPP effectiveness due to regulatory and governance challenges. It concludes that strengthening legislative frameworks, improving transparency, and enhancing revenue reinvestment mechanisms are critical to achieving a more efficient, equitable, and sustainable toll fee management system in Zambia.

1. Introduction

The financing of public road infrastructure remains a major challenge for emerging economies, particularly in the context of increasing urbanization, population growth, and economic expansion. In Zambia, toll fees have become an important domestic resource mobilization mechanism aimed at supporting the maintenance, rehabilitation, and expansion of the national road network. The introduction of the National Road Tolling Programme (NRTTP), managed by the National Road Fund Agency in collaboration with the Road Development Agency, reflects a strategic shift toward user-based financing models that reduce reliance on external funding sources.

Despite the growing importance of toll revenue in infrastructure financing, concerns persist regarding how effectively these funds are managed. Issues related to operational efficiency in revenue collection, transparency in financial management, and the equitable allocation of resources continue to raise questions among policymakers and stakeholders. These challenges are particularly significant in the context of increasing infrastructure demand, where inefficiencies in fund management may limit the ability of toll systems to achieve their intended developmental outcomes.

Although existing literature highlights the role of tolling systems and Public-Private Partnerships (PPPs) in enhancing infrastructure development, there remains limited empirical evidence linking toll revenue collection to measurable infrastructure outcomes in Zambia. Furthermore, gaps exist in understanding how governance frameworks, institutional coordination, and strategic management practices influence the effectiveness and sustainability of toll-funded projects. This lack of comprehensive analysis creates uncertainty regarding whether current systems are delivering value for money and supporting balanced regional development.

In response to these gaps, this study examines the strategic management of toll fee revenue in Zambia, with a focus on efficiency, governance, and infrastructure outcomes. The purpose is to provide a structured assessment of how toll revenues are collected, managed, and utilized, and to identify areas where strategic improvements can enhance accountability, optimize resource use, and support sustainable infrastructure development.

1.2 Statement of the Problem

The strategic management of toll fee revenue in Zambia plays a critical role in financing public road infrastructure and supporting national development objectives. Since the implementation of the National Road Tolling Programme (NRTTP), toll gates have generated substantial domestic revenue, amounting to billions of Kwacha in recent years. For instance, "the National Road Fund Agency collected K4 billion from Toll Gates against a target of K2.7 billion" (NRFA, 2026). These revenues, managed by the National Road Fund Agency, have become an essential component of infrastructure financing, supplementing constrained government budgets and supporting road-related projects (Mutungwa, 2024). Additionally, literature suggests that Public-Private Partnerships (PPPs) can enhance infrastructure delivery through improved efficiency and resource mobilization (Engel, Fischer and Galetovic, 2020; Song, Shangguan and Li, 2021).

Despite this strong revenue performance, concerns persist regarding inefficiencies in collection systems, limited transparency, and challenges in the strategic utilization of funds. Issues such as revenue leakages, delayed remittances, and weak institutional coordination raise questions about the effectiveness of governance mechanisms. Although toll systems are expected to generate broader socio-economic benefits, including improved connectivity and reduced transport costs (Rahayu and Kipuw, 2020), the extent to which these benefits are being realized remains unclear.

Furthermore, there is limited empirical evidence linking toll revenue collection to measurable infrastructure outcomes in Zambia. While existing studies acknowledge governance weaknesses and regulatory ambiguities (McDermot et al., 2022; Zulu et al., 2023), they do not adequately examine how these challenges affect the efficiency and sustainability of toll-financed projects. This gap makes it difficult to determine whether increasing revenue levels are translating into tangible improvements in road quality and accessibility.

This study therefore seeks to address this gap by providing an evidence-based evaluation of the strategic management of toll fee revenue in Zambia. It focuses on efficiency, governance, and the relationship between revenue collection and infrastructure outcomes, with the aim of informing policy and improving the effectiveness of toll-funded infrastructure development.

1.3 Objectives of the Research

- To determine the effectiveness of the current toll fee revenue collection systems at selected toll gates in Zambia.
- To assess the role of public-private partnerships in enhancing toll fee management in Zambia.
- To establish challenges and opportunities in optimizing toll fee revenue allocation for road infrastructure development.

2 Literature Review

This section reviews existing literature on toll fee management and Public-Private Partnerships (PPPs), with a focus on their role in infrastructure financing. Toll fees are widely recognized as an important revenue source for road development, particularly in emerging economies where fiscal constraints limit public funding. Studies emphasize the importance of efficient collection systems, transparent governance, and well-structured PPP frameworks in ensuring sustainability (Engel, Fischer and Galetovic, 2020).

However, much of the existing literature adopts a generalized global perspective, often overlooking country-specific institutional and operational dynamics. In the case of Zambia, there is limited empirical research examining how toll systems function within local governance structures and economic conditions (Mutungwa, 2024). This creates a gap in understanding how global best practices translate into the Zambian context.

2.1 Theoretical Literature Review

Concepts of Toll Management

Toll management involves the integration of policies, technologies, and institutional frameworks aimed at ensuring efficient revenue collection and effective utilization. While theory emphasizes efficiency and transparency, practical implementation often reveals trade-offs between revenue generation, user affordability, and public acceptance. For instance, poorly managed toll systems can reduce compliance and undermine trust, even when revenue targets are achieved.

PPPs are frequently identified as mechanisms for improving efficiency through private sector participation (Engel, Fischer and Galetovic, 2020). However, empirical evidence suggests that PPP success is highly context-dependent. While they can enhance operational efficiency and innovation, poorly designed contracts or weak regulatory oversight may lead to inefficiencies and public dissatisfaction (Zulu et al., 2023). This highlights that PPPs are not inherently effective but require strong governance frameworks to deliver intended outcomes. Technology adoption theories further suggest that digital tolling systems such as RFID, NFC, and AI can improve efficiency and accuracy (Sukumar et al., 2023). Nevertheless, the effectiveness of these technologies depends on infrastructure readiness, user adoption, and system reliability factors that vary significantly across countries.

Sustainable Infrastructure Financing

Sustainable toll management requires balancing financial efficiency with social equity and long-term infrastructure needs. Lifecycle Cost Analysis (LCCA) provides a framework for evaluating infrastructure investments over time, promoting better allocation of resources (Sukumar et al., 2023). Similarly, dynamic pricing mechanisms can optimize revenue while managing traffic congestion. However, global evidence indicates that financial sustainability alone is insufficient. Weak governance structures and macroeconomic instability can undermine even well-designed toll systems (World Bank, 2023). This suggests that sustainability depends not only on revenue generation but also on institutional capacity and accountability mechanisms. In many developing contexts, including Zambia, achieving this balance remains a significant challenge.

2.2 Empirical Literature Review

Global Overview of Toll Management

Globally, advanced toll systems demonstrate how technology and governance can enhance efficiency. In the United States, electronic toll collection systems such as E-ZPass have significantly improved traffic flow and revenue efficiency. However, fragmentation across multiple agencies creates coordination challenges, limiting system integration (Transport Topics, 2024). European countries have gone further by integrating environmental objectives into toll systems, using pricing mechanisms to incentivize low-emission vehicles and reduce congestion (Sukumar et al., 2023). These systems combine efficiency with sustainability, reflecting strong institutional coordination.

China presents a more centralized and technologically advanced model, utilizing artificial intelligence and nationwide electronic tolling systems to enable real-time traffic management and dynamic pricing (Precedence Research, 2024). Unlike decentralized systems, China's approach benefits from strong state coordination and large-scale infrastructure investment.

In contrast, developing countries such as Nigeria illustrate the consequences of weak governance. Despite the presence of toll systems, challenges such as corruption, revenue leakages, and lack of transparency undermine effectiveness (Aladejebi, 2021). Similarly, Indonesia demonstrates that while toll roads can stimulate economic growth, outcomes depend on consistent investment and governance capacity (Rahayu and Kipuw, 2020). While developed countries achieve efficiency through advanced technology and strong institutions, many developing countries struggle due to governance weaknesses. This contrast highlights that technology alone is insufficient without effective institutional frameworks.

African Overview of Toll Management

In Africa, toll management outcomes vary widely depending on governance and public acceptance. South Africa’s system initially improved revenue generation but faced strong public resistance due to perceived lack of transparency and high costs (OUTA, 2024). This suggests that even technologically advanced systems can fail without stakeholder trust.

Ghana’s adoption of electronic tolling improved efficiency, yet the suspension of tolls during the COVID-19 pandemic revealed the vulnerability of toll systems to socio-economic pressures (Ghana Web, 2024). This indicates that toll systems must be flexible and responsive to changing economic conditions.

Kenya’s PPP-driven projects, such as the Nairobi Expressway, demonstrate improved infrastructure quality and efficiency through private sector involvement (Standard Media, 2024). However, affordability concerns persist, requiring tiered pricing models. Across Africa, successful toll systems depend not only on technology and PPPs but also on transparency, affordability, and public acceptance. Countries that fail to address these factors experience resistance and inefficiencies.

Zambian Context of Toll Management

Zambia has made progress in modernizing toll collection through electronic systems introduced by the National Road Fund Agency. The Electronic Toll Card system has improved transaction efficiency and reduced reliance on cash (NRFA, 2024).

However, unlike China and European countries, Zambia faces challenges related to system reliability, limited user adoption, and infrastructure constraints (eToll Zambia, 2024). These issues reduce the overall effectiveness of technological innovations.

The National Road Tolling Programme, introduced in 2013, has generated significant revenue and reduced dependence on external financing (Chilunjika, 2023). However, in contrast to Kenya’s PPP success, Zambia’s PPP implementation remains limited and faces challenges related to contract design and regulatory oversight (Zulu et al., 2023). This limits the potential efficiency gains associated with private sector participation.

Operational challenges also persist. Although RFID technology has improved efficiency compared to manual systems, congestion at major toll gates and system delays continue to affect performance (S et al., 2022). Proposed solutions such as NFC and Automated Vehicle Recognition (AVR) could improve efficiency, but their effectiveness will depend on investment capacity and user adoption.

Unlike many global examples where strong governance supports technological systems, Zambia’s toll management challenges are more closely linked to institutional weaknesses, coordination issues, and limited technological integration. This suggests that improving governance may be as important as adopting new technologies.

2.3 Enhancing Toll Revenue Management through PPPs

PPPs are widely promoted as a solution for improving toll revenue management by leveraging private sector efficiency and innovation (Chilunjika, 2023). However, evidence shows that their success depends heavily on contract design, risk-sharing mechanisms, and regulatory oversight (Rouhani et al., 2018).

In Zambia, weak institutional capacity and governance challenges may limit the effectiveness of PPP arrangements. Without transparency and accountability, PPPs risk reinforcing inefficiencies rather than resolving them (Zulu et al., 2023). While PPPs offer potential benefits, they are not a universal solution. Their effectiveness depends on strong governance frameworks, which remain a key challenge in the Zambian context.

2.4 Overall Literature Gap

The reviewed literature demonstrates that successful toll management depends on the integration of technology, governance, and financial sustainability. However, there is limited empirical research specifically examining how these factors interact within Zambia. Most studies either focus on global best practices or broadly discuss governance challenges without linking them to measurable infrastructure outcomes. As a result, there is insufficient evidence on whether Zambia’s toll revenue is being strategically managed to deliver tangible improvements in road infrastructure. This study therefore addresses this gap by providing a context-specific analysis of toll revenue management in Zambia, focusing on efficiency, governance, and infrastructure outcomes.

2.5 Conceptual Framework

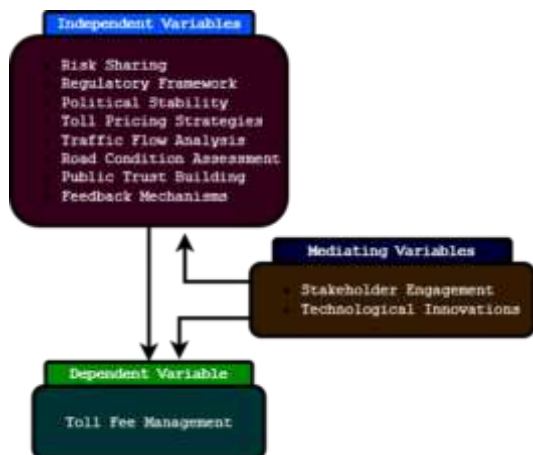


Figure 1: Conceptual Framework

2.6 Theoretical Framework

This study is grounded in Public-Private Partnership (PPP) Theory, Revenue Management Theory, and Stakeholder Theory, which collectively explain the strategic management of toll fee revenue in Zambia in relation to efficiency, governance, and infrastructure outcomes.

Public-Private Partnership (PPP) Theory explains how collaboration between government and private entities can improve infrastructure delivery through risk-sharing, access to capital, and operational efficiency (Ngoma, 2015; Banda & Jeke, 2018). In this study, PPP Theory is directly linked to Objective ii (evaluating the role of PPPs in toll fee management) and the variable of governance. It is used to assess whether PPP arrangements enhance institutional efficiency, improve accountability, and contribute to better infrastructure outcomes. Despite policy support such as the PPP Act of 2009, implementation challenges remain (Mukuka, 2023; UNCTAD, 2024), making it necessary to evaluate their effectiveness in practice.

Revenue Management Theory focuses on optimizing revenue through strategic pricing and efficient collection systems (Mudenda, 2017; National Road Fund Agency, 2023). This theory is linked to Objective i (assessing the efficiency of toll fee revenue collection systems) and the variable of efficiency. It guides the analysis of whether toll pricing structures and collection mechanisms in Zambia maximize revenue while maintaining affordability and accessibility for users.

Stakeholder Theory emphasizes the importance of balancing the interests of multiple stakeholders, including government institutions, private investors, and road users (Chicago Scholarship Online, 2023). It is linked to Objective iii (examining challenges and opportunities in revenue allocation) and the variables of transparency, accountability, and public acceptance. This theory helps evaluate how stakeholder engagement influences trust, compliance, and the equitable distribution of toll revenues.

Collectively, these theories provide an integrated framework linking the study's key variables efficiency (revenue collection and pricing), governance (PPP structures and accountability), and infrastructure outcomes (allocation and development impact) to the research objectives. This alignment enables a focused analysis of whether toll fee revenue in Zambia is strategically managed to achieve sustainable and equitable infrastructure development.

3 Research Methodology

This study adopts a pragmatist research philosophy and a mixed-methods case study design to investigate the strategic management of toll fees in Zambia. Grounded in a pluralistic ontological perspective, the research recognizes both objective realities, such as revenue flows, traffic volumes, and infrastructure expenditures, and subjective perceptions related to fairness, transparency, and efficiency (Dube, Nkomo & Apadile-Thokweng, 2024; Shan, 2024). Epistemologically, the study integrates quantitative and qualitative approaches to generate practical and policy-relevant knowledge by combining structured survey data with qualitative insights from key stakeholders. The case study design focuses on Zambia as the unit of analysis, enabling an in-depth examination of its infrastructure financing context, governance structures, and operational challenges. The study utilized a quantitative sample of 103 respondents and a qualitative sample of 20 participants. Stratified random sampling was employed for the quantitative component to ensure representation across key stakeholder groups, while purposive sampling was used to select knowledgeable participants for the qualitative interviews. This combination enhances both generalizability and depth, thereby strengthening the validity and reliability of the findings.

Quantitative data were analyzed using Microsoft Excel and the Statistical Package for the Social Sciences (SPSS), applying descriptive statistics such as frequencies and percentages, as well as inferential techniques including correlation and regression analysis to examine relationships between toll revenue performance and management strategies. Qualitative data from interviews were analyzed using thematic analysis, following a systematic process of familiarization, coding, theme development, and interpretation to identify patterns in strategic management practices and institutional dynamics. The analysis also explored the role of public-private partnerships (PPPs) in revenue optimization and infrastructure development, guided by frameworks from the World Bank (2023) and OECD (2021). By triangulating findings from both quantitative and qualitative data, the study enhances analytical depth and ensures that conclusions are robust, contextually grounded, and relevant for policy and strategic decision-making.

Validity and Reliability Test

To ensure the rigor of the study, both validity and reliability were carefully addressed throughout the research process. Content and construct validity were achieved by designing data collection instruments based on established literature and aligning survey questions with the study objectives to accurately capture key variables related to toll fee management. Triangulation of data sources, including surveys, interviews, and secondary documents, further enhanced validity by providing multiple perspectives on the research problem.

Reliability was ensured through the use of standardized questionnaires and consistent data collection procedures, allowing for replicability of results. Additionally, a pilot test of the survey instrument was conducted to identify ambiguities and improve clarity, thereby increasing the consistency of responses. These measures collectively strengthened the credibility, dependability, and overall trustworthiness of the study findings.

4 Results and Discussion

This chapter interprets the findings of the study in relation to its three main objectives: evaluating the effectiveness of toll fee revenue collection systems, examining the role of Public-Private Partnerships (PPPs), and identifying challenges and opportunities in optimizing toll revenue allocation for road infrastructure development. The discussion situates the findings within existing literature and highlights their theoretical and practical implications.

4.1 Demographics of Respondents

Gender

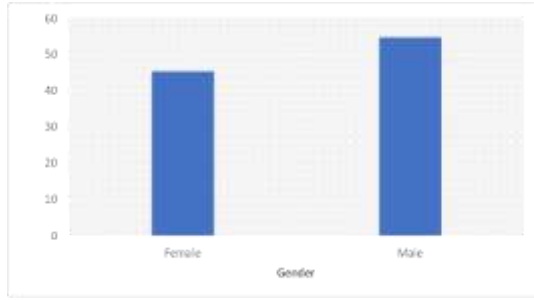


Figure 2: Gender Distribution

Education Levels

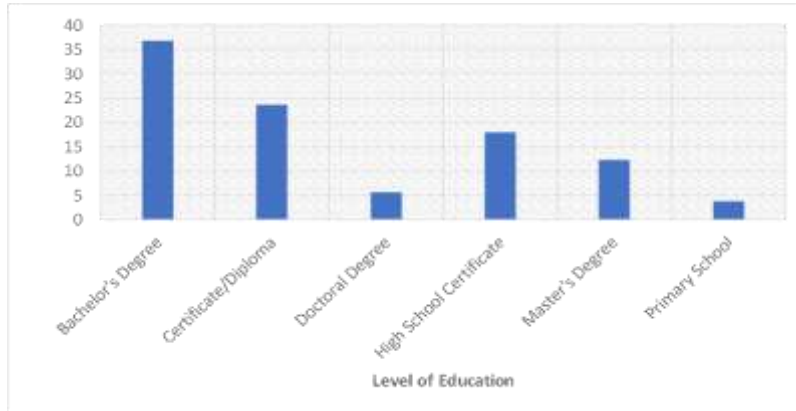


Figure 3: Distribution of Education Levels

Figure 3 above presents the educational attainment levels of a group of individuals, showing the percentage (%) of people in each category. The data reveals that the largest segment of the population holds a Bachelor's Degree (36.8%), followed by those with a Certificate/Diploma (23.6%). Lower levels of education, such as High School Certificate and Primary School, represent smaller portions of the group (17.9% and 3.8% respectively). Similarly, higher degrees like Master's and Doctoral are also less common, accounting for 12.3% and 5.7% of the sample, respectively. The relatively high proportion of respondents with tertiary education suggests that perceptions expressed are informed by professional and policy awareness, strengthening the credibility of responses related to governance and revenue allocation.

Do you think Zambia can learn from best practices in other countries?

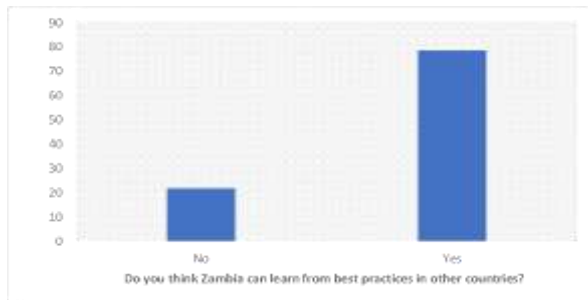


Figure 4: Whether Zambia can learn from other countries

Figure 4 presents the responses to the question, "Do you think Zambia can learn from best practices in other countries?" A significant majority, 78.3% (83 respondents), believe that Zambia can indeed benefit from adopting best practices from other nations. Conversely, a smaller portion, 21.7% (23 respondents), do not believe Zambia can learn from other countries in this context. This indicates a strong consensus among the respondents that there is potential for Zambia to improve by learning from the experiences of other countries.

4.2 Role of Public-Private Partnerships in Enhancing Toll Fee Management in Zambia

Public Perception

Table 1: Role of PPP

	N	%
Allocation of toll revenue to infrastructure development	5	4.7%
Digital payment systems to improve efficiency	16	15.1%
Public reporting on toll revenue usage	28	26.4%
Regular road maintenance programs	38	35.8%

A plurality of respondents (36.8%) described the system as necessary but needing improvement, indicating conditional acceptance rather than full endorsement. Additionally, 17.9% perceived inefficiency and lack of transparency. These findings align with studies by Mutungwa (2024) and Zulu et al. (2023), which highlight governance gaps in Zambia's tolling framework. However, the study adds value by quantifying the extent of public ambivalence. The implication is that revenue generation alone does not guarantee public confidence; transparency and visible reinvestment are critical for legitimacy.

Comparative evidence from other countries, such as South Africa's e-tolling system, shows that public trust can decline when users perceive mismanagement of funds. This supports institutional theory, which emphasizes transparency and accountability as key drivers of compliance. A limitation of this finding is its reliance on perception-based data rather than objective financial audits.

Technological Advancements and Operational Challenges

The introduction of electronic tolling systems, such as RFID-based technologies, indicates progress toward modernization. However, 34% of respondents reported delays at toll gates, suggesting that technological implementation has not fully resolved operational inefficiencies. This challenges assumptions that digitization automatically improves efficiency (Sukumar et al., 2023). Instead, effectiveness depends on system maintenance, integration, and traffic management.

Compared to advanced systems in countries like China and Europe, Zambia's approach reflects incremental rather than transformative innovation. The implication is that technology must be complemented by institutional reforms and infrastructure planning. While user-reported delays provide useful feedback, reliance on subjective experiences limits precise measurement of operational performance.

Transparency and Accountability

Only 28.3% of respondents viewed the system as well managed and transparent, indicating that transparency is not widely perceived as institutionalized. However, concerns appear to relate more to the visibility of reinvestment rather than allegations of corruption. This suggests a shift in focus from corruption control to outcome-based accountability.

International evidence shows that toll systems gain legitimacy when users can observe tangible improvements in infrastructure. The Zambian case suggests that communication and visibility of expenditures are key areas for improvement. A limitation of this finding is the absence of financial data verification, as it relies on perceptions rather than audited evidence.

How would you describe Zambia's current toll fee system?

Table 2: Current Toll Fee System

	N	%
Expensive and burdensome for road users	11	10.4%
Fees should be used to maintain roads	1	0.9%
Inefficient and lacks transparency	19	17.9%
It's great	1	0.9%
Necessary but needs improvement	39	36.8%
Not bad	2	1.9%
Well managed and transparent	30	28.3%
Total	103	

4.3 Learning from Global Best Practices

A strong majority (78.3%) of respondents agreed that Zambia can learn from international best practices. This indicates openness to reform rather than resistance to tolling. However, the implication is not direct replication but contextual adaptation of global models. Zambia's current systems demonstrate modernization efforts but lack advanced features such as dynamic pricing and integrated traffic analytics. This finding reinforces the need for policy transfer that aligns with local institutional capacity and economic conditions.

Role of Public-Private Partnerships (PPPs)

PPPs are perceived as important mechanisms for improving toll infrastructure, but their effectiveness depends on governance quality, transparency, and equitable implementation. The findings position PPPs as neither wholly beneficial nor problematic, but rather conditionally effective.

Perceived Strategies for Toll Management

Respondents identified road maintenance (35.8%), public reporting (26.4%), and infrastructure allocation (17.9%) as key strategies for managing toll revenues. This reflects a strong demand for visible reinvestment and accountability. The relatively lower emphasis on digital systems (15.1%) suggests that governance transparency is prioritized over technological efficiency.

These findings support Mutungwa (2024) and Zulu et al. (2023), who emphasize the importance of strategic management and transparency. However, the study highlights a perceptual gap between revenue collection and visible infrastructure outcomes, suggesting that legitimacy depends on demonstrating how revenues are used rather than just collecting them.

Fairness of Toll Fees

A majority of respondents (77.4%) considered toll fees fair compared to other services, indicating general acceptance of tolling as a financing mechanism. This contrasts with cases such as South Africa, where public opposition has been stronger. The findings suggest that users are willing to pay when they perceive value-for-money.

However, the 22.6% who disagreed indicates that perceptions of fairness are not universal. This highlights the importance of maintaining service quality to sustain public acceptance. The limitation of this finding is the lack of disaggregation by income or location, which may conceal inequalities.

PPPs and Sustainable Development

PPPs are recognized for enabling infrastructure modernization through private investment and technical expertise. However, concerns remain regarding

transparency, contract design, and equitable distribution of benefits. Stakeholders emphasized that PPP success depends on regulatory enforcement, performance monitoring, and clear communication.

The findings align with governance theory, which suggests that institutional trust influences the effectiveness of infrastructure finance mechanisms. PPPs can improve efficiency, but without accountability, their benefits may not translate into public legitimacy.

4.4 Challenges and Opportunities in Toll Revenue Allocation

The findings indicate that toll fee collection in Zambia faces significant operational and systemic challenges, with 59.4% of respondents highlighting key concerns that undermine efficiency and public trust. The most prominent issue is poor road maintenance despite toll payments (25.5%), suggesting a disconnect between revenue collection and visible infrastructure improvements, which weakens public confidence and willingness to pay. This is followed by high toll fees (23.6%), raising concerns about affordability and the fairness of the pricing structure. Additionally, long queues at toll plazas (16.0%) point to inefficiencies in the collection system, while limited payment options (13.2%) indicate gaps in technological integration. Lastly, unclear usage of toll revenues (5.7%) emphasizes the need for greater transparency and accountability, as public trust is closely linked to how effectively and visibly these funds are utilized.

Connection to Literature

These challenges align with existing literature emphasizing the importance of transparency, efficiency, and accountability in toll management. Studies by Mutungwa (2024) and Zulu et al. (2023) highlight similar governance and operational issues. The findings confirm that toll systems must address both technical and institutional factors to function effectively.

Opportunities for Optimization

Despite the challenges, several opportunities exist. Enhancing transparency and accountability is critical for building public trust. Improving operational efficiency through better payment systems and traffic management can reduce congestion and delays. Expanding payment options, including mobile platforms, can increase accessibility.

Equitable pricing strategies should also be considered to ensure fairness across different user groups. Finally, prioritizing road maintenance and rehabilitation is essential to demonstrate the tangible benefits of toll revenue. Together, these measures can improve system performance, strengthen public acceptance, and ensure sustainable infrastructure development.

5 Conclusions and Recommendations

5.1 Conclusions

The study concludes that Zambia's toll fee revenue collection system demonstrates mixed effectiveness, with general public acceptance but notable concerns regarding transparency, operational efficiency, and affordability. While electronic tolling has improved revenue collection, challenges such as traffic congestion, limited payment options, and perceptions of inadequate road maintenance continue to affect user satisfaction and trust. Public-private partnerships (PPPs) show potential to enhance toll management, but their success depends heavily on stronger governance, accountability, and visible reinvestment of revenues. Overall, although opportunities exist to improve the system, addressing these structural and perceptual challenges is essential for achieving a more efficient, equitable, and sustainable tolling framework.

5.2 Recommendations

- Establish a transparent toll revenue reporting system by developing a publicly accessible digital dashboard that clearly shows toll revenue collection and allocation by project, region, and expenditure category. This will enhance accountability and rebuild public trust.
- Upgrade toll collection infrastructure and technology by implementing advanced RFID systems, automated vehicle identification, and fully functional electronic toll collection (ETC) systems to reduce congestion and improve operational efficiency at toll plazas.
- Implement equitable and context-sensitive toll pricing structures by introducing differentiated pricing based on vehicle type, frequency of road usage, and user affordability, while periodically reviewing rates to ensure fairness and sustainability.
- Ring-fence toll revenues for road maintenance and rehabilitation by establishing a policy that allocates a fixed percentage of toll income directly to road upkeep, ensuring visible improvements in infrastructure quality.
- Strengthen governance and regulatory frameworks for Public-Private Partnerships (PPPs) by enforcing transparent procurement processes, clear contractual obligations, and continuous monitoring and evaluation mechanisms to enhance efficiency and accountability.
- Expand and integrate digital payment systems by incorporating mobile money platforms, banking applications, and digital wallets into the toll payment system to improve accessibility, convenience, and user compliance.

Declaration of Competing Interests

The authors declare that they not aware of any competing financial interests or personal relationships that may have influenced the work described in this document.

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Ethical considerations

The article followed all ethical standards appropriate for this kind of research.

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