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FCDO EVIDENCE FUND

EX-POST ECONOMIC EVALUATION OF ZAMBIAN TRANSPORT INFRASTRUCTURE BETWEEN 2010 – 2020

FINAL REPORT

NOVEMBER 2025

DTS

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Project Information Sheet

Client	Foreign Commonwealth and Development Office (FCDO)
Project Code	2403_ZAM
Project Name	Ex-Post Economic Evaluation of Zambian Transport Infrastructure Investment, 2010-2020
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Start Date	1 July 2024

Quality Assurance and Review

Version	Authors(s)	Reviewers	Date
1.0	Maysam Abedin Robert Geddes	Alan Whitworth (FCDO)	11 March 2025
2.0	Maysam Abedin Robert Geddes Graham Smith John Mututwa		3 June 2025
3.0			1 August 2025
4.0			12 October 2025
4.1			27 October 2025
4.2			30 November 2025

Notice

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ACRONYM, UNITS AND CURRENCIES

ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
AfDB	African Development Bank
ATC	Air Traffic Control
C400	Copperbelt 400 Project
CAPEX	Capital Expenditures
CEA	Cost-effectiveness Analysis
DED	Detailed Engineered Designs
DTS	Developing Transport Solutions Ltd.
GHG	Greenhouse Gases
GVA	Gross Value Added
HDM-4	Highway Development and Management Model (Version 4.2)
HPIC	Heavily Indebted Poor Country
ICAO	International Civil Aviation Authority
IMF	International Monetary Fund
IPC	Interim Payment Certificate
IRI	International Roughness Index
L400	Lusaka 400 Project
LIC	Low Income Country
KKIA	Kenneth Kaunda International Airport (Lusaka Airport)
MFNP	Ministry of Finance and National Planning
MIHUD	Ministry of Infrastructure, Housing and Urban Development
MLGRD	Ministry of Local Government and Rural Development
MOFNP	Ministry of Finance and National Planning
MTL	Ministry of Transport and Logistics
NCC	National Council for Reconstruction
NMT	Non-Motorised Transport
NRFA	National Roads Fund Agency
OPEX	Operating Expenditures
RED	Road Economic Decision Model
PAD	Project Appraisal Document
PF	Patriotic Front
PID	Project Information Database
PIM	Public Investment Management
PPP	Private Public Partnership
RAMS	Road Asset Management Systems
RDA	Roads Development Agency
RFS	Rescue and Fire Service
RII	Responsible Infrastructure Investment
RMI	Road Management Initiative
RoadSIP	Road Sector Investment Programme
ROMDAS	Road Measurement Data Acquisition System
RRMP	Road Rehabilitation and Maintenance Project
RSAWP	Road Sector Annual Workplan
RUC	Road User Charges
SMKIA	Simon Mwansa Kapwepwe International Airport (Ndola Airport)
TOR	Terms of Reference
TSG	Technical Support Group
VTTS	Value of Travel Time Savings
VOC	Vehicle Operating Costs
WB	World Bank
ZACL	Zambia Airports Corporation Limited
ZIPAR	Zambia Institute for Policy Analysis and Research

EXECUTIVE SUMMARY

Background and Objectives

The FCDO's Responsible Infrastructure Investment (RII) Campaign promotes transparency in public infrastructure to address inefficiencies identified by IMF and World Bank studies. To support this, FCDO commissioned an ex-post economic evaluation of Zambia's transport investments (2010–2020) to inform better Public Investment Management (PIM) and raise awareness of infrastructure decision-making impacts.

Zambia has emerged as a key case in global debt restructuring under the G20 Common Framework, largely due to its extensive borrowing for infrastructure projects between 2010 and 2020. While a few initiatives, such as the Kafue Gorge Lower power project and the Kazungula Bridge, underwent formal appraisal, the majority were implemented without adequate evaluation. Studies by Zambia Institute of Policy Analysis and Research (ZIPAR 2012) and the International Monetary Fund (IMF 2017) highlighted significant weaknesses in Zambia's system for assessing and prioritising public investments. These shortcomings have been linked to the country's economic crisis, although detailed project-level evidence remains limited. In response, Zambia enacted the National Planning and Budgeting Act of 2020, mandating formal appraisal processes for major public investments to promote economic efficiency and strengthen fiscal discipline. For these reasons, Zambia has been selected for this Ex-Post economic analysis of its transport sector investments between 2010 and 2020, with the aim of addressing past inefficiencies and guiding future policy improvements.

Methodology

The study employed a structured methodology to evaluate Zambia's transport sector investments from 2010–2020. It involved identifying eligible road projects through a systematic selection process, guided by criteria such as project type, funding source, and size. A long list of 494 projects was narrowed to 27 using an algorithmic approach. The methodology included a literature review, stakeholder consultations, and data collection—mainly from secondary sources. Ex-post economic analyses were conducted on selected road and airport projects (and where possible compared to the ex-ante appraisal). Regression modelling estimated traffic growth elasticity with respect to GDP, and HDM-4 was used for detailed evaluation of road projects. Maintenance expenditures were reduced in order to help finance a substantial increase in capital investment in infrastructure upgrades. An HDM-4 Strategy Analysis was subsequently conducted to evaluate the economic trade-offs and long-term cost implications of this reallocation of resources.

Headline Finding – The Transport Capital Expansion Programme was Economically Inefficient

An individual evaluation of the 27 road infrastructure projects reveals that ten roads, alongside the Kenneth Kaunda International Airport (KKIA) upgrade, are projected to generate positive net economic returns, with estimated Net Present Values (NPVs) exceeding zero. Conversely, the remaining 17 road projects, as well as the construction of the new Simon Mwansa Kapwepwe International Airport (SMKIA), are expected to yield negative economic returns, as indicated by negative NPVs.

When analysed in aggregate, the collective investment in all 27 road projects and the two airport projects is projected to deliver a marginally positive economic return, with a combined real NPV (2023 prices) of approximately $600 million. However, the following two critical economic principles warrant consideration.

- **Project Optimisation and Efficiency:** A positive NPV indicates that a project's benefits exceed its costs, but it does not necessarily mean that the project is economically optimised. Suboptimal design choices (e.g. in the case of KKIA), cost overruns, or inefficient implementation can still reduce potential net benefits. Therefore, while several projects exhibit positive NPVs, their actual economic efficiency may fall short of what could have been achieved under optimal planning, cost control, and execution conditions.
- **Opportunity Cost and Budgetary Trade-offs**: Evaluating project viability in isolation is insufficient without accounting for the opportunity cost of capital allocation. While definitive attribution is challenging, the substantial decline in road maintenance expenditure between 2010 and 2020 provides compelling evidence that maintenance was likely deprioritised to accommodate large-scale capital upgrades. This reallocation of fiscal resources likely contributed to the deterioration of the overall road network, with adverse macroeconomic implications due to reduced transport efficiency and asset longevity. Moreover, without a

rigorous appraisal process, mutually exclusive projects with potentially higher NPVs may be ignored or crowded out, leading to suboptimal public investment decisions.

- **Inefficient Project Bundling**: From a public investment efficiency perspective, high-performing projects should not be used to offset or justify the inclusion of low-return or economically unviable projects. The bundling of economically inefficient projects, such as SMKIA and the 17 road projects with negative NPVs, within the broader investment portfolio dilutes overall economic returns. Excluding these poorly performing projects from the investment program would have resulted in a significantly higher return on public capital.

In light of the opportunity cost of diverted maintenance expenditure and the inefficiencies arising from the inclusion of economically unviable projects, this analysis concludes that the transport expansion programme is expected to generate a cumulative net economic loss, with an estimated Net Present Value (NPV) of negative $7.2 billion over the appraisal period 2010–2061.

Findings - Road Projects

Only seven road projects (representing 28% of total investment value) had documented ex-ante economic appraisals. While some appraisals may have existed, poor documentation limited access. Among those evaluated, there was no consistent bias in forecasts, with some projects, like the Kitwe–Chingola Dual Carriageway, showing alignment between projected and actual outcomes. However, appraisal methodologies varied widely, with inconsistent use of discount rates, time horizons, and benefit definitions, indicating a lack of standardisation.

Ex-post analysis using the HDM-4 model revealed significant variation in project performance. While some roads are now expected to yield poor returns, the overall portfolio demonstrated moderately positive results. With a total real expenditure of $3.86 billion (in 2023 prices), the road investments are expected to generate a net present value (NPV) of $0.94 billion, a benefit-cost ratio (BCR) of 1.12, and an internal rate of return (IRR) of 12.9%. Despite these positive indicators, the analysis did not account for opportunity costs. As already stated, underinvestment in road maintenance, averaging $106 million annually (versus an optimal $264 million) is expected to reduce overall economic efficiency. It is estimated that redirecting funds from capital expansion to maintenance could have yielded an additional $6.73 billion in NPV.

It is important to underscore that record-keeping related to road sector investments was inadequate. In particular, the documentation of actual expenditures on both maintenance and capital projects was incomplete and often delayed. While the research team obtained maintenance expenditure data for the period 2014–2020, the accounts of the National Road Fund Agency (NRFA) for the years 2010–2013 required extensive interrogation and the application of several assumptions to fill data gaps. More concerning, however, was the absence of reliable, consolidated information on aggregate capital expenditure in the road sector for the entire 2010–2020 period. Such deficiencies in financial data management significantly undermine transparency, accountability, and the effectiveness of PIM. Robust record-keeping systems are essential for evidence-based decision-making, accurate performance evaluation, and efficient allocation of resources within the road infrastructure sector. The current state of data availability therefore constrains the ability to assess investment efficiency, monitor value-for-money outcomes, and plan sustainable financing for future road development.

Findings - Airport Projects

Both the KKIA and SMKIA projects were appraised by a contractor that was later awarded the implementation contract, a practice that raises serious concerns regarding conflicts of interest and the integrity of the appraisal process. In both cases, passenger and traffic forecasts were markedly over-optimistic through to 2023, resulting in over-designed infrastructure and inflated projections of economic returns. Furthermore, the KKIA project was appraised using financial rather than economic metrics, limiting its usefulness for public investment evaluation. The SMKIA appraisal blended financial and economic elements, undermining methodological clarity. Ex-post analysis shows that the KKIA is expected to be economically viable, with a 13.1% IRR and a positive NPV of $152 million (real, 2023 prices). In contrast, SMKIA is now expected to significantly underperform, with a 4.7% IRR and a negative NPV of $490 million (real, 2023 prices), suggesting a substantial economic loss. A cost-effectiveness review of KKIA indicated that $124 million (nominal, 2014 prices) could have been saved by omitting non-essential features, potentially reducing the total cost to $236 million (nominal, 2014 prices).

Recommendations of this Research

Since 2020, Zambia has made significant progress in strengthening public investment management through new policies, tools, and institutional reforms. Key developments include the National Public

Investment Strategy (2024–2026), the General Appraisal Manual, and the introduction of a Multi-Criteria Analysis (MCA) framework to prioritise infrastructure projects. While mandating economic appraisals is a step forward, its weight in project selection in the MCA is limited to 25%, raising concerns about whether economic efficiency is undervalued. Recommendations include reassessing this weighting and setting minimum thresholds for economic viability.

This research highlights significant inconsistencies in the conduct of economic appraisals, particularly in the application of discount rates, valuation of benefits, and selection of appraisal periods, which severely undermine the comparability and credibility of project evaluations. There is an urgent need for a standardised appraisal policy framework, specifically tailored to the transport sector, to promote methodological rigour and eliminate poor appraisal practices. This need is especially acute in the case of aviation projects such as KKIA and SMKIA, where the contractors ultimately awarded the implementation contracts played a central role in the design process, including the preparation of economic and financial assessments. In both instances, financial appraisals were erroneously presented as economic evaluations, thereby misrepresenting the projects' broader economic viability.

In the road sector, cooperation with the Road Development Agency (RDA) revealed data limitations and poor document management, hindering comprehensive analysis. Despite having tools like HDM-4 and Road Measurement Data Acquisition System (ROMDAS), the RDA relies heavily on external consultants for economic appraisals. The report recommends strengthening internal capacity through training and improved project information systems to ensure better planning, transparency, and accountability in infrastructure investment.

Table 0-1: Research Questions and Summary Conclusions

Ref	Research Question	Summary Conclusion
(1a)	(Roads) - Expected ex-ante economic viability of the project (using metrics such as NPV, IRR, HDM-4) when the decision to undertake it was announced, compared to doing nothing?	Only seven projects (26% of projects and 28% of total investment) included economic evaluations. Some other appraisals may have existed but were not accessible due to documentation issues. The evidence does not indicate a consistent bias in ex-ante appraisals. For example, projects like the Kitwe–Chingola Dual Carriageway and Mufuchani Bridge showed close alignment between forecasted and actual outcomes. However, significant differences were observed in appraisal methodologies, including varying discount rates, appraisal periods, and benefit identification approaches, highlighting a lack of standardisation (see Section 6.5).
(1b)	(Roads) - For those roads for which sufficient data is available, what is the estimated ex-post economic viability of the project in 2024, based on actual costs and traffic up to 2023 and expected future costs and traffic, compared to doing nothing?	The HDM-4 assessment shows wide variation in the economic performance of individual road projects, with some yielding poor returns. However, the overall portfolio (2010–2020) demonstrates a moderately positive outcome, with a total real expenditure of $3.86 billion (2023 prices) and an NPV of $0.94 billion, resulting in a Benefit-Cost Ratio (BCR) of 1.12 and an IRR of 12.9%. (See Section 6.2) While this indicates positive returns, the analysis does not consider opportunity costs—particularly that maintenance investments might have offered better value for money, as highlighted in research question (e).
(2a)	(KKIA, Ndola Airport) - Expected ex-ante economic viability of the project (using metrics such as NPV, IRR) when the decision to undertake it was announced, compared to doing nothing?	The ex-ante appraisal of the KKIA project is misclassified as an economic appraisal when it is actually a financial appraisal, limiting its relevance for evaluating public investment from a societal perspective. Financial appraisals focus on cash flows and investor returns, while economic appraisals assess broader societal impacts. This misclassification reflects a conceptual misunderstanding. Perhaps more importantly, the prospective contractors provided the feasibility consulting services which raises conflict of interest considerations. For the Ndola Airport project, the appraisal estimated a 14% IRR and an NPV of $41.2 million over 25 years, using an 8% discount rate and $397 million in capital costs. However, it blended financial and economic elements, such as including revenue streams in the economic analysis—an approach that undermines methodological consistency and risks overstating the project's true economic value. (See Section 8.2)
(2b)	(KKIA, Ndola Airport) - viability of the project in 2024, based on actual costs and traffic up to 2023 and expected future operating costs and passenger traffic	The ex-post evaluation shows that KKIA is likely to be economically viable, with a 13.1% IRR and a positive NPV of $152 million, indicating moderately positive returns and above the social discount rate. In contrast, SMKIA underperforms significantly, with a 4.7% IRR and a large negative NPV of -$490 million, suggesting substantial economic loss. While KKIA is justified economically, SMKIA does not meet viability thresholds, and its implementation lacks clear economic justification unless supported by non-monetised strategic or social factors. (See Section 8.3)
(2c)	(KKIA) Is there sound evidence for claims that the airport could have been upgraded for US$150 million	A cost effectiveness analysis of the KKIA estimated that approximately $124 million could have been saved by omitting non-essential aspects of the airport upgrade. Therefore the KKIA could have been upgraded for $236 million (See Section 8.1)

Ref	Research Question	Summary Conclusion
	instead of the actual cost of $360 million?	
(3a)	(If possible to assess) What was the impact of single source procurement on project costs and viability compared to competitive procurement?	Due to poor archival practices, the researchers were unable to access reliable data on specific procurement modalities and the number of bidders. As a result, this research question could not be reliably evaluated.
(3b)	What has been the impact of the overall transport infrastructure programme on Zambia's economic growth and debt?	Between 2010 and 2020, Zambia underinvested in road maintenance, spending an average of $105 million annually—well below the optimal $264 million. Redirecting funds from capital expansion to maintenance could have yielded a $6.7 billion NPV. In aviation, KKIA showed a positive NPV of $152 million, while SMKIA showed a negative NPV of $489.7 million. Combined, inefficient infrastructure investment decisions may cost the economy an estimated $7.2 billion over the appraisal period 2010 - 2061. (See Section 9.7). A total of 16 road projects, along with the upgrades to Kenneth Kaunda International Airport (KKIA) and Simon Mwansa Kapwepwe International Airport (SMKIA), were either partially or fully financed through external borrowing. Between 2010 and 2020, total borrowing for these infrastructure investments amounted to approximately US$2.97 billion (nominal terms). Notably, around 75 percent of the debt associated with the road sector and the two airport projects originated from the China EXIM Bank, under terms broadly resembling commercial lending conditions. Such financing arrangements imposed a heavier burden on public finances compared to concessional loans, increasing the country's exposure to debt distress risks. Debt servicing obligations were significant and estimated to be $201 million / annum in 2020 (real, 2023 prices) and rising to $271 million by 2023. At its peak in 2019 the outstanding loan balances is estimated to have been $2.9 billion (real, 2023 prices). (See Section 4.1 for the analysis focused on the road sector and Section 9.8 for the transport sector).

ACKNOWLEDGEMENTS

We would like to express our sincere gratitude to the individuals and institutions whose support made this research possible.

We are especially grateful to the Foreign, Commonwealth & Development Office (FCDO) for funding this research. Thanks go to Alan Whitworth, Miljan Sladoje, Mulenga Musonda, and Claire Hilton for their active involvement in the planning and management of the study on behalf of FCDO.

We also extend our appreciation to the Ministry of Finance and National Planning (MoFNP) for providing overall project oversight from the Government of Zambia. We are particularly thankful to Ireen Musonda, Hudson Mulumbi, and Brian Nshindano for their guidance and coordination throughout the process.

Special thanks are due to Eng. Luboto Siame, whose dedicated efforts in searching the Road Development Agency's (RDA) archives were instrumental in retrieving essential data on road projects. We also acknowledge Eng. Edgar M. Kakoma and Eng. Maketo Muyunda of the RDA for their support and engagement at the senior management level.

We are grateful to Harriet Nakazwe, Ngoza Matakala, and Daniel Longwe of the Zambia Airports Corporation Limited (ZACL) for facilitating a supervised site visit to both Kenneth Kaunda International Airport and Simon Mwansa Kapwepwe International Airport in Ndola, and for providing timely access to relevant data.

We gratefully acknowledge the National Road Fund Agency (NRFA) for providing valuable data and insights on road financing and implementation. In particular, we extend our sincere appreciation to Eng. Nonde Musawa, Eng. Ngulube Zikani Vernon, Eng. Charles Kandeke, and Eng. Sureya Malik for their contributions and support.

Finally, we would like to thank Leanne Jones (FCDO) and Randa Snobar (Integrity Global) for their support in managing the contractual aspects of this study.

1 INTRODUCTION

1.1 Background and Objective

The UK Foreign, Commonwealth and Development Office (FCDO) is supporting the "Responsible Infrastructure Investment (RII) Campaign" which promotes greater transparency and accountability in public infrastructure investment. This is in response to International Monetary Fund (IMF) and World Bank (WB) cross-country econometric studies of the efficiency of infrastructure investment which found that, in Low Income Countries '*On average, more than one-third of the resources spent on creating and maintaining public infrastructure are lost because of inefficiencies'* (IMF 2023). One of the main causes of this inefficiency is weak Public Investment Management (PIM), leading to selection of projects with low economic viability. While the damaging impact of poor project selection on Low Income Countries' (LIC) growth and debt is well understood by development partners, there appears to be little government or public awareness in the affected countries.

The RII Campaign therefore seeks to increase government and public awareness of the importance for growth and for debt sustainability of transparent PIM by ensuring that economically viable infrastructure investments are prioritised and procured through a transparent and competitive process. By increasing the awareness of policy makers and stakeholders of the dangers of inadequate PIM, it is expected that they will be more likely to demand transparency and to challenge poor infrastructure decisions.

The effectiveness of the RII Campaign has been constrained by the lack of quantitative country-level evidence on the impact of weak PIM on growth and debt. The FCDO therefore commissioned the *"Ex-Post Economic Evaluation of Zambian Transport Infrastructure Investment, 2010-2020",* with the broad objective to "undertake a quantitative ex-post economic evaluation of the Government of the Republic of Zambia's infrastructure investment in the transport sector over the period 2010 – 2020 in order to assess the impact on Zambia's economic growth and debt, and thus provide lessons and recommendations for strengthening Public Investment Management". The outcomes of the study will be used to raise awareness of RII campaign issues, both in Zambia and globally. The study is financed by the Evidence Fund, an FCDO programme intended to help develop evidence-informed policies, programmes and practices which contribute to development outcomes.

1.2 Selection of Zambia for the Case Study

Zambia is a key case in global debt restructuring under the G20 Common Framework due to its experience with heavy borrowing, particularly for infrastructure, between 2010–2020. Despite some evidence of appraised projects like the Kafue Gorge Lower (power sector) and Kazungula Bridge (transport sector), most were implemented without proper evaluation. A 2012 ZIPAR / International Growth Centre study and an IMF 2017 Public Investment Management Assessment (PIMA) highlighted weaknesses in Zambia's system for assessing and prioritising public investments. The country's economic crisis has been partly attributed by the IMF and World Bank to unappraised, inefficient projects, though they have not provided detailed project-level evidence.

This Ex-Post Evaluation focuses on the transport sector, which saw the bulk of investments and where data is more readily available to assess productivity. In response to past issues, Zambia passed the National Planning and Budgeting Act of 2020, requiring formal appraisal of major public investments. The evaluation aims to guide policy and strengthen the Public Investment Management system in line with the Act to promote economic growth.

1.3 Research Objectives

The following are the specific objectives of the assignment:

- to assess and quantify the economic impact of Zambia's infrastructure investments in roads between 2010 and 2020;
- to assess and quantify the economic impact of Zambia's infrastructure investments in airports between 2010 and 2020; and finally,
- to disseminate, both in Zambia and globally, the findings of the study through the RII campaign to demonstrate the importance of PIM to governments and civil society.

This research project addresses nine specific research questions, organized into three categories: (1) the road sector, (2) the airport sector, and (3) the overall transport sector. The table below outlines these questions along with the corresponding sections of the report where they are discussed and analysed.

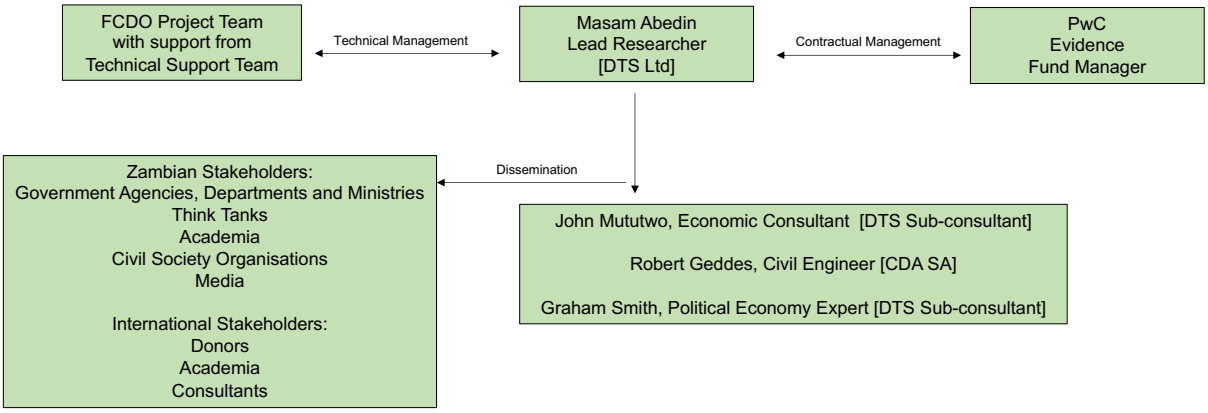
Table 1-1: Project Research Question and Reference to Section

Ref	Research Question	Reference
(1a)	(Roads) - Expected ex-ante economic viability of the project (using metrics such as NPV, IRR, HDM-4) when the decision to undertake it was announced, compared to doing nothing?	Section 6.5
(1b)	(Roads) - For those roads for which sufficient data is available, what is the estimated ex-post economic viability of the project in 2024, based on actual costs and traffic up to 2023 and expected future costs and traffic, compared to doing nothing?	Section 6.2
(2a)	Kenneth Kaunda International Airport (KKIA) in Lusaka, and Simon Mwansa Kapwepwe International Airport (SMKIA) in Ndola - Expected ex-ante economic viability of the project (using metrics such as NPV, IRR) when the decision to undertake it was announced, compared to doing nothing?	Section 8.2
(2b)	(KKIA, SMKIA) - viability of the project in 2024, based on actual costs and traffic up to 2023 and expected future operating costs and passenger traffic	Section 8.3
(2c)	(KKIA) Is there sound evidence for claims that the airport could have been upgraded for US$150 million instead of the actual cost of $360 million?	Section 8.1
(3a)	(If possible to assess) What was the impact of single source procurement on project costs and viability compared to competitive procurement?	Insufficient data to assess
(3b)	On the basis of the individual project analysis, what has been the impact of the overall transport infrastructure programme on Zambia's economic growth and debt?	Section 9.7

1.4 Governance Structure and Operational Procedures

The governance and operational structure and procedures of the project is presented in the diagram below. Masam Abedin of DTS Ltd. has overall responsibility for the research team and resources while PwC is responsible for contract management issues as the Evidence Fund Manager. Technical issues are coordinated between the FCDO Project Team (with support from the Technical Support Group, TSG) and the research team. Dissemination of the study findings will be coordinated by the research team with John Mututwa leading the campaign to disseminate with Zambian stakeholders.

Figure 1-1: Research Team and Relationship with Stakeholders



1.5 Structure of this Report

This report is structured into nine chapters, including this introductory chapter:

- Chapter 2 outlines the research methodology, detailing the data collection process, the identification of road projects, and the economic approach used for the ex-post analysis.
- Chapter 3 provides an overview of Zambia's road sector, covering its historical development, current debt levels, road maintenance funding, and the present condition of the road network.
- Chapter 4 analyses road sector financing, including debt accumulation and the issuance of Eurobonds.
- Chapter 5 presents a summary of the road projects that met the criteria for inclusion in this study.

- Chapter 6 evaluates road investments made between 2010 and 2020, presenting the findings of both ex-ante and ex-post economic analyses.
- Chapter 7 offers an overview of airport infrastructure investments at Kenneth Kaunda International Airport (KKIA) and Simon Mwansa Kapwepwe International Airport (SMKIA).
- Chapter 8 presents the economic analysis of the airport investments.
- Chapter 9 concludes the report with a summary of key findings from the ex-post evaluation of road and airport investments in Zambia between 2010 and 2020, along with recommendations

2 RESEARCH METHODOLOGY

2.1 Overarching Methodology

The overall methodology employed to address the research question comprises the following key components:

- Identification and Selection of Eligible Road Projects: a systematic process was used to identify and select road projects that met the criteria for inclusion in the study, focusing on those implemented between 2010 and 2020.
- Literature Review: a comprehensive review of relevant academic and policy literature was conducted to provide context, identify knowledge gaps, and inform the analytical framework.
- Stakeholder Consultations: engagements were held with key stakeholders, including government agencies, development partners, and sector experts, to gather insights, validate findings, and ensure the relevance of the research.
- Data Collection: Predominantly secondary data were collected from various sources, including project documentation, government reports, and interviews, to support the economic analysis, however, some primary sources were collected during the site visits.
- Economic Analysis of Road and Airport Projects: a detailed economic evaluation was carried out, including both ex-ante and ex-post analyses, to assess economic impact of selected road and airport infrastructure investments.

2.2 Identification of and Selection of Eligible Road Projects

The process of identifying and selecting road projects for inclusion in the study followed a systematic, multi-step approach:

2.2.1 Drafting a Long List of Road Projects

An initial long list of road projects was compiled using available data sources, including government records, project databases, and reports. This list served as the foundational dataset from which eligible projects would be screened. A total of 494 projects were identified in the long-list (the long list is presented in Annex 1).

2.2.2 Defining Eligibility Criteria

To ensure consistency, relevance, and analytical rigor, a clear set of qualifying definitions was developed to guide the selection of road projects for inclusion in the study. These criteria are outlined below:

- Type of Projects: only projects classified as upgrading interventions were considered eligible. These types of projects were prioritised because they represent a tangible expansion of the road network's capacity and functionality. This includes:
  - upgrading from gravel to paved surfaces
  - widening of existing paved roads to add additional lanes

  Projects focused solely on rehabilitation, periodic maintenance, or routine maintenance were excluded, as they are considered to maintain or restore existing infrastructure rather than expand it.
- Funding Source: projects financed through any funding source were deemed eligible. This includes:
  - Government budget allocations
  - Development partner contributions
  - Commercial bank loans
  - Contractor-financed arrangements

  This inclusive approach ensures a comprehensive representation of investment modalities in Zambia's road sector.
- Project Size: to filter out smaller-scale or lower-impact projects, where ex-ante economic appraisals are neither practical not warranted, a minimum unit cost threshold of $100,000 / kilometre (in real 2023 prices) was applied. This criterion effectively excludes low-cost gravel road projects and ensures that only substantial investments are analysed.
- Infrastructure Type: the focus was strictly on roads and bridges, which are central to the country's transport infrastructure. Projects involving non-core infrastructure—such as

weighbridges, toll booths, or capacity-building initiatives—were excluded to maintain analytical focus on physical network expansion.

2.2.3 Screening and Final Selection Using an Algorithmic Approach

An algorithm was developed to systematically apply the qualifying definitions to the initial long list of road projects. This automated approach ensured a high degree of objectivity, transparency, and consistency in the selection process, minimizing the risk of bias or oversight.

By using this structured methodology, the resulting shortlist of road projects was both representative of the broader investment landscape and analytically robust. This provided a solid foundation for conducting a credible and meaningful economic evaluation in the subsequent phases of the study.

The result was that 27 road and bridge projects were selected (please refer to Section 5 for the full list of qualifying road projects.

2.3 Stakeholder Consultations

As part of the data collection and stakeholder consultation mission undertaken from 25th November to 6th December 2024, the following stakeholders were consulted. Full details of the stakeholder meetings are presented in Annex 2.

- Ministry of Finance and National Planning
- Ministry of Transport and Logistics
- Ministry of Infrastructure, Housing and Urban Development
- Roads Development Agency (RDA)
- National Road Fund Agency (NRFA)
- Zambia Airports Corporation Limited (ZACL)

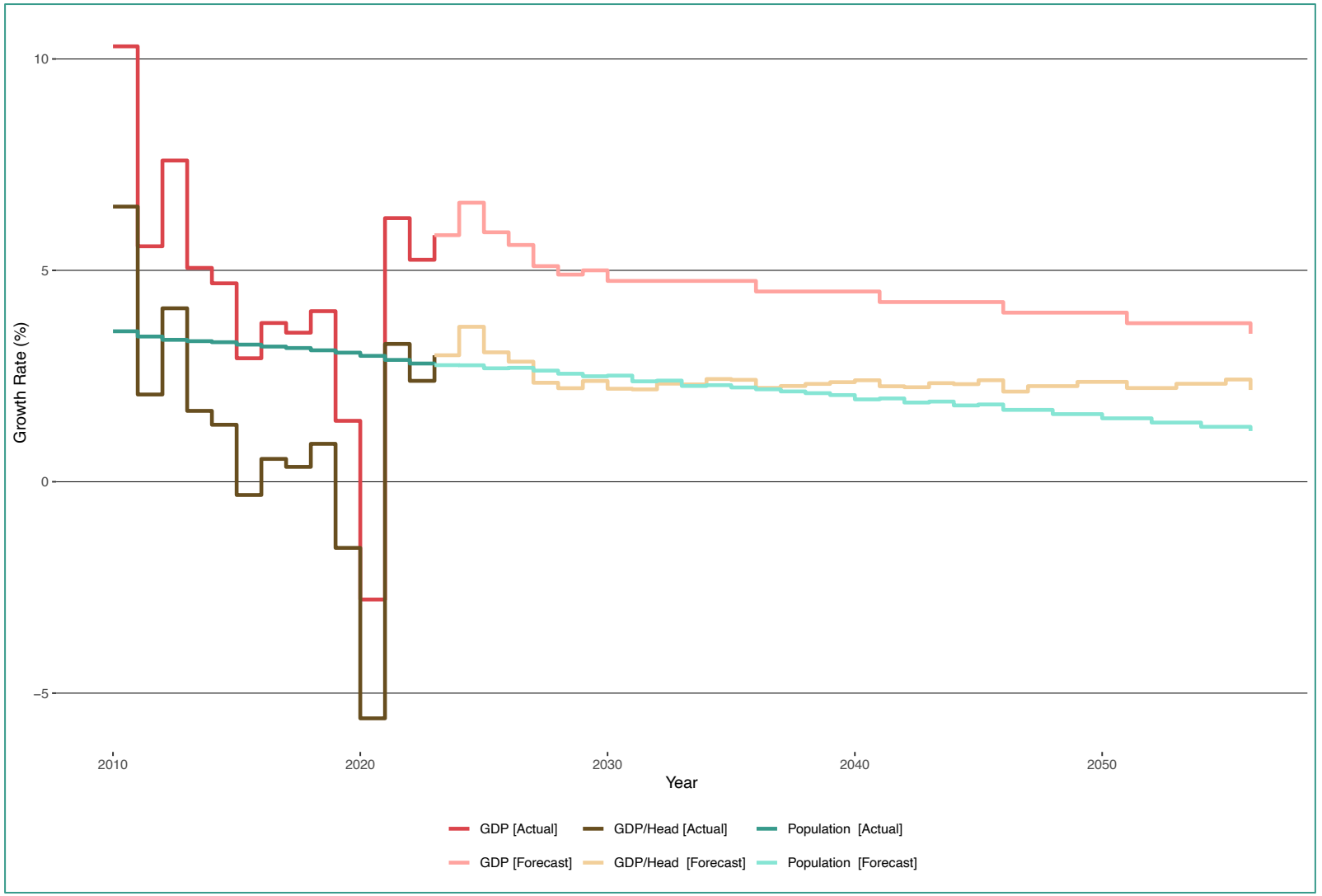
2.4 Data Collection

2.4.1 Secondary Sources

Secondary sources formed the majority of the data required for this study. These included a wide range of official documents and datasets, as outlined below:

- Road Sector Annual Workplans (RSAWPs), 2010–2020: these documents were used to compile the initial long list of road projects considered for evaluation.
- Data Submitted by the Road Development Agency (RDA): the RDA provided detailed information on contract values, implementation periods, project status, and procurement modalities. This data was sourced from RDA's internal archives and through consultations with project managers.
- Traffic and Toll Data: traffic count data from RDA and toll revenue data from the National Road Fund Agency (NRFA) were used to support the economic analysis of road usage and performance.
- Project-Specific Documentation: where available, design reports, feasibility studies, and World Bank Project Appraisal Documents (PADs) were reviewed. However, such documentation could only be identified for nine road projects. (See Section 6.5 for the complete list.)
- Road Works Unit Costs: unit cost data for various types of road works were obtained from RDA to support cost benchmarking and economic evaluation.
- Network Condition Reports: RDA's periodic reports on the condition of the national road network were used to assess the baseline and post-investment status of selected roads.
- Macroeconomic Data (2010–2024): key macroeconomic indicators—including real and nominal GDP, Consumer Price Index (CPI), and exchange rates—were sourced from the World Bank to support the economic modelling and inflation adjustments.
- For forecast GDP data from the IMF was used for years 2024 - 2029, and researchers' assumptions for years 2030 and after. Population forecasts were sourced from the United Nations Development Programme (UNDP).

Figure 2-1: Exogenous Actual and Forecast Values



2.5 Ex-Post Economic Analysis of Road and Airport Projects

2.5.1 Ex-Post Analysis of Roads Projects

Given that all the projects involve upgrading from unpaved to paved standards, road widening, or both, the Highway Development and Management Model (HDM-4) is the most appropriate methodology for forecasting the economic benefits of these interventions. HDM-4 enables a comprehensive evaluation of road investment strategies by simulating the performance, maintenance requirements, and associated costs of different road types over time. It takes into account factors such as traffic volumes, pavement deterioration, maintenance strategies, and vehicle operating costs, making it particularly well-suited for analysing long-term infrastructure impacts.

HDM-4 carries out economic and technical appraisals by comparing the costs of road works against the benefits derived from reduced road user costs, vehicle wear and tear, time savings, and accident reductions. These outputs are critical for evaluating the Net Present Value (NPV) and Economic Internal Rate of Return (EIRR) of each project, ensuring that investments are prioritised based on their overall economic efficiency.

A calibrated HDM-4 model has been developed for Zambia by the consultants, providing a solid foundation for this research. However, some unit cost parameters—such as construction, maintenance, and vehicle operating costs—have been updated to reflect the time horizon of the study, which spans project start dates from 2010 to 2020, with 2044 used as the potential final appraisal year. These updates ensure that the model remains reflective of current and projected conditions, allowing for more accurate and relevant economic forecasts. Annex 4 presents the calibration parameters for HDM-4 modelling.

The following costs and benefits streams were considered in the appraisal model for roads:

- Capital Costs
- Life cycle maintenance costs
- Vehicle Operating Costs (VOC)
- Travel Time Savings
- Residual value of the infrastructure in the final appraisal year

The bridge projects were appraised by comparing capital investment costs against a counterfactual scenario involving continued reliance on pontoon transport. The analysis incorporated projected reductions in vehicle (road transport vehicles and pontoons) operating costs (VOC), time savings for users, and the residual value of the infrastructure at the end of the appraisal period.

There are three notable exceptions to the methodology outlined above. The Kazungula Bridge, by far the largest and most capital-intensive of the bridge projects, is expected to generate significant wider network effects. As such, it was re-appraised by revisiting both the traffic forecasts and capital costs relative to the original ex-ante appraisal. Similarly, the Lusaka Decongestion Project, which is anticipated to induce complex changes in traffic flows across the urban transport network, was re-appraised by updating the estimated costs and benefits from its initial appraisal. In contrast, due to a lack of detailed information on the Lusaka 400 package of projects, their returns were approximated by applying the average economic performance observed across the other urban road investments.

2.5.2 Impact of the Road Transport Investment Programme on the Zambian Economy

As this research has found, over the past decade, Zambia's road sector saw a steady decline in maintenance spending as budget priorities shifted toward capital investments in road expansion (see Section 3.2). Although this research has concluded that the expansion program yielded a positive economic return (see Section 6.2.4 for the economic results), this does not necessarily indicate an optimal allocation of resources between maintenance and new construction.

The underinvestment in maintenance likely incurred opportunity costs not captured in the expansion program's BCR. To evaluate these trade-offs, a Strategy Analysis was conducted using the HDM-4 model. Unlike project-level analysis, Strategy Analysis operates at a network-wide level, assessing long-term investment strategies under fiscal constraints. It helps determine the most economically efficient allocation of resources by comparing various scenarios—such as different maintenance standards or funding levels—and their cumulative impact on road network performance and costs.

2.5.3 Ex-Post Analysis of Airport Projects

The framework for the economic appraisal of Kenneth Kaunda International Airport (KKIA) and Simon Mwansa Kapwepwe International Airport (SMKIA) was developed through informed consultations with ZACL and supported by available data. The appraisal identified several key benefits:

- Increased Capacity at KKIA: The expansion enabled the airport to accommodate additional passenger traffic that the previous infrastructure could not support.
- Regulatory Compliance at SMKIA: Due to international aviation regulations, the former Ndola airport could no longer operate as an international facility. In the absence of SMKIA, international passengers would have been required to travel to or from KKIA, incurring higher travel costs.
- Reduced Delays: The new airports improved operational efficiency, reducing aircraft queuing times and clearance delays, thereby generating significant travel time savings.

The economic analysis was based on both actual and forecast traffic data. However, due to the absence of verifiable data on time and cost savings, the analysis relied heavily on ZACL's professional assessments of operational conditions before and after the interventions. While these insights are considered credible, the lack of empirical data introduces a degree of uncertainty regarding the confidence level of the cost-benefit analysis (CBA) results.

Table 2-1: Overview of Economic Appraisal Methodology

Sector	Project	Methodology
Roads	Chama - T2 (Lot 1) Chama - T2 (Lot 2) D145 (T4 - Feira) Fatima Indeni Road Kalulushi - Lufwanyama Katoba - Chirundu Kitwe - Chingola Dual Carriageway Landless Corner - Mumbwa (Lot 1) Landless Corner - Mumbwa (Lot 2) Leopards Hill Road to Jct RD481 Mansa - Luwingu Road Mbala - Nakonde Mongu – Kalabo Pedicle Road Sesheke - Senanga Road (Lot 1) Sesheke - Senanga Road (Lot 2) Sesheke - Senanga Road (Lot 3) Zambia Township Roads	HDM-4 Project Analysis (CAPEX, OPEX, VOC, time-savings, residual value)
	Chiawa Bridge Construction Kafue Hook Bridge Mufuchani Bridge Sioma Bridge	Be-spoke spreadsheet model (CAPEX, OPEX, VOC, time-savings, residual value)
	Kazungula Bridge Lusaka Decongestion Project	Due to complex network changes re-appraised by revisiting both the traffic forecasts and capital costs relative to the original ex-ante appraisal
	Lusaka 400 (Phase 1) Lusaka 400 (Phase 2) Lusaka 400 (Phase 3)	Lack of project data – assumed performance observed across the other urban road investments
	Impact of Maintenance	HDM-4 Strategy Analysis (CAPEX, OPEX, VOC, time-savings)
Airports	KKIA SMKIA	Be-spoke spreadsheet model (CAPEX, OPEX, VOC, time-savings, journey ambience, accessibility and foregone travel)

2.5.4 Discount Rates and Appraisal Periods

A uniform discount rate of 12% was applied across all projects for the economic appraisal. For the road projects, the appraisal horizon includes the construction phase followed by 20 years of operation, with a residual value incorporated in the 21st year. Accordingly, the overall appraisal period for the road portfolio spans 2010–2043.

In contrast, the airport projects were appraised over a 40-year horizon, reflecting their longer asset lifespan and higher capital intensity. Consequently, the appraisal period for these investments extends from 2015 to 2061, encompassing both construction and operational phases.

2.5.5 A Caveat on the Term 'Ex-Post'

Best practice in economic appraisal recommends that the evaluation period align with the expected economic life of the asset, to ensure a comprehensive assessment of both costs and benefits over its full operational lifespan. For paved road infrastructure, the standard assumed asset life is typically 20 years, whereas for large-scale capital-intensive assets such as airports, a longer appraisal horizon, commonly 30 to 50 years, is warranted due to their extended serviceability and slower depreciation. This research adopts a 40-year appraisal period for airport projects to reflect these considerations.

Accordingly, for infrastructure projects initiated between 2010 and 2020, a portion of the appraisal period would have already elapsed by the current reference year (2023). This elapsed portion can be evaluated using observed data on realised costs and benefits, constituting an ex-post analysis. The remaining years, covering the future operational period, are inherently prospective and therefore can be considered ex-ante, based on projected OPEX, usage patterns, and economic impacts. While it is acknowledged that the appraisal includes a forward-looking ex-ante component, the evaluation is nevertheless categorised as ex-post for the purposes of this research, given that it is anchored in observed outcomes for a significant portion of the appraisal period (including the actual CAPEX).

2.6 Price Normalisation and Currency Conversion Methodology

This research places a strong emphasis on economic impact assessment and employs a rigorous economic appraisal framework, which necessitates expressing all costs and benefits in constant prices relative to a common reference year. To ensure consistency and comparability across projects and time periods, all monetary values have been converted to real 2023 US dollar terms wherever feasible.

This process involved two key steps: first, converting costs denominated in Zambian Kwacha into US dollars using the real exchange rate to account for relative price movements between the two currencies; and second, adjusting nominal US dollar values to real 2023 price levels using appropriate deflators based on annual changes in the US GDP deflator or Consumer Price Index (CPI).

In certain instances, however, it may be more appropriate or informative to present values in nominal terms, particularly where the focus is on actual budgetary outlays or historical financial flows. In such cases, nominal values have been retained and clearly indicated. For completeness and transparency, Annex 10 provides selected tables and figures in alternative price bases to those presented in the main text, enabling cross-referencing and sensitivity to the choice of price level.

3 ZAMBIA ROADS SECTOR

3.1 Historical Performance

Major policy and institutional reforms were carried out in the road sector in Zambia in the 1990s under the World Bank's Road Management Initiative (RMI). The RMI resulted in the establishment of three new semi-autonomous road sector agencies.

- The National Road Fund Agency (NRFA) to mobilise and manage the Road Fund.
- The Road Development Agency (RDA) to develop and manage the road infrastructure.
- The Road Transport and Safety Agency (RTSA) to manage road transport, road traffic and road safety in Zambia.

The RMI reforms were a response to the deterioration in the condition of the Zambia road network in the 1980s/1990s due to inadequate maintenance. The economic mismanagement of the United National Independence Party (UNIP) government, combined with the sharp drop in world copper prices from the mid-1970s, had led to continuous large fiscal deficits until the early 2000s. With deficits financed by borrowing, debt accumulated rapidly; it was unsustainable by 1980 and by 1990 Zambia was effectively bankrupt with the highest public debt *per capita* in the world. Economic growth was negative, and Zambia was in continuous fiscal and debt crisis from the 1970s until the early 2000s. With virtually all government expenditure going to salaries and debt service, road maintenance funding was negligible between the 1970s and mid-1990s. A survey of 8,800 km of trunk, main and district roads in 1995 found that only 20% were in 'good' condition. 29% were in 'fair' condition and 51% were in 'poor' condition. 90% of feeder roads were in poor condition (World Bank 1997).

The RMI (originally the Road Maintenance Initiative) was a World Bank regional initiative intended to address the widespread problem across Africa of insufficient funding for maintenance. The objective was to secure reliable and sufficient funding for road maintenance through Road User Charges (RUC) and apply them to road maintenance through an efficient commercially orientated road agency (National Road Fund Agency 2014). In Zambia a levy on the price of fuel was introduced and the proceeds earmarked specifically for road maintenance (see below).

The RMI reforms took place alongside the preparation of the first Road Sector Investment Programme (RoadSIP I), which was launched in 1997. RoadSIP I had a budget of US$ 500 million funded from Government, RUCs and (mainly) development partners. The objectives of RoadSIP I included bringing a core road network of 33,500 km into a maintainable condition and bringing the overall condition of the road network to at least 50% good condition and only 10% poor condition for all types of roads. The Core Road Network is defined under RoadSIP as "the bare minimum road network that Zambia requires to be maintained continuously and on a sustainable basis in order to realize its social and economic potential" (World Bank 1997).

The World Bank Memorandum on Support to RoadSIP I (World Bank 1997) states that "*The project will help address deficiencies in the road network, increase the proportion of the network in good condition, and improve sector management and financing. The principal measure of project benefits will be reduction in vehicle operating costs (VOC). Through focusing only on the highest priority rehabilitation projects and on maintenance of the existing roads, the project is to yield acceptable economic rates of return - this is expected to be in the range of 12% to 42% with a weighted average of 21% for rehabilitation projects identified under the first two-year program".*

A total of 1,910 km of Trunk, Main and District roads and 415 km of Urban Roads received full rehabilitation under RoadSIP I, whilst 6,542 km of feeder roads received either full rehabilitation or spot improvements. The performance of RoadSIP I was considered "moderately successful" as some of the works were not completed within the five-year time span (Ministry of Communication and Transport 2003). RoadSIP I ended in 2002.

In 2003 the Government commenced preparations for RoadSIP II, and requested financial support from international development partners including the World Bank. The cost was estimated at US$1.2 billion. The proposed programme focused on bringing a Core Road Network of 41,000 km into maintainable condition while addressing poverty reduction, agriculture production and economic diversification. The RoadSIP II "Bankable Document" did not include a list of priority roads because it was assumed that the whole of the Core Road Network would receive rehabilitation, periodic and routine maintenance. Prioritisation was assumed to be "inherently built into the scheduling of proposed interventions within the various sub-sectors included in the programme" (Ministry of Communication and Transport 2003). The donor group disagreed with this approach and RoadSIP II was never finalised by the Government.

Despite the lack of agreement on RoadSIP II, the World Bank continued its support to the roads sector in the 2000s through the "Road Rehabilitation and Maintenance Project (RRMP)". Phase 1 (US$50 million) from 2003 to 2008 focused on the establishment of the RDA, NRFA and RTSA as well as the maintenance and rehabilitation of priority road and bridges. The loan was subsequently increased by US$25 million for the reinstatement and improvement of about 190 river crossings which were damaged by floods and the construction of a bridge on the Kafue River at Chiawa. Additional support was provided to the road sector agencies including capacity building for the RDA on bridge management (World Bank 2007).

The second phase of the RRMP (US$ 75 million) included the rehabilitation of a 51 km section of the Lusaka - Chirundu Road, improvements to district roads and the construction of the Mufuchani Bridge on the Kafue River near Kitwe (World Bank 2009). These works were completed in 2015.

The European Union and the Africa Development Bank continued their support to the sector in the 2010s through the rehabilitation and widening of the Great East Road from the Luangwa River to the Malawi border at Mwami (360 km). A feasibility study carried out in 2010 noted that the existing road did "not comply with modern geometric standards or the needs of a strategic corridor carrying fast moving heavy traffic" and "lack of maintenance has resulted in extensive deterioration of some road sections, particularly between Luangwa and Katete" with the narrow road cross-section and lack of paved shoulders and parking areas making the road "particularly dangerous, especially at night and when vehicles break down" (Egis et al. 2010). The road was widened to comply with regional trunk road standards and provided with asphalt concrete surfacing on a crushed stone base. The project was funded by concessional loans from the European Investment Bank and the AfDB with a budget of EUR 239 million, and the works were substantially complete by 2017.

The Movement for Multi-party Democracy (MMD) government's economic reforms, along with the RMI reforms, restored macroeconomic stability in Zambia in the early 2000s. This facilitated the write-off of most of Zambia's foreign debt under the HIPC initiative in 2006. Average real GDP growth averaged 6.8% pa between 1999 and 2011, against a backdrop of low debt levels, high international copper prices, and high foreign direct investment (FDI), among others (Ministry of Finance and National Planning 2013). This was the longest period of sustained growth in Zambia's history.

A national election in 2011 led to a change in Government. The new government of the Patriotic Front (PF) embarked on an ambitious road infrastructure development programme, aiming to transform the country from a landlocked economy to a "land-linked" country. The RDA was ordered to report directly to the Office of the President[1] and was instructed to launch a series of major road investments (LEA Associates 2020). The prioritisation of road investments was largely political, without robust economic appraisal. This was in contrast to RoadSIP 1, when all projects were appraised and technical and economic selection criteria were agreed in advance.

According to a World Bank study of 2013 *(*Raballand et al. *2013)*, the implementation of "unplanned" (i.e. unprioritised) projects by GRZ began as early as 2008. According to the report, *"political interference is usually recorded in project selection through unplanned projects. In Zambia, within the last few years the number of unplanned projects has increased, thereby reducing the RDA's adherence to its original work plan. Over the period 2008-2011, almost 40% of the total value of government-funded road projects was for unplanned projects. This has put an additional pressure on the institution (RDA) and staff, leaving the door open for political interference and procedural shortcuts. In addition, the unplanned nature of some decisions on project selection raises serious doubts as to whether the funds are likely to be used effectively*".

Though this research was unable to access reliable statistics on total capital expenditure in the road sector, it is established that at least $2.961 billion (nominal) and $3.856 billion (real, 2023 prices) was contracted between 2010 – 2020 (see Section 5). Most of the projects were financed by loans principally the China Exim Bank ($2.12 billion, real, 2023 prices) and Eurobonds($1.08 billion, real, 2023 prices) - see Section 4 for further details. Some projects were funded directly by the Government, partly by diverting funds earmarked for road maintenance (see below). The projects were implemented under a series of government programmes including Link Zambia 8000, Copperbelt 400, Lusaka 400 and Pave Zambia 2000.

Link Zambia 8000 was launched in 2012 with the objective of upgrading to bituminous standard approximately 8,000 km of roads linking districts and provinces throughout Zambia. The programme was characterised by inadequate planning, unrealistic expectations and rushed procurement. Some

[1] During this period RDA remained under the institutional responsibility of the Ministry of Works, later to become the Ministry of Infrastructure, Housing and Urban Development. The RDA continued to report to the Office of the President until the advent of the next government under President Lungu in 2015.

works contracts were awarded but never commenced on site, while others were left incomplete with the contracts terminated by the RDA. There was inadequate funding to pay the contractors and the consultants engaged for design and supervision (LEA Associates 2020).

Some projects under Link Zambia 8000 were completed but without careful consideration of their economic viability. For example, the Government spent US$ 287 million, equivalent to about 4 per cent of the national budget, for the construction of a 35 km road through the Barotse Flood Plains of the Zambezi River between Mongu and Kalabo in Western Zambia (Sanyikosa, R. 2011). 85% was funded through a US$243 million preferential buyer's credit from China Exim Bank. The cost of construction per kilometre was about ten times the normal cost of a rural road due to the large number of bridges and scarcity of good road construction materials in the project area. The road provides quicker access to remote communities on the west bank of the Zambezi River but traffic is low. Data from the NRFA toll station at Tapo shows less than 300 vehicles per day using the road in 2024. Any significant increase in traffic on the road will depend on linking Kalabo by paved road to the Angola road network.

The Pave Zambia 2000 Project provided improved access to social services in urban areas using the interlocking paving brick and cobblestones in all 10 provinces. The project objectives included employment creation, including the establishment of women groups, which received training in cobblestone production and laying from the National Council for Construction (Ministry of Transport, Works, Supply and Communications 2015).

The Lusaka 400 project aimed to rehabilitate and upgrade 400 km of selected roads in Lusaka at an estimated cost of US$ 348 million with a loan from the China Exim Bank. The project was implemented by the RDA and commenced in 2013. The objective was to reduce congestion of motorized and non-motorized traffic and improve safety for road users, including through the provision of street lighting (China Aiddata n.d.).

The Ministry of Local Government implemented the Lusaka Decongestion Project, which built grade-separated interchanges at intersections in Lusaka to ease traffic congestion. This US$289 million project was jointly funded by the Exim Bank of India and the Zambian Government. It was launched in 2018 and resulted in a significant improvement to traffic flows in the capital (NRFA u.d.).

3.2 Road Maintenance Funding

Table 3-1 provides a summary of Road Sector Annual Work Plan (RSAWP) allocations from 2010 to 2020. During this period, total Road User Charges (RUCs) increased from ZMW 44 million in 2013 to ZMW 2.4 billion by 2021, mainly as a result of the introduction of road tolls. (NRFA 2024). According to the Public Roads Act (2002) the RUCs are to be allocated *"for the construction, maintenance and rehabilitation of roads based on a percentage of the annual work programme of the Road Development Agency"*. The legal framework therefore offers a large level of freedom and assumes the RDA is able to efficiently allocate the NRFA resources.

One of the main RUCs is the Fuel Levy. Following decades of inadequate maintenance, the adoption of a fuel levy, proceeds of which were specifically earmarked for routine road maintenance, was a condition of donor financing for RoadSIP 1. From 1996 onwards part of the excise duty on petrol and diesel was designated as fuel levy, which became the main source of maintenance funding. (Raballand and Whitworth 2014).

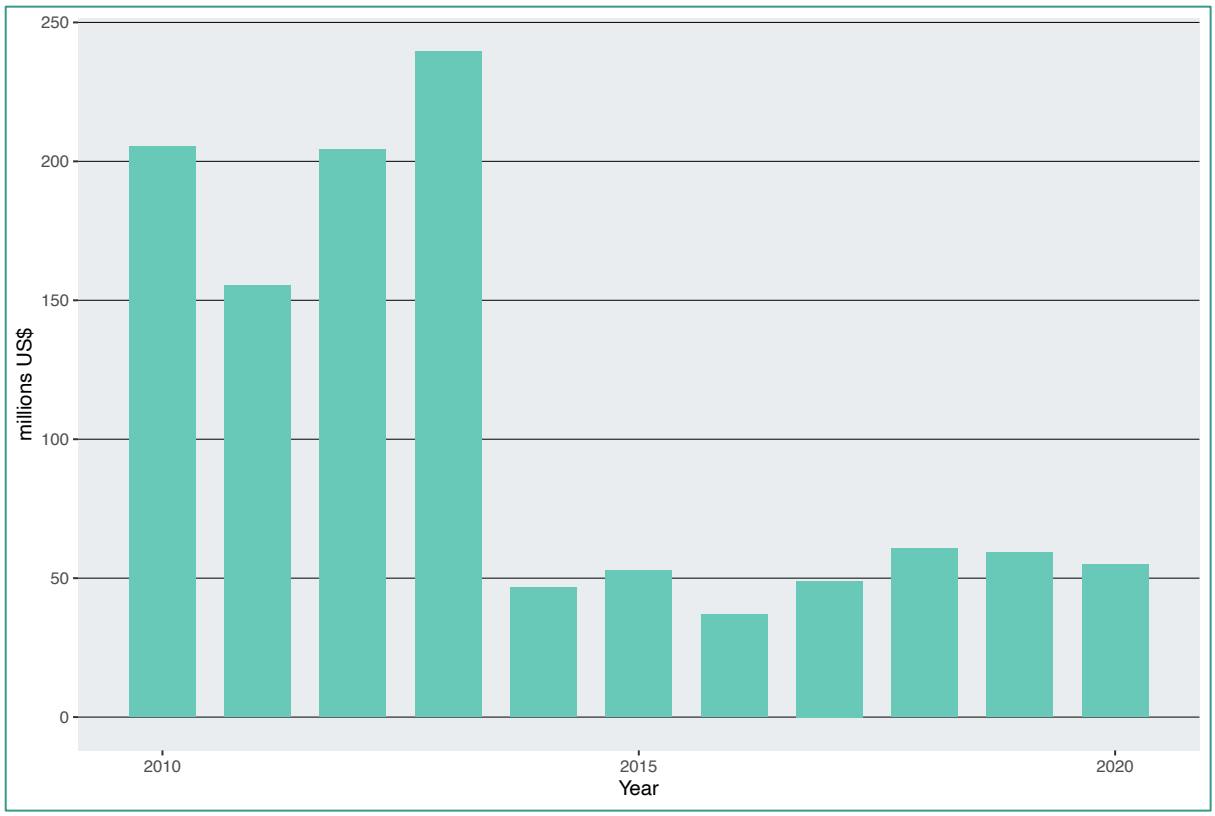
As shown in Table 3-1 and Figure 3-1 spending on road maintenance was approximately $200 per annum (2023 prices) between 2010 – 2013 and approximately $50 per annum (2023 prices) between 2014 – 2020. This indicates that the expansion in Zambia's road programme was partly financed by diverting fuel levy funds intended for maintenance to capital projects (National Road Fund Agency 2024). It is worth noting that the draft ROADSIP III (2025–2035) proposes allocating at least 80% of available funds to road maintenance and 20% to operations, with the objective of preserving the road network and supporting sustained long-term economic growth.

Table 3-1: Zambia's Road Maintenance Funding (2010-2021) (millions US$, 2023 prices)

Year	Maintenance Expenditures
2010	205.3
2011	155.4
2012	204.1
2013	239.7
2014	46.7
2015	52.8
2016	37.0
2017	49.0
2018	60.8
2019	59.4
2020	54.8

Source: Years 2010 – 2012 estimated from National Roads Fund Agency. Years 2014 – 2020 provided by National Roads Fund Agency. *Year 2013 interpolated by research team. Conversion to real values estimated by research team.*

Figure 3-1: Zambia's Road Sector Annual Work Plan (RSAWP) Allocations (2010-2021) (millions US$, 2023 prices)



Source: Years 2010 – 2012 estimated from National Roads Fund Agency. Years 2014 – 2020 provided by National Roads Fund Agency. *Year 2013 interpolated by research team. Conversion to real values estimated by research team.*

The use of Road User Charges to finance capital investment is against the general principles of the road sector reforms Zambia implemented with support of the World Bank and other cooperating partners during the 1990s. This included the World Bank funded Road Rehabilitation and Maintenance Project (RRMP), which aimed to ensure financial sustainability of the road sector by raising resources for road maintenance and rehabilitation (World Bank 2010). The failure to ensure financial and economic prudence in the road sector, including the neglect of road maintenance has resulted in deterioration of the existing road network, and thereby increasing transport costs (Boardman et al. 2018).

Furthermore, evidence from various African countries indicates that prioritizing road maintenance can yield greater economic returns than new road construction. For instance, in Rwanda, a case study demonstrated that regular maintenance of a road, costing approximately RWF 4.2 million annually, accumulated to RWF 33.6 million over eight years. Without such maintenance, the road would have required rehabilitation costing around RWF 70 million after the same period. Thus, timely maintenance resulted in savings of about RWF 36.4 million, highlighting its cost-effectiveness

(Ministry of Infrastructure, Rwanda 2021). Similarly, in South Africa, the South African Road Federation emphasized that neglecting road maintenance leads to rapid deterioration, necessitating costly rehabilitations. Proper maintenance extends the structural life of roads, preventing higher expenses associated with major repairs and ensuring safer, more efficient transportation networks. (SARF u.d). These examples underscore the economic advantages of regular road maintenance over new construction, emphasizing the importance of preserving existing infrastructure to optimize resource utilization and support sustainable development. This issue is further explored for Zambia's road network in Section 6.6.

3.3 Current Status of the Road Network

Despite the major investments in roads in the 2000s and 2010s, the overall condition of the Zambia road network is believed to have steadily deteriorated (LEA Associates 2020*)*. Many roads that were rehabilitated in the 2000s had reverted to poor condition by 2020; an example is the M10 Livingstone to Sesheke road in Western Province. Because maintenance has high economic returns compared to capital projects (by delivering the same level of service at a minimum cost), the combination of inadequate road maintenance and poor economic project appraisal and selection processes have contributed to Zambia's deteriorating economic performance over time, despite huge road infrastructure investments made (Boardman et al. 2018) (Ministry of Finance and National Planning 2023).

4 ROAD SECTOR DEBT IN ZAMBIA

4.1 External Funding of Roads

Based on our investigation of the selected road projects, we identified 16 projects that were either partially or fully funded through external borrowing from eight international lenders.

The total borrowing amounted to approximately $2.232 billion (nominal), with the EXIM Bank of China providing the vast majority (60% of the total), and followed by the Development Bank of China (15% of the total). The remaining contributions came from:

- Exim Bank of India – 11%
- Development Bank of South Africa (DBSA) – 7%
- African Development Fund – 4%
- Poly Technologies (China) – 2%
- World Bank (IDA)– 1%
- Government of Japan – 1%

This lending profile underscores the dominant role of Chinese financing in Zambia's road infrastructure development.

Table 4-1: Lending Institutions Contribution to External Finance of Research Roads Projects (2010 – 2020)

Lender	Nominal US$	Real US$ (2023)	Real ZMW (2023)
EXIM Bank of China	1,326,116,992	1,694,127,122	22,727,362,290
China Development Bank	322,619,568	421,977,695	4,724,840,732
Exim Bank of India	245,739,817	305,472,579	4,527,258,862
DBSA	155,526,380	209,072,326	2,464,593,468
African Development Fund	77,520,000	99,775,489	1,229,337,240
Poly Technologies	44,000,000	53,391,098	828,051,668
IDA (World Bank)	23,215,388	30,453,239	360,071,127
Government of Japan	14,698,030	18,917,739	233,086,110
Total	2,209,436,175	2,834,774,859	37,156,782,067

*Source: MOFNP (Lusaka 400 Ph 1-3, Zambia Township Roads, Kazangula Bridge, Mansa – Luwingu, Mbala – Nakonde, Mongu – Kalabo), *Assumed for Sesheke – Senanga Lots 1 – 3 , Kalulushi – Lufwanyama and Sioma Bridge based on consultant's research of publicly available material and discussions with stakeholders.*

Table 4-2: Roads Projects Funded From External Borrowing (nominal values in stated currencies)

#	Road Project	Borrow Year	Borrow Amount	Borrow Currency	Funder
1	Lusaka 400 (Phase 1)	2013	295,798,237	USD	EXIM Bank of China
2	Lusaka 400 (Phase 2)	2017	197,877,928	USD	EXIM Bank of China
3	Lusaka 400 (Phase 3)	2019	204,940,175	USD	EXIM Bank of China
4(i)	Zambia Township Roads	2018	197,391,778	USD	EXIM Bank of China
4(ii)	Zambia Township Roads	2018	44,000,000	USD	Poly Technologies
5(i)	Kazungula Bridge	2014	51,000,000	SDR	African Development Fund
5(ii)	Kazungula Bridge	2014	1,557,179,536	JPY	Government of Japan
6(i)	Mansa - Luwingu Road	2013	120,225,783	USD	China Development Bank
6(ii)	Mansa - Luwingu Road	2013	202,393,785	USD	China Development Bank
7	Mufuchani Bridge	2014	5,860,400	SDR	IDA (World Bank)
8	Chiawa Bridge Construction	2012	14,307,580	USD	IDA (World Bank)
9	Mbala - Nakonde	2012	1,182,846,760	CNY	EXIM Bank of China
10	Mongu – Kalabo	2011	242,722,247	USD	EXIM Bank of China
11	Sesheke - Senanga Road (Lot 1)	2011	48,511,412	USD	Development Bank of South Africa (DBSA)*
12	Sesheke - Senanga Road (Lot 2)	2011	44,183,780	USD	Development Bank of South Africa (DBSA)*
13	Sesheke - Senanga Road (Lot 3)	2011	37,125,396	USD	Development Bank of South Africa (DBSA)*
14	Kalulushi - Lufwanyama	2016	10,529,158	USD	Development Bank of South Africa (DBSA)*
15	Sioma Bridge	2013	15,176,634	USD	Development Bank of South Africa (DBSA)*
16	Lusaka Decongestion Project	2017	245,739,817	USD	Exim Bank of India

*Source: MOFNP (Lusaka 400 Ph 1-3, Zambia Township Roads, Kazangula Bridge, Mansa – Luwingu, Mbala – Nakonde, Mongu – Kalabo), *Assumed for Sesheke – Senanga Lots 1 – 3 , Kalulushi – Lufwanyama based on consultant's research and discussions with stakeholders.*

A financial model has been developed to assess the entire portfolio of loans, incorporating critical variables such as loan tenor, applicable interest rate structures (both fixed and variable), and contractual terms including grace periods, capitalised interest, and associated service charges. The modelling exercise includes forward-looking projections of debt servicing requirements, covering both interest and principal repayments, as well as forecasted outstanding loan balances. The results of this analysis are presented in Figure 4-1, Figure 4-2 and Figure 4-3, below.

Figure 4-1 presents the nominal value of loan disbursements in US dollars over the period 2010 to 2020. The chart illustrates year-on-year variations in external borrowing, highlighting several peaks in sovereign loan uptake. The most significant disbursement occurred in 2013, with over $600 million disbursed. A secondary peak is evident in 2011 and 2017. Overall, the data reflects a non-linear borrowing pattern, possibly indicative of a financing strategy tied to project-based needs. This visualisation serves as the foundational input for subsequent analysis of debt servicing (Figure 4-2) and outstanding balances (Figure 4-3), providing context for evaluating the structure and sustainability of public debt over the observed period.

Figure 4-1: Roads Project Aggregate Principal Loan Amounts (2010-2020) (millions US$, nominal)

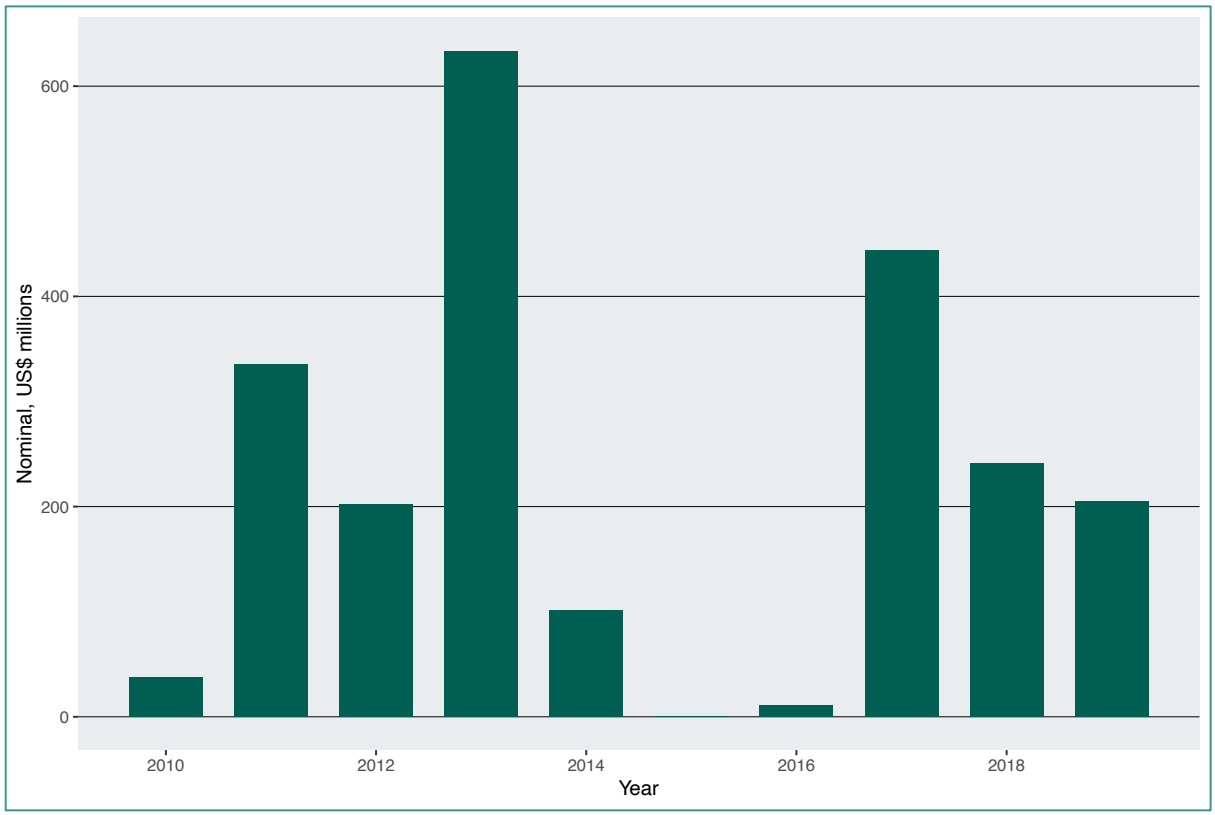


Figure 4-2 presents the scheduled debt service obligations for road projects, comprising both interest and principal repayments, based on the original contractual terms of the loan agreements, without adjusting for subsequent defaults or restructuring arrangements. Figure 4-3 illustrates the trajectory of projected outstanding loan balances associated with roads projects over time, based on the amortisation schedules initially stipulated within the original loan agreements. This projection assumes uninterrupted adherence to contractual repayment terms, thus offering a baseline view of sovereign debt evolution under a "no-default" scenario. However, the Government of Zambia experienced a significant sovereign debt event in 2020, when it defaulted on one of its Eurobond obligations. This marked a turning point in the country's external debt management. In the aftermath of the default, the Government of Zambia suspended regular debt service payments on the majority of its external obligations—with exceptions maintained for preferred creditors such as the IMF, the World Bank, and the AfDB.

In response to escalating debt distress and to seek coordinated relief, Zambia formally applied for restructuring under the G20 Common Framework for Debt Treatments beyond the Debt Service

Suspension Initiative (DSSI). This strategic move signalled the commencement of a formal debt resolution process, aimed at restoring debt sustainability through renegotiation with both official and private creditors.

As a result, while Figure 4-2 and Figure 4-3 reflects the theoretical amortisation profile, the actual trajectory of outstanding balances post-2019 is likely to diverge substantially due to the accumulation of arrears, ongoing negotiations, and the eventual outcomes of the restructuring process..

As a result, while the estimated debt service figures for the period 2010 to 2019 reflect actual cash outflows made by the Government of Zambia, the figures from 2020 onwards represent contractual debt service obligations that were due but largely not honoured. These post-default figures therefore illustrate the magnitude of the arrears accumulation and serve as a proxy for the scale of fiscal consolidation and restructuring required under ongoing debt resolution efforts

Debt servicing costs associated with road infrastructure projects increased to approximately $150 million (2023 prices) by 2019, with projections indicating a further escalation to over US$200 million (2023 prices) per annum by 2020. By 2019, the outstanding loan balance had reached an estimated US$1.98 billion (2023 prices), with projections indicating a decline to approximately US$712 million (2023 prices) by 2024, assuming adherence to the original repayment schedule.

Figure 4-2: Roads Project Scheduled Debt Service Obligations (2010-2024) (millions US$, real)

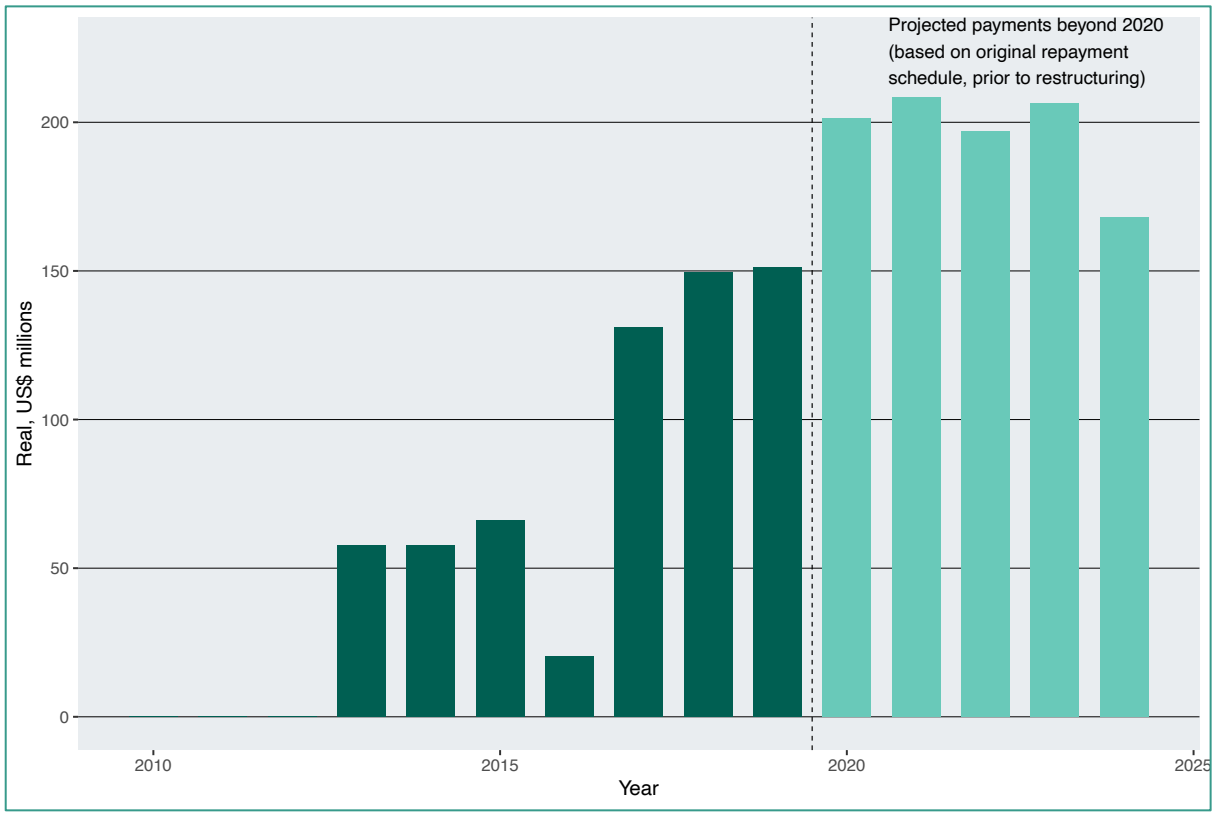
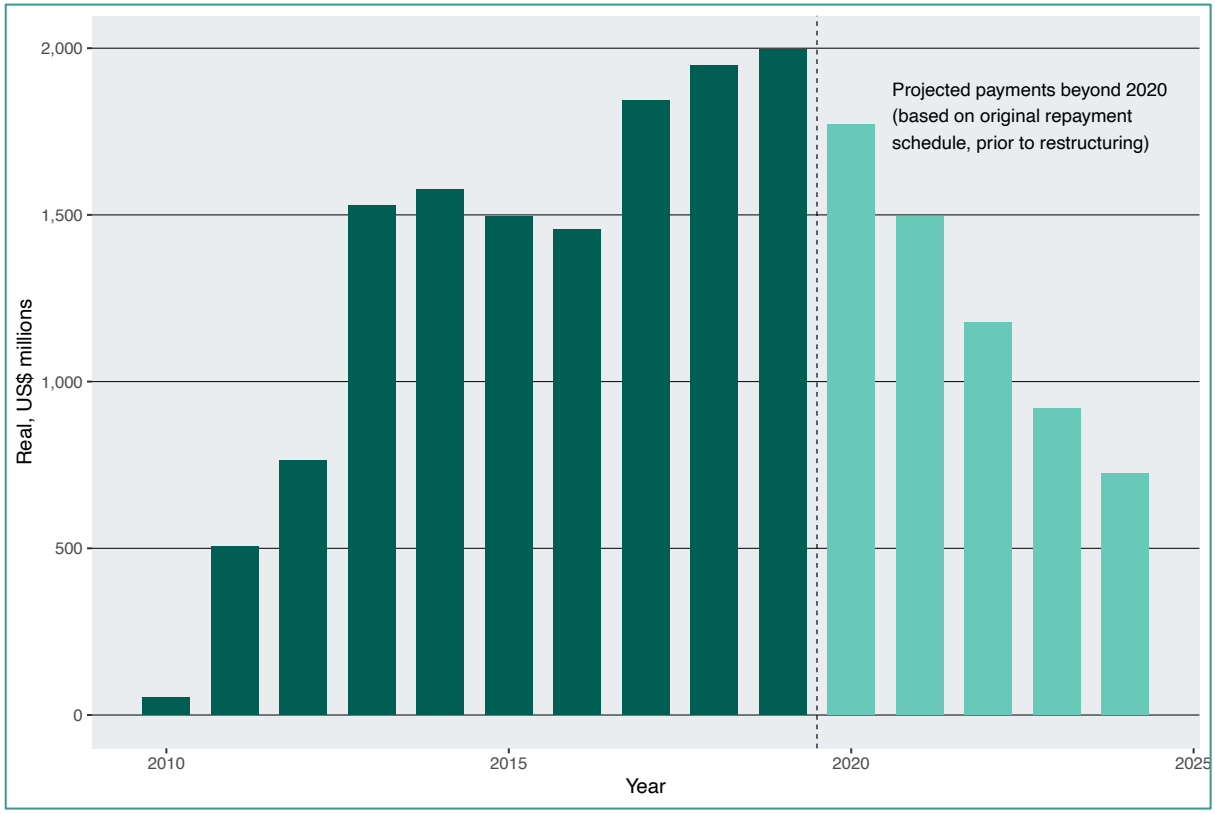


Figure 4-3: Roads Project Projected Outstanding Loan Balance (2010-2024) (millions US$, real)



4.2 Current Debt Situation

The NRFA undertook a debt validation exercise with the respective roads institutions and the Ministry of Finance and National Planning (MFNP) and recorded the findings in the Road Sector Debt Report of June 2024. The NRFA described the process as verifying certified amounts, supporting documentation, interest claims, Value-Added Tax / Withholding Tax issues, payments, expired/terminated loans for externally funded projects, litigation and judgement costs and all terminated locally funded projects in the roads sector.

Debt is reported as of June 2024, although the report states that the roads sector has not accrued any debt from 2022 (apart from termination and litigation costs) since contracts since then have been administered within the approved annual work plans. The debt should therefore all relate to the period up to December 2021. Debt before this date is referred to as "legacy arrears" by MFNP and is the subject of the Dismantling of Domestic Arrears Strategy (DDAS) which is referred to later in this report.

As shown in the tables below, in June 2024 total road sector debt was estimated at ZMW 17.6 billion (approximately $685.0 million). There are two major categories of debt: "Verified and Audited" are creditors known to NRFA while "Pipeline" is debt that has not formally been verified by the NRFA and of which the values may still change.

There are three types of pipeline debt. The funding of "externally funded" contracts was terminated and transferred to the NRFA although the final values of these contracts are still under negotiation. "Terminated RDA contracts" are contracts terminated prematurely in 2022 as a cost-saving measure, however, the termination values of all these contracts have also not yet been finalised. "Certified Interim Payment Certificates (IPCs) not yet verified and audited" are cases where the RDA withheld submitting IPCs for various reasons. Pipeline debt makes up nearly half of total debt, and it is imperative that it be formalised (verified and brought onto the NRFA's books).

The debt includes some items not related to roads contracts, specifically commercial loan liabilities and RTSA creditors – note that commercial loans and RTSA debt are not part of this assignment. It excludes retention moneys on certified works estimated at ZMW 2.3 billion.

The fact that the roads debt position cannot be simply obtained from the accounting system of the NRFA is of concern. This does not only relate to the pipeline portion of debt, but also to the verified and audited component. Rather than being a standard creditors report from the accounting system,

the data supporting the Road Sector Debt Report is in the form of manually compiled spreadsheets, upon official request with various inconsistencies and gaps.

Table 4-3: Verified and Audited Road Sector Debt as of June 2024, ZMW, millions, nominal

#	Institution / Intervention	No. Contracts	Value of contracts (commitment)	Certified	Interest Claims	Total Certified	Total Paid	Balance (debt)
1	RDA Works	32	45,521.81	22,046.36	1,019.13	23,065.49	19,685.31	3,283.81
2	RDA Consultancy	92	7,085.83	1,257.08	85.08	1,342.16	573.11	683.97
3	RDA Routine	481	1,317.71	1,155.50		1,155.50	1,106.61	48.89
4	RDA Feeder Roads	8	5,682.88	686.59		686.59	457.00	229.60
							Sub-total	4,246.26
5	MLGRD Urban Road	39	6,444.70	2,861.76	477.30	3,339.06	2,242.79	1,096.28
6	MLGRD Feeder Roads	241	12,962.36	5,346.00		5,346.00	3,533.27	1,812.73
7	MLGRD Routine	41	325.54	291.67		291.67	270.33	21.34
9	MLGRD Consultancy	13	229.67	140.70		140.70	110.38	30.32
							Sub-total	2,960.67
10	NRFA - LOANS (NAPSA, NATSAVE, INDO-Z)	4	5,704.13	5,704.13	4,433.69	10,137.82	9,669.20	468.62
11	RTSA	1	278	223.45		223.45	199.49	23.96
12	Litigation / Judgement Costs	5	1,648.96	1,648.96		1,648.96	232.16	1,416.80
							Sub-total	1,909.38
							TOTAL	**9,116.31**

Source: MFNP-DDAS (2024-2029), 2024 and NRFA, 2024

Table 4-4: Verified and Audited Road Sector Debt as of June 2024, ZMW, millions, nominal

#	Institution / Intervention	No. of Contracts	Value of contracts (commitment)	Certified	Interest Claims	Total Certified	Total Paid	Balance (debt)
1	External Funded Projects - Terminated Loan	9	-	5,733.40		5,733.40	2,123.43	3,609.97
							Sub-total	3,609.97
2	Terminated RDA contracts	76	27,812.16	4,067.31		4,067.31	-	4,067.31
3	Certified IPCs not yet verified & audited	29		811.78		811.78	-	811.78
							Sub-total	4,879.09
							TOTAL	8,489.06

Source: MFNP-DDAS (2024-2029), 2024 and NRFA, 2024

4.3 Eurobonds

The Government of Zambia issued three Eurobonds: the first in 2012 for $0.75 billion (coupon rate 5.375%,10 year tenor), the second in 2014 for $1.0 billion (coupon rate 8.5%, 10 year tenor), and the third in 2015 for $1.25 billion (9.375%, 11 year tenor). In total, these issuances raised $3.0 billion in nominal terms. It is challenging to ascertain the precise final expenditure of the Eurobonds. However, analysis of previous statements confirms that approximately $0.31 billion and ZMW 4.0 billion have been allocated for road infrastructure. Converting all values in real US$ (2023 price levels) it is estimated that the total value of Eurobond issuance was $3.899.4 billion with $1,082.9 billion (or 28%) spent on roads.

Table 4-5: Eurobonds Issuance and Expenditure (real US$, 2023 prices)

Year	Eurobond (US$, millions)	Exp roads (US$, millions)	Exp Eurobond source
2012	$995.3	$205.7	Eurobond I
2013	-	$202.7	Eurobond I
2014	$1,287.1	$209.5	Eurobond II
2015	$1,607.0	$350.4	Eurobond III
2016	-	$114.6	Eurobond II
Total	$3,899.4	$1,082.9	-

Source: Finance Minister to Parliament, 2018 (https://diggers.news/business/2018/02/26/mwanakatwe-explains-eurobond-interest-payment/

5 ROAD INFRASTRUCTURE INVESTMENTS

5.1 Identification of Roads Projects for Evaluation

The RDA provided assistance for identifying projects carried out between 2010 – 2020 which could form the basis of the economic evaluation of road investments. The methodology for identifying roads was as follows:

- Potential projects were identified from the Road Sector Annual Work Plan (RSAWP) by combining announced projects and removing duplicates and non-qualifying projects. This provided a long list of 494 road sections (See Annex 1 for the full list). Where a road project was let through more than one construction lot, each lot has been analysed separately.
- A shortlist was compiled by identifying projects whereby a contract was signed between 2010 – 2020. This reduced the list of road sections to 52.
- Road rehabilitation projects were excluded, resulting in a final list of 29 projects. Rehabilitation works are designed to restore infrastructure to its original condition, rather than enhance capacity or surface quality. As such, they are not considered to constitute an expansion of the road network and were therefore omitted from the analysis.
- Each of the shortlisted roads was viewed using satellite imagery to verify that the works were at least substantially completed. This resulted in reduction of the list to 27 projects.
- RDA data on the contract amount, start and completion date etc., were verified from RDA and NRFA Annual Reports and news reports in the local media.

Table 5-1 presents the 27 road improvement projects. In total, 2,058 kilometres of roads were upgraded, comprising 1,296 km for inter-urban projects and 762 km for urban projects. Five bridge projects were also undertaken.

The total contract value is $2.961 billion (nominal) and $3.856 billion (real, 2023 prices). The breakdown of the contract value is as follows:

- $1.511.4 billion (nominal) or $2.047 billion (real, 2023 prices) are for inter-urban roads
- $1.120 billion (nominal) or $1.356 billion (real, 2023 prices) are for urban roads
- $0.330 billion (nominal) or $0.453 billion (real, 2023 prices) are for bridge projects

The breakdown for unit prices are as follows:

- $1.34 million / km (nominal) or $1.83 million / km (real, 2023 prices) are for inter-urban roads
- $1.79 million / km (nominal) or $2.14 million / km (real, 2023 prices) are for urban roads
- $112,083 / metre (nominal) or $155,750 million / metre (real, 2023 prices) are for bridge projects

Table 5-1: Road sections selected for evaluation

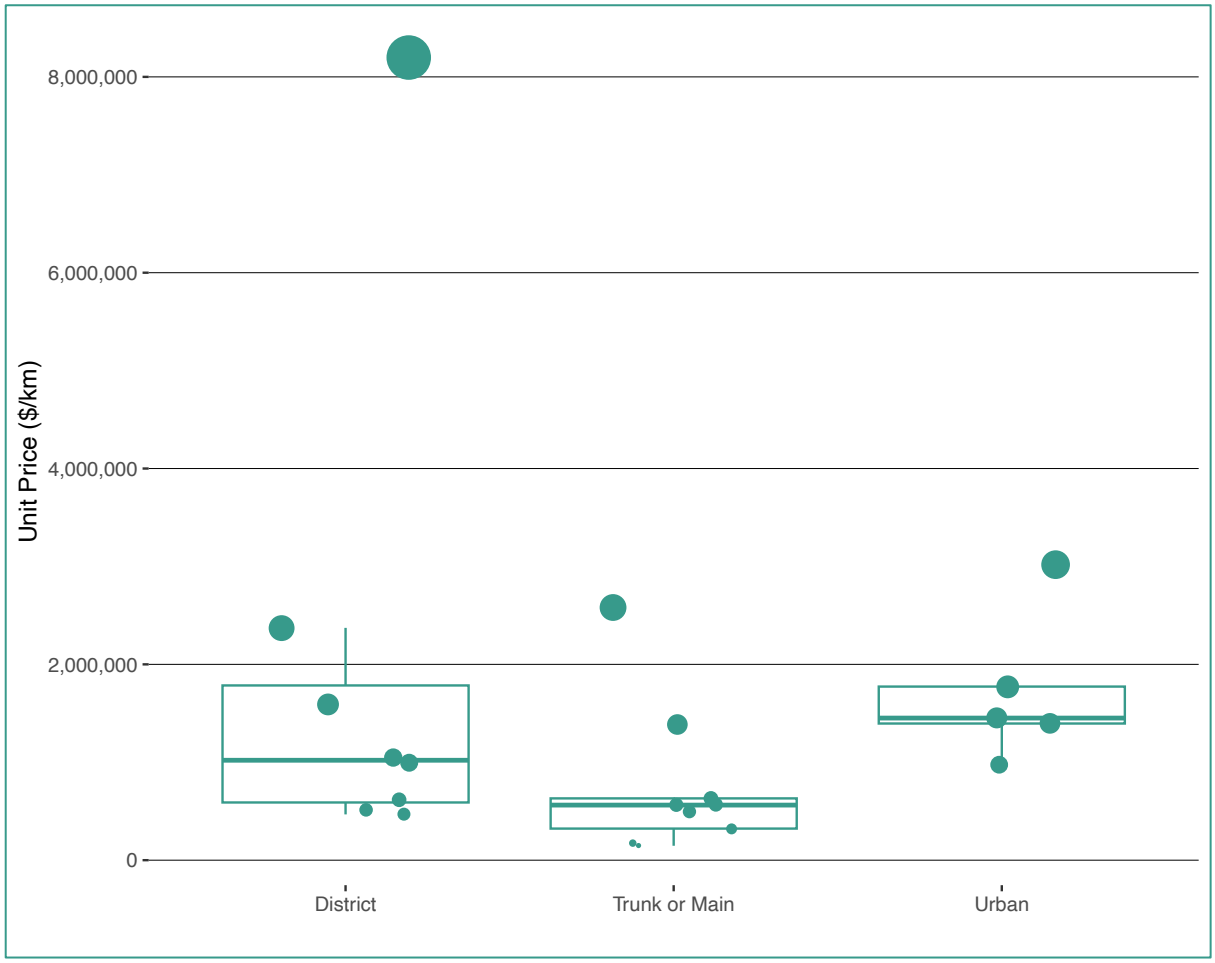
Project	Length (km)	Project Type	Implementation Period	Contract Value		Unit Cost ($/ km[road], $/m [bridge])		External Borrowing
				($, nominal)	($, real 2023 prices)	($, nominal)	($, real 2023 prices)	
Chama - T2 (Lot 1)	30.0	Roads Inter-urban	2016 - 2022	$29,814,020	$39,311,778	$993,801	$1,310,393	No
Chama - T2 (Lot 2)	47.0	Roads Inter-urban	2013 - 2016	$24,094,903	$34,804,589	$512,658	$740,523	No
Chiawa Bridge Construction	0.1	Bridge	2012 - 2014	$9,688,859	$14,307,580	$69,206	$102,197	No
D145 (T4 - Feira)	91.0	Roads Inter-urban	2013 - 2016	$42,557,507	$61,167,693	$467,665	$672,172	No
Fatima Indeni Road	14.6	Roads Inter-urban	2013 - 2015	$8,974,609	$12,945,155	$614,699	$886,654	No
Kafue Hook Bridge	0.3	Bridge	2015 - 2022	$17,446,702	$23,087,230	$64,617	$85,508	No
Kalulushi - Lufwanyama	60.0	Roads Inter-urban	2016 - 2021	$10,529,158	$14,012,927	$175,486	$233,549	Yes
Katoba - Chirundu	10.0	Roads Inter-urban	2015 - 2019	$23,726,351	$31,702,072	$2,372,635	$3,170,207	No
Kazungula Bridge	0.9	Bridge	2014 - 2020	$274,475,626	$375,701,502	$297,373	$407,044	Yes
Kitwe - Chingola Dual Carriageway	45.5	Roads Inter-urban	2013 - 2021	$117,534,937	$170,216,467	$2,583,185	$3,741,021	No
Landless Corner - Mumbwa (Lot 1)	30.6	Roads Inter-urban	2010 - 2011	$9,873,695	$14,631,172	$322,670	$478,143	No
Landless Corner - Mumbwa (Lot 2)	54.4	Roads Inter-urban	2019 - 2021	$8,004,757	$9,919,390	$147,146	$182,342	No
Leopards Hill Road to Jct RD481	58.5	Roads Inter-urban	2012 - 2014	$92,918,326	$137,594,347	$1,588,619	$2,352,442	No
Lusaka Decongestion Project	95.7	Roads Urban	2017 - 2021	$289,105,667	$344,530,739	$3,020,958	$3,600,112	Yes
Lusaka 400 (Phase 1)	58.5	Roads Urban	2013 - 2017	$348,293,745	$445,650,876	$5,954,757	$7,619,266	Yes
Lusaka 400 (Phase 2)	58.5	Roads Urban	2017 - 2020	$241,180,000	$290,680,794	$4,123,440	$4,969,752	Yes
Lusaka 400 (Phase 3)	58.5	Roads Urban	2019 - 2022	$241,106,088	$274,795,572	$4,122,176	$4,698,163	Yes
Mansa - Luwingu Road	205.0	Roads Inter-urban	2013 - 2021	$284,133,570	$399,830,793	$1,386,017	$1,950,394	Yes
Mbala - Nakonde	171.9	Roads Inter-urban	2012 - 2016	$180,000,001	$233,380,206	$1,047,120	$1,357,651	Yes
Mongu – Kalabo	35.0	Roads Inter-urban	2011 - 2016	$286,935,923	$374,416,500	$8,198,169	$10,697,614	Yes
Mufuchani Bridge	0.2	Bridge	2014 - 2016	$7,728,609	$10,833,213	$48,304	$67,708	Yes
Pedicle Road	61.2	Roads Urban	2011 - 2024	$30,218,394	$45,979,874	$493,845	$751,428	No
Sesheke - Senanga Road (Lot 1)	85.0	Roads Inter-urban	2010 - 2015	$48,511,412	$72,067,615	$570,722	$847,854	Yes
Sesheke - Senanga Road (Lot 2)	70.0	Roads Inter-urban	2010 - 2013	$44,183,780	$65,776,037	$631,197	$939,658	Yes
Sesheke - Senanga Road (Lot 3)	66.0	Roads Inter-urban	2010 - 2015	$37,125,396	$55,152,771	$562,506	$835,648	Yes
Sioma Bridge	0.3	Bridge	2013 - 2015	$20,389,982	$29,305,498	$80,913	$116,292	Yes
Zambia Township Roads	160.0	Roads Urban	2018 - 2021	$232,225,621	$273,919,723	$1,451,410	$1,711,998	Yes

Source: Researchers estimates based on data provided by RDA

5.2 Summary Analysis on Unit Costs

The spread of roads project unit prices is shown in Figure 5-1 in 2023 real prices. The average unit price for Trunk and Main Road projects is approximately $1,250,000 and the average unit price for urban roads project is $1,767,202 per km. For these two classes of roads, both the values and spread of unit prices is within the acceptable range. For district roads both the average unit price ($2,020,399) and the spread is larger than expected, with a very significant outlier, the Mongu – Kalabo project with a unit price of approximately $8,200,000 per km.

Figure 5-1: Boxplot Showing Roads Project Unit Price (real 2023 prices)



There are five bridge projects and the average unit price for bridges is approximately $260,000 per metre (as shown in Figure 5-2). There is only one significant outlier, the Kazangula Bridge, which cost $297,000 per metre. If this project is removed from the database, then the average unit price is approximately $94,000 per metre.

It should be noted that apart from bridge span, there are many other factors that significantly impact on the price of bridge construction, such as width and deck level, access roads and safety features etc.

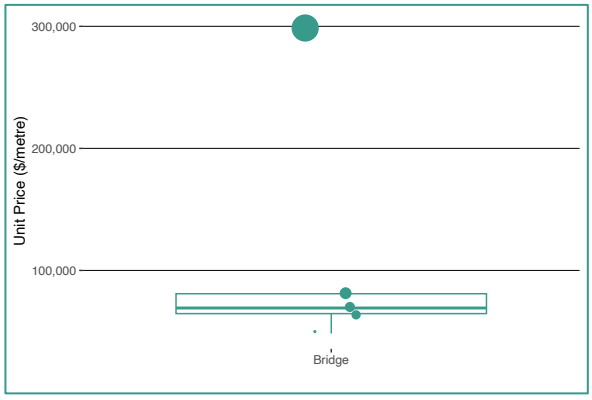


Figure 5-2 Boxplot Showing Bridge Project Unit Price (real 2023 prices)

6 APPRAISAL OF ROAD INVESTMENTS 2010 TO 2020

6.1 Roads Research Questions

Three specific research questions have been addressed with respect to the roads sector:

- Expected ex-ante economic viability of the project when the decision to undertake it was announced, compared to doing nothing?
- For those roads for which sufficient data is available, what is the estimated ex-post economic viability of the project in 2024, based on actual costs and traffic up to 2023 and expected future costs and traffic, compared to doing nothing?
- What was the impact of single source procurement on project costs and viability compared to competitive procurement?

6.2 Economic Analysis of Roads Projects

The ex-post economic analysis has been conducted on the selected road projects using mainly data provided by the RDA and open-source data available on the internet. The process is summarised below.

6.2.1 Traffic Levels

Along with CAPEX, traffic levels on the roads are the most important piece of data for economic analysis. For some projects we have data on actual traffic levels, either through feasibility studies, RDA commissioned counts (see Annex 5), NRFA tolling (see Annex 5) and moving counts (see Annex 6). In such cases, the traffic counts have been used as actuals and forecasts/growth rates based on elasticity values with respect to exogenous variables derived from regression analysis (see 6.2.2). The exogenous data over the appraisal period is presented in Figure 2-1, with forecasted GDP by IMF (2024 - 2029) and research team (2029 onwards) and population forecasts from the United Nations Development Programme (UNDP).

The table below presents the traffic levels in Annual Average Daily Traffic (AADT) and the source of the estimation, along with the corresponding date. It is crucial to acknowledge that the researchers have made assumptions regarding the distribution of truck sizes and that several surveys did not include tractors or motorcycles in their vehicle classification. Consequently, the researchers have made assumptions about the mode split based on the available data.

The data exhibits substantial variations in AADT among the projects. While some projects have AADT values below 100, others have AADT exceeding 1,000. However, when comparing the projects, it is crucial to account for the range of survey years, which spans from 2005 to 2024.

Table 6-1:Traffic Count and Source of Data

Project	Count Source / Method	Year	Car	Pick-up / 4WD	Minibus	Bus	Light Truck	Medium Truck	Heavy Truck	Very Heavy Truck	Tractor	Motor-cycle	AADT
Chama - T2 (Lot 1)	RDA Counts	2024	41	41	1	-	3	2	-	-	0	55	143
Chama - T2 (Lot 2)	RDA Counts	2024	14	25	1	-	0	1	1	0	0	41	84
Chiawa Bridge Construction	RDA Counts	2004	1	23	0	0	2	3	2	3	1	17	54
D145 (T4 - Feira)	RDA Counts	2011	46	68	15	3	12	14	3	3	5	81	252
Fatima Indeni Road	Moving Counts	2024	77	113	-	-	30	35	13	14	8	-	290
Kafue Hook Bridge	RDA Counts	239	306	412	398	64	87	149	21	95	1	112	1,646
Kalulushi - Lufwanyama	Moving Counts	2024	597	563	151	67	108	187	28	108	5	154	1,967
Katoba - Chirundu	Moving Counts	2024	24	35	45	10	37	43	15	17	7	-	231
Kawambwa - Mporokoso	Synthetic Estimation	2025	83	122	23	5	21	24	14	15	9	151	468
Kitwe - Chingola Dual Carriageway	NRFA, RDA Counts (Average)	2016	2,601	2,167	433	289	180	415	179	1,173	6	642	8,084
Landless Corner - Mumbwa (Lot 1)	RDA Counts	2024	157	146	37	10	27	47	6	19	1	71	521
Landless Corner - Mumbwa (Lot 2)	RDA Counts	2024	140	84	5	1	35	48	10	13	1	112	449
Leopards Hill Road to Jct RD481	Moving Counts	2024	780	1,148	26	6	141	165	60	65	71	110	2,570
Mansa - Luwingu Road	NRFA, RDA Counts (Average)	2013	67	63	24	11	19	32	7	27	1	99	350
Mbala - Nakonde	Design / Feasibility Data	2013	72	58	35	5	55	40	12	39	2	31	347
Mongu – Kalabo	NRFA Counts	2021	84	124	6	1	6	7	3	4	7	116	358
Mufuchani Bridge	Moving Counts	2024	485	714	377	83	87	101	37	40	57	2,067	4,047
Pedicle Road	NRFA, RDA Counts (Average)	2016	47	45	29	13	19	32	7	28	1	88	308
Sesheke - Senanga Road (Lot 1)	Design / Feasibility Data	2005	-	37	1	3	4	7	6	1	0	-	59
Sesheke - Senanga Road (Lot 2)	Design / Feasibility Data	2005	-	37	1	3	4	7	6	1	0	-	59
Sesheke - Senanga Road (Lot 3)	Design / Feasibility Data	2005	-	37	1	3	4	7	6	1	0	-	59
Sioma Bridge	NRFA Counts	2023	111	104	18	8	12	21	5	19	1	118	416
Zambia Township Roads (Rehabilitation/Upgrade)	Moving Counts	2024	1,513	2,228	873	191	82	95	34	37	-	232	5,285
Zambia Township Roads (Upgrade)	Moving Counts	2024	1,513	2,228	873	191	82	95	34	37	-	232	5,285
Zambia Township Roads (Widening)	Moving Counts	2024	1,893	2,786	1,147	251	94	109	40	43	-	141	6,504

Source: Researchers estimates based on data provided by RDA and NRFA

6.2.2 Regression Modelling

To estimate the elasticities of traffic to exogenous variables, a double-log regression model was employed. Models testing population and GDP per capita did not yield reliable economic outputs. Models incorporating GDP (which encompasses both population and income growth integrated into the indicator) produced significant and valid results. The elasticity of GDP was estimated to be 1.7 for light vehicles, -2.6 for buses, 0.6 for light trucks, and 0.7 for heavy trucks. Dummy interactions with GDP resulted in increased elasticities for buses, with -1.1 for trunk roads and -1.3 for main roads, and increased elasticities for heavy trucks, with 2.2 for truck roads and 2.1 for main roads. The results are presented in the table below.

Table 6-2:Double Log Model for Light Vehicle (cars and pick-ups)

Coefficient	estimate	std. error	t-value
$ß_1$	1.703	0.204	8.367***
$ß_2$	0.023	0.072	0.323
$ß_3$	0.073	0.089	0.819
$ß_4$	-0.954	0.476	-2.007**
$ß_5$	-0.163	0.301	-0.542
$ß_6$	-0.205	0.334	0.613
$ß_7$	2.120	1.484	1.429

*Adjusted R^2= 0.320, *** = significance at 0.01, ** = significance at 0.05, * = significance at 001*
Model form: $ln(Y) = ß_1 ln(GDP) + ß_2 D_{TRUNK} + ß_3 D_{MAIN} + ß_4 D_{URBAN} + ß_5 ln(GDP) D_{TRUNK} + ß_6 ln(GDP) D_{MAIN} + ß_7 ln(GDP) D_{URBAN}$
Source: Researcher's estimates

Table 6-3:Double Log Model for Buses (including minibuses and large buses)

Coefficient	estimate	std. error	t-value
$ß_1$	-2.584	0.245	-10.550***
$ß_2$	0.159	0.086	1.841
$ß_3$	0.203	0.106	1.920
$ß_4$	-0.987	0.578	-1.707
$ß_5$	1.504	0.361	4.165***
$ß_6$	1.299	0.400	3.244**
$ß_7$	-0.595	1.781	-0.334

*Adjusted R^2= 0.224, *** = significance at 0.01, ** = significance at 0.05, * = significance at 001*
Model form: $ln(Y) = ß_1 ln(GDP) + ß_2 D_{TRUNK} + ß_3 D_{MAIN} + ß_4 D_{URBAN} + ß_5 ln(GDP) D_{TRUNK} + ß_6 ln(GDP) D_{MAIN} + ß_7 ln(GDP) D_{URBAN}$
Source: Researcher's estimates

Table 6-4:Double Log Model for Small Trucks (≤ 2 axles)

Coefficient	estimate	std. error	t-value
$ß_1$	0.573	0.244	2.351*
$ß_2$	0.034	0.087	0.395
$ß_3$	0.051	0.106	0.484
$ß_4$	-1.632	0.570	-2.864**
$ß_5$	-0.015	0.361	-0.043
$ß_6$	0.149	0.401	0.371
$ß_7$	1.204	1.778	0.677

*Adjusted R^2= 0.063, *** = significance at 0.01, ** = significance at 0.05, * = significance at 001*
Model form: $ln(Y) = ß_1 ln(GDP) + ß_2 D_{TRUNK} + ß_3 D_{MAIN} + ß_4 D_{URBAN} + ß_5 ln(GDP) D_{TRUNK} + ß_6 ln(GDP) D_{MAIN} + ß_7 ln(GDP) D_{URBAN}$
Source: Researcher's estimates

Table 6-5:Double Log Model for Heavy Trucks (≥ 3 axles)

Coefficient	estimate	std. error	t-value
$ß_1$	0.655	0.324	2.023*
$ß_2$	0.052	0.105	0.500
$ß_3$	0.029	0.130	0.227
$ß_4$	-0.003	0.811	-0.004
$ß_5$	1.572	0.457	3.441***
$ß_6$	1.403	0.505	2.777**
$ß_7$	-3.156	2.295	-1.375

*Adjusted R^2= 0.251, *** = significance at 0.01, ** = significance at 0.05, * = significance at 001*
Model form: $ln(Y) = ß_1 ln(GDP) + ß_2 D_{TRUNK} + ß_3 D_{MAIN} + ß_4 D_{URBAN} + ß_5 ln(GDP) D_{TRUNK} + ß_6 ln(GDP) D_{MAIN} + ß_7 ln(GDP) D_{URBAN}$
Source: Researcher's estimates

6.2.3 Traffic Backcasting and Forecasting

By applying the previously mentioned elasticity of traffic growth with respect to GDP, we can forecast traffic volumes for years following the traffic count survey, and backcast for years preceding it. The results are presented in Table 6-6 below.

Table 6-6:Traffic Estimates for Project Roads

Project	AADT (year=project start)	AADT (year=counts survey)	AADT (year=2025)
Chama - T2 (Lot 1)	98 (2022)	143 (2024)	157 (2025)
Chama - T2 (Lot 2)	44 (2016)	84 (2024)	93 (2025)
Chiawa Bridge Construction	160 (2014)	54 (2004)	312 (2025)
D145 (T4 - Feira)	346 (2016)	252 (2011)	593 (2025)
Fatima Indeni Road	157 (2015)	290 (2024)	313 (2025)
Kafue Hook Bridge	1646 (2022)	1738 (2024)	1842 (2025)
Kalulushi - Lufwanyama	1068 (2021)	644 (2011)	1605 (2025)
Katoba - Chirundu	237 (2019)	231 (2024)	234 (2025)
Kawambwa - Mporokoso	337 (2023)	468 (2025)	468 (2025)
Kitwe - Chingola Dual Carriageway	11041 (2021)	11041 (2021)	13287 (2025)
Landless Corner - Mumbwa (Lot 1)	404 (2011)	404 (2011)	1008 (2025)
Landless Corner - Mumbwa (Lot 2)	357 (2021)	449 (2024)	489 (2025)
Leopards Hill Road to Jct RD481	1311 (2014)	2570 (2024)	2797 (2025)
Mansa - Luwingu Road	459 (2021)	350 (2013)	679 (2025)
Mbala - Nakonde	381 (2016)	347 (2013)	560 (2025)
Mongu – Kalabo	298 (2016)	358 (2021)	516 (2025)
Mufuchani Bridge	3220 (2016)	4047 (2024)	4334 (2025)
Pedicle Road	386 (2024)	370 (2023)	423 (2025)
Sesheke - Senanga Road (Lot 1)	144 (2015)	59 (2005)	307 (2025)
Sesheke - Senanga Road (Lot 2)	129 (2013)	59 (2005)	307 (2025)
Sesheke - Senanga Road (Lot 3)	144 (2015)	59 (2005)	307 (2025)
Sioma Bridge	311 (2015)	416 (2023)	497 (2025)
Zambia Township Roads (Rehabilitation/Upgrade)	4040 (2021)	5285 (2024)	5555 (2025)
Zambia Township Roads (Upgrade)	4040 (2021)	5285 (2024)	5555 (2025)
Zambia Township Roads (Widening)	5029 (2021)	6504 (2024)	6816 (2025)

Source: Researcher's estimates

6.2.4 Summary Economic Results

The table below summarises the ex-post economic results of the road projects. The dataset presents the economic performance of various road and bridge infrastructure projects across Zambia, assessed in real 2023 currency values. Each project is evaluated in terms of its length (where applicable), contract value (both nominal and real), unit cost, Internal Rate of Return (IRR), Net Present Value (NPV), and Benefit-Cost Ratio (BCR).

The updated ex-post economic analysis reveals a wide range of outcomes in terms of economic viability. The most outstanding performers include Landless Corner – Mumbwa (Lot 2) and Kalulushi – Lufwanyama, which are expected to deliver exceptionally high returns with IRRs of 27.1% and 22.2%, positive NPVs of $27.9 million and $45.1 million, and robust BCRs of 3.10 and 2.95, respectively, signalling highly attractive investments. Other high performing projects such as Lusaka Decongestion Project, Lusaka 400 (Phases 1 to 3), Kitwe–Chingola Dual Carriageway, and Zambia Township Roads also demonstrate excellent returns, with IRRs ranging from 17.4% to 21.4%, NPVs between $277.8 million and $912.4 million, and BCRs well above 1.6, underscoring their economic strength. In contrast, several projects like Chama – T2 (Lots 1 and 2), Chiawa Bridge, Katoba – Chirundu, and Sioma Bridge reflect negative IRRs, highly negative NPVs (ranging from -$37 million to -$87 million), and very low BCRs (0.05 to 0.16), indicating very bad investment decisions. Mid-range performers such as D145 (T4 – Feira) and Leopards Hill Road to Jct RD481 show moderate IRRs (around 8–10%), but their NPVs remain negative and therefore still reflecting a poor return on investment. Overall, while a subset of projects offers compelling economic value, others show limited justification when viewed through a cost-benefit lens.

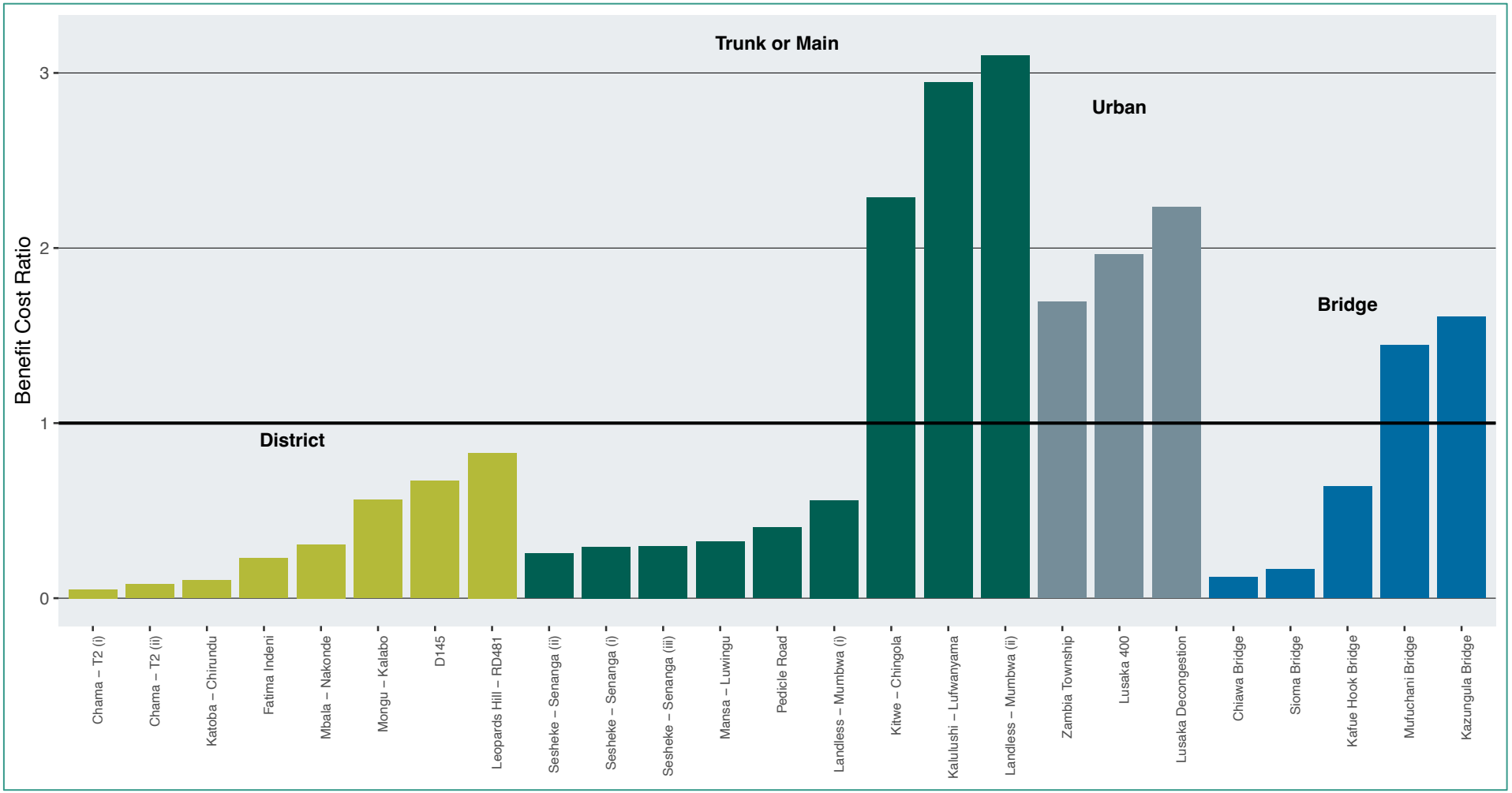
Table 6-7: Summary Economic Indicators (Roads Projects 2010 – 2020)

Project	Km	Contract Value ($ millions, Nominal)	Contract Value ($ millions, Real, 2023)	Unit Cost $million/km (Real, 2023)	IRR	NPV	BCR
Chama - T2 (Lot 1)	30.0	29.81	39.31	1.3	-2.0%	-59.4	0.05
Chama - T2 (Lot 2)	47.0	24.09	34.80	0.7	-1.6%	-87.1	0.08
Chiawa Bridge Construction	0.1	9.69	14.31	102.2	-0.7%	-37.7	0.12
D145 (T4 - Feira)	91.0	42.56	61.17	0.7	8.4%	-52.9	0.67
Fatima Indeni Road	14.6	8.97	12.95	0.9	1.6%	-27.2	0.23
Kafue Hook Bridge	0.3	17.45	23.09	85.5	7.9%	-13.5	0.64
Kalulushi - Lufwanyama	60.0	10.53	14.01	0.2	22.2%	45.1	2.95
Katoba - Chirundu	10.0	23.73	31.70	3.2	-1.1%	-55.9	0.10
Kazungula Bridge	0.9	274.48	375.70	407.0	16.1%	449.1	1.61
Kitwe - Chingola Dual Carriageway	45.5	117.53	170.22	3.7	17.5%	435.0	2.29
Landless Corner - Mumbwa (Lot 1)	30.6	9.87	14.63	0.5	6.2%	-26.1	0.56
Landless Corner - Mumbwa (Lot 2)	54.4	8.00	9.92	0.2	27.1%	27.9	3.10
Leopards Hill Road to Jct RD481	58.5	92.92	137.59	2.4	10.2%	-71.3	0.83
Lusaka Decongestion Project	95.7	289.11	344.53	3.6	21.4%	573.7	2.23
Lusaka 400 (Phase 1)	357.6	348.29	445.65	1.2	18.6%	912.4	1.96
Lusaka 400 (Phase 2)	172.8	241.18	290.68	1.7	19.0%	398.7	1.96
Lusaka 400 (Phase 3)	136.0	241.11	274.80	2.0	19.0%	300.5	1.96
Mansa - Luwingu Road	205.0	284.13	399.83	2.0	4.7%	-540.4	0.32
Mbala - Nakonde	171.9	180.00	233.38	1.4	3.3%	-449.1	0.31
Mongu – Kalabo	35.0	286.94	374.42	10.7	7.4%	-483.5	0.56
Mufuchani Bridge	0.2	7.73	10.83	67.7	17.3%	12.1	1.44
Pedicle Road	61.2	30.22	45.98	0.8	6.8%	-54.8	0.40
Sesheke - Senanga Road (Lot 1)	85.0	48.51	72.07	0.8	3.7%	-166.0	0.29
Sesheke - Senanga Road (Lot 2)	70.0	44.18	65.78	0.9	2.5%	-176.5	0.25
Sesheke - Senanga Road (Lot 3)	66.0	37.13	55.15	0.8	3.8%	-126.4	0.30
Sioma Bridge	0.3	20.39	29.31	116.3	-0.1%	-65.7	0.16
Zambia Township Roads	160.0	232.23	273.92	1.7	17.4%	277.8	1.69

Source: Researcher's estimates

Figure 6-1, below presents the Benefit-Cost Ratios (BCRs) of projects grouped by project type. District road projects consistently exhibit BCRs below 1, raising critical concerns about the economic justification for paving roads in low-demand, rural areas. These results underscore the need for scrutiny before committing to costly upgrades in districts with limited traffic volumes or economic activity. In contrast, trunk or main roads display a wide range of BCRs, reflecting the variation in demand, connectivity benefits, and implementation efficiency across corridors. Bridge projects similarly show mixed performance, likely influenced by localised factors such as strategic importance and construction cost intensity. Urban infrastructure projects, on the other hand, uniformly demonstrate positive economic returns, largely attributable to higher population densities, greater traffic volumes, and improved accessibility benefits, characteristics that typically enhance the economic viability of urban transport investments.

Figure 6-1: Benefit Cost Ratio (Roads Projects 2010 – 2020)



6.2.5 A Case Study: Economic Analysis of the Mongu–Kalabo Road

The Mongu–Kalabo road, frequently labelled "Africa's most expensive road," has garnered widespread criticism due to its exceptionally high unit cost of $10.7 million per kilometre (2023 prices). With an Internal Rate of Return (IRR) of only 7.4% and a Benefit-Cost Ratio (BCR) of 0.56, the project falls well below accepted thresholds for economic viability and, by conventional standards, should not have been undertaken. However, despite its poor performance, it does not warrant the notoriety it has received as the most wasteful investment of the post-2010 road infrastructure boom. Unlike most road projects that derive benefits from improved conditions along existing routes, Mongu–Kalabo's justification rests on significant distance savings through diverted traffic. Prior to its construction, travel between Mongu and Kalabo required a 386 km detour via the M10 and the unpaved RD319. The new 35 km road eliminated this detour, saving 351 km per trip. These savings do contribute to vehicle operating cost and travel time reductions, providing a modest economic rationale. Nonetheless, these benefits were insufficient to justify the project's scale and cost, even if its overall performance was not the worst among its peers.

6.3 Aggregate Economic Benefits

The initial HDM-4 assessment of individual road projects indicates a high degree of variability in economic performance, with 17 projects demonstrating suboptimal or negative returns. However, when considered in aggregate, the portfolio of road investments yields an overall economically neutral to moderately positive outcome. As summarised in the accompanying table, total expenditure on roads and bridges amounted to approximately $2.96 billion in nominal terms, equivalent to $3.9 billion (in real, 2023 prices). The NPV of CAPEX is estimated at $8.0 billion. The consolidated Net Present Value (NPV) of these projects is estimated at $0.9 billion, corresponding to an aggregate Benefit-Cost Ratio (BCR) of 1.12.

Table 6-8: Economic Analysis of the Roads Sector Investments, Years 2010 - 2020

Indicator	Value
Total CAPEX (nominal)	$2,961 million
Total CAPEX (real, 2023 prices)	$3,856 million
NPV CAPEX ($, 2023)	$8,017 million
NPV of Road Projects	+$939 million
BCR of Road Projects	1.12
IRR of Road Projects	12.9%

Source: Researcher's estimates

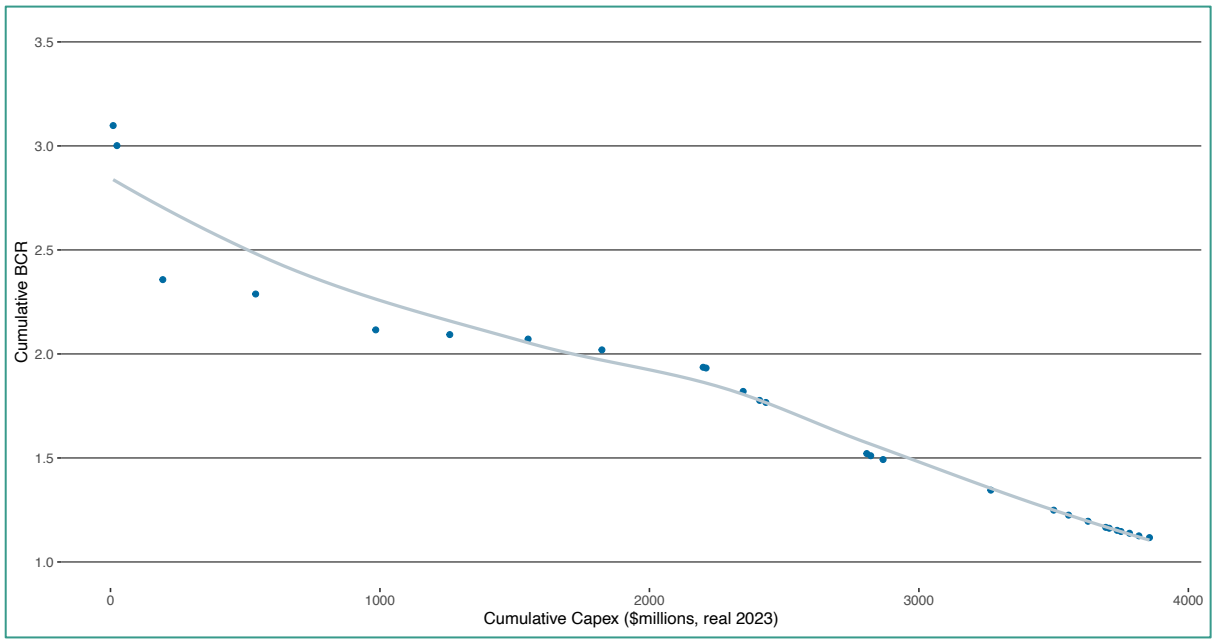
While this suggests a positive return on public investment, it is important to note that the analysis does not account for the opportunity costs associated with the allocation of funds. Specifically, as it is elaborated in Section 6.6, that increased investment in routine and periodic maintenance often delivers significantly higher economic returns. Therefore, the observed returns from capital expansion must be viewed in the context of foregone alternatives that may have enhanced overall network efficiency and generated superior value for money.

6.4 Diminishing Marginal Returns

Ranking the road projects by descending order of their economic performance—specifically by their Benefit-Cost Ratios (BCRs)—enables the construction of a marginal benefits curve, as illustrated in Figure 6-2. This curve represents the incremental economic value generated per dollar spent across the portfolio of projects. The shape of the curve provides important insights into the efficiency of public investment allocation within the road sector.

The analysis reveals that the top 50% of performing projects, i.e. the first $1.9 billion (2023 prices) of investment, is directed toward projects with relatively high economic returns, generally yielding BCRs of 2.0 or greater. This indicates that for every dollar invested, the economy receives at least 2.0 dollars in benefits—suggesting a strong value-for-money proposition during the early stages of capital deployment. However, as investment expands beyond this $1.9 billion threshold, the cumulative BCR declines below 2.0 This downward trend reflects diminishing marginal returns, where successive projects deliver progressively lower economic benefits relative to their costs. This pattern underscores the importance of prioritising high-return projects and suggests that continued expansion without strategic prioritisation can dilute the overall economic effectiveness of infrastructure investment.

Figure 6-2: Cumulative CAPEX and BCR



Source: Researcher's estimates

6.5 Ex-Post versus Ex-Ante Results

Table 6-9, below presents a review of the economic appraisals conducted prior to project implementation. The research team obtained 11 feasibility or design reports relevant to this study. Of these, only seven included an economic evaluation, representing just 26% of the projects by count and approximately 28% by total investment value. It is important to acknowledge that additional projects may have undergone economic appraisal; however, these reports were not made available to the research team, likely due to issues related to documentation retrieval or archival gaps.

The ex-post economic evaluations of the Kazungula Bridge and the Lusaka Decongestion Project have been developed by scaling the original ex-ante appraisal results, incorporating updated capital expenditure (CAPEX) figures and uplifted benefits to reflect the expanded project scope. However, since the ex-post assessments rely heavily on the same underlying data and modelling framework used in the ex-ante evaluations—albeit with adjusted inputs—comparing the two sets of indicators offers limited analytical value. The overlap in data and methodology diminishes the incremental insight such a comparison would typically provide in a conventional ex-post vs. ex-ante analysis.

Nonetheless, several noteworthy comparisons can be drawn. The available evidence does not suggest a consistent pattern of systematic overestimation or underestimation in ex-ante economic appraisals of road projects. For instance, the Kitwe–Chingola Dual Carriageway performed as initially forecasted with an ex-ante BCR of 2.8 versus an ex-post CBR of 2.3. Similarly, the Mufuchani Bridge showed close alignment between forecasts and outcomes, with an ex-ante Internal Rate of Return (IRR) of 14.1% and an ex-post IRR of 17.3%. However, the Sesheke–Senanga Road project demonstrated over optimistic economic returns, with an ex-ante IRR of 11.5% and between 2.5 – 3.8% in the ex-post analysis.

There is a marked divergence in the methodologies employed across the ex-ante economic appraisals. Notably, key parameters such as discount rates and appraisal periods differ substantially between studies. Furthermore, the selection of economic variables and the identification and quantification of benefit streams exhibit significant variability, reflecting a lack of standardisation in the appraisal framework.

Table 6-9: Ex-Ante versus Expost Economic Analysis

Road Project	CBA evidenced	Ex-Ante						Ex-Post					
		AADT	CAPEX ($ in millions, ZMW in billions)	r	years	IRR	BCR	AADT	CAPEX (2023, real)	r	years	IRR	BCR
Katoba - Chirundu	No	587 (2015)	ZMW1056					237 (2019)	31.7	12%	20	-1.1%	0.10
Kazungula Bridge	Yes	116 (2009)	$259.3 (2011)	12%	30	23%	1.21	n/a	$375.7	12%	20	16.1%	1.61
Kitwe - Chingola	Yes	2,575 (2009)	$141.0 (2009)	10%	20	10.2%	2.83	8,084 (2016)	$170.2	12%	20	17.5%	2.29
Lusaka Decongestion Project	Yes (pre-feasibility)	Network model	$56.8 (2009)	12%	20	23%	n/a	n/a	$344.53	12%	20	21.4%	2.23
Mansa - Luwingu	No	434 (2015)	$242.1 (2015)					459 (2021)	$399.8	12%	20	4.7%	0.32
Mbala - Nakonde	No	381 (2013)	$180.0 (2013)					381 (2011)	$233.4	12%	20	3.3%	0.31
Mufuchani Bridge	Yes	Not known	$8.0 (2009)	10%		14.1%		3220 (2016)	$10.8	12%	20	17.3%	1.44
Sesheke - Senanga Road (Lot 1)	Yes	59 (2006)	$132.7	12%	25	11.5%	n/a	144 (2015)	$72.1	12%	20	3.7%	0.29
Sesheke - Senanga Road (Lot 2)								144 (2015)	$65.8	12%	20	2.5%	0.25
Sesheke - Senanga Road (Lot 3)								144 (2015)	$55.2	12%	20	3.8%	0.30

Source: Ex-Ante (specific project design / feasibility reports), Ex-Post (Researcher's estimates)

6.6 The Opportunity Cost of Road Expansion

6.6.1 Underinvestment in Maintenance

As illustrated in Figure 3-1, annual expenditure on road maintenance declined steadily over the decade, as fuel levy proceeds earmarked for maintenance were diverted to capital investment in road expansion. While the road expansion program generated a positive economic return, with an estimated benefit-cost ratio (BCR) of 1.12, this does not imply that the overall allocation of resources between maintenance and capital works was economically optimal.

The observed expenditure pattern has likely resulted in underinvestment in maintenance and the BCR associated with the expansion program does not account for the opportunity cost of deferred or inadequate maintenance. To quantify this opportunity cost and assess the economically efficient allocation of resources, a comprehensive Strategy Analysis was undertaken using the HDM-4 model. This analysis allows for a comparison of alternative investment strategies, capturing the broader economic implications of maintenance underfunding within a constrained fiscal environment.

6.6.2 Strategy Analysis Overview

An HDM-4 Strategy Analysis, in contrast to an HDM-4 Project Analysis, operates at a network-wide or programmatic level. It is used to evaluate and optimise medium- to long-term investment strategies across multiple road links or regions, subject to defined budgetary and policy constraints. The goal is to determine the optimal allocation of resources across the network, identifying which types of interventions should be applied, when, and where, to maximise overall economic returns. Unlike Project Analysis, which evaluates discrete alternatives, Strategy Analysis considers a broader set of scenarios and policy options, such as different maintenance standards or funding levels, and assesses their cumulative impact on network performance, costs, and benefits over time. It is a planning tool used by road authorities and policymakers to guide sustainable investment and maintenance strategies at the macro level.

6.6.3 Zambia Road Network

Drawing on data from the 2011 Road Condition Report, a historical baseline of the road network as of 2010 was established, disaggregated by functional classification, surface type, and pavement condition. A summary of the network condition at that time is provided in Table 6-10. Feeder roads were excluded from this analysis, as they fall outside the scope of the present study. The network included in the HDM-4 Strategy Analysis comprises a total length of 26,121 kilometres.

The Trunk, Main, District, and Urban road classes were segmented into 144 distinct sections within the HDM-4 model. Each section reflects a unique combination of road classification, surface type, pavement condition, and traffic characteristics. Traffic input data were derived from Road Development Authority (RDA) traffic counts, using the mean and standard deviation values to represent average traffic volumes and variability across the network. This segmentation allowed for a granular and representative modelling framework to support the strategic evaluation of maintenance and investment alternatives.

Table 6-10: Classified Road Network (excluding Primary and Feeder)

Classification	Paved			Unpaved			Total
	Condition						
	Good	Fair	Poor	Good	Fair	Poor	
Trunk	1,602	1,315	106	0	27	67	**3,116**
Main	1,443	1,270	173	118	208	489	**3,701**
District	740	1,110	206	2,330	2,272	7,049	**13,707**
Urban	507	612	1,696	376	737	1,669	**5,597**
Total	4,292	4,308	2,181	2,824	3,243	9,273	**26,121**

Source: 2011 Road Condition Report (RDA)

6.6.4 Optimised Road Expenditure Regime

Between 2010 and 2020, average annual expenditure on road maintenance was approximately $106 million (2023 prices), declining from around $200 million between 2010 - 2014 to approximately $50million (2023 prices) between 2014 – 2020 (see Section 3.2). However, based on an HDM-4 Strategy Analysis, the economically optimal level of maintenance investment is estimated at $264 million per annum (2023 prices) representing a $158.5 million increase. Over the period 2010 – 2020 this level of expenditure would have resulted in a maintenance expenditure of $2.9 billion (instead of

$1.2 billion actual maintenance expenditure (2023 prices). It is estimated that this increased level of road maintenance would yield an economic BCR of 3.04 (see Table 6-11, below)

6.6.5 Impact on the Economy

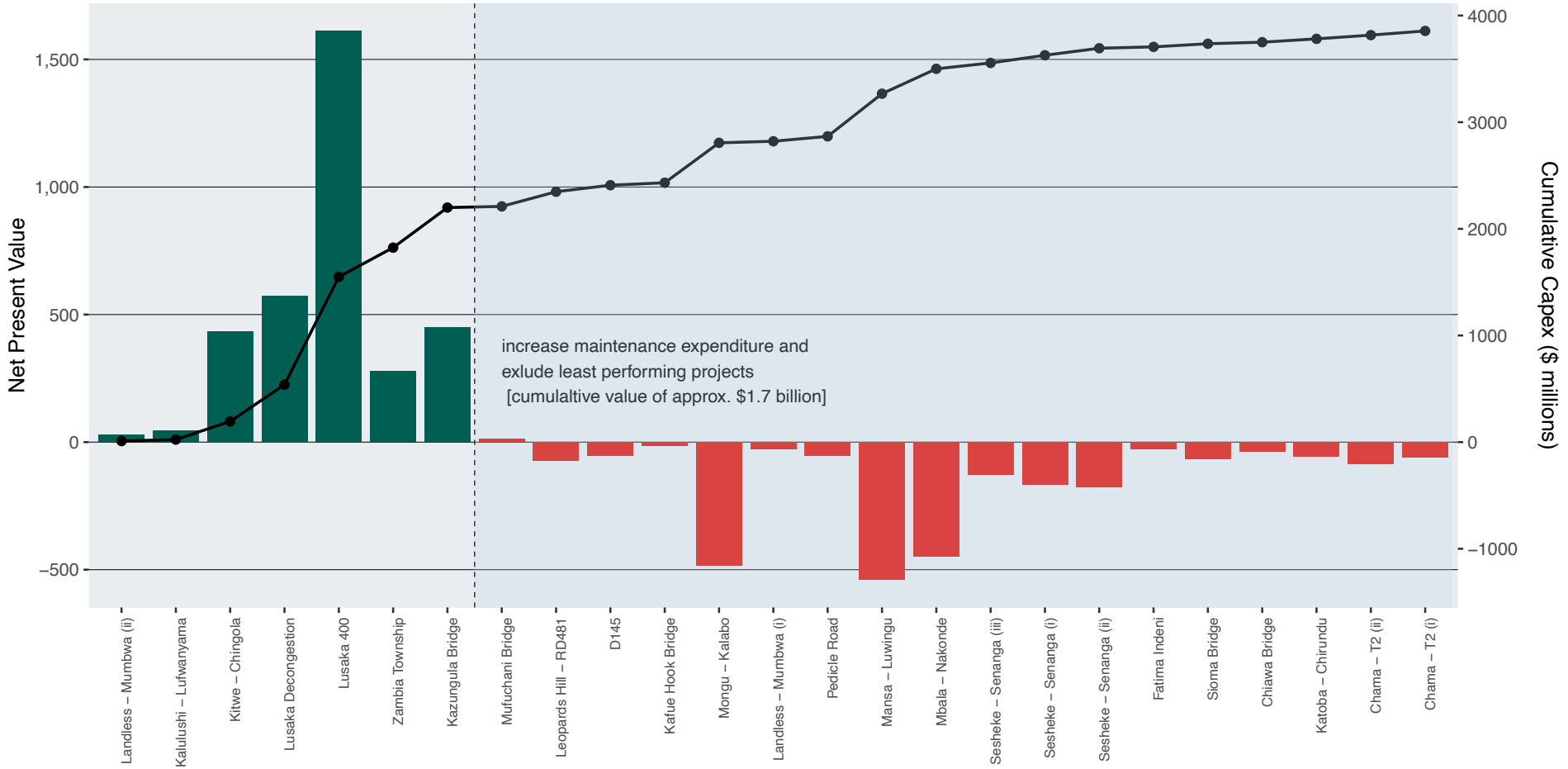
This optimised maintenance expenditure level ($2.91 billion, 2023 prices, over the period 2010 – 2020), is assessed to yield a benefit-cost ratio (BCR) of 3.04, significantly outperforming the BCR of 1.12 associated with capital road expansion projects implemented over the same period. Allocating resources according to this maintenance-optimised strategy, while directing the residual budget towards the highest performing capital investments (and excluding the projects which drag the net NPV down) generates an estimated net present value (NPV) of $6,731 million. This figure reflects the opportunity cost of the road expansion bias during the decade, quantifying the foregone economic benefits of underinvestment in maintenance. The methodology is presented graphically in Figure 6-3.

Table 6-11: Actual Maintenance versus Optimised Maintenance Expenditure (real 2023 prices)

Scenario	Description	Value
Pro-Capital (Road Expansion)	Actual expenditure on maintenance between 2010 – 2020)	$106 million / annum
Pro-Maintenance	Optimised maintenance expenditure estimated by HDM4 Strategy Analysis	$264 million / annum
∆ Maintenance Exp		+ $159 million / annum (or $1,743 million between 2010 – 2020)
BCR	due to increased maintenance only	3.04
NPV	due to increased maintenance (of $1,743) and reduction of expenditure on capital projects (of $1,743 million)	+ $ 6,731 million

Source: Actual constructed by author from the Road Sector Annual Work Plan (RSAWP) Allocation Data (NRFA). Conversion to real values estimated by research team. Optimised is based on HDM4 Strategy Analysis conducted by research team

Figure 6-3: Bar Chart of NPV (left axis) and Line Chart of Cumulative CAPEX (right axis). Poorest Performing Projects Highlighted Red



7 AIRPORT INFRASTRUCTURE INVESTMENTS

7.1 Overview

The government carried out the expansion of the Kenneth Kaunda International Airport (KKIA) at Lusaka and the construction of a new airport near Ndola as part of its infrastructure investments in the 2010s. The Ndola airport serves the Copperbelt area and is known as the Simon Mwansa Kapwepwe International Airport (SMKIA). The projects were funded by loans from the Exim Bank of China.

The existing terminal building at KKIA was built in 1967 and could not provide the quality of service and safety standard expected of a modern international airport. Renovation and upgrading of the facility were required to meet the anticipated future demand for passenger and freight capacity and comply with international safety standards. Improvements to the airport were expected to attract more airlines to serve the airport and support a government objective to establish Lusaka as a regional hub.

The infrastructure investments at KKIA included a new terminal building, presidential terminal, air traffic control building and tower and a new airport hotel. The project also included the construction of a shopping centre and office buildings which are outside the airport security area. The design assumed that demand would increase from about 1 million passengers per annum in 2012 to 3.2 million passengers per annum in 2030 (China Jiangsu 2013). The construction works at KKIA were contracted to China Jiangsu International Economic and Technical Cooperation Group (CJIETC). The Contractor initiated the project, arranged the funding carried out the feasibility studies, and was responsible for the design of the facilities. Construction started in 2015 and the new terminal was officially opened in August 2021.

Ndola's airport was close to the central commercial area and had limited space for expansion to meet the increasing demand for air travel from Ndola and the wider Copperbelt area. The Government therefore decided to build a completely new facility at a site about 10 kilometres west of Ndola along the Ndola-Kitwe dual carriageway road. The new airport was designed to handle 1 million passengers per annum, which is the demand expected in about 2035 (China State Construction Engineering Corporation 2014).

The infrastructure investments at SMKIA included all facilities needed for the operation of an international airport including runway and taxiways, terminal building, fire station, air traffic control building and tower, instrument landing systems, offices, cargo facilities and water and power supplies. The development included a hotel within the airport grounds, but it was not complete at the time of this study. The construction works were contracted to China State Construction Engineering Corporation (CSCEC) under a design and build arrangement. The Contractor initiated the project, arranged the funding and carried out the feasibility studies. Construction started in 2017 and the airport was opened in August 2021.

7.2 Kenneth Kaunda International Airport (KKIA)

7.2.1 Facilities

The study team visited KKIA on 27th November 2024. The observations of the team included the following:

- The airport is generally well laid out and functional, providing for safe and efficient processing of passengers and a good passenger experience. The quality of workmanship on the civil and building works was good.
- The new terminal building is designed for 6 million passengers per year with the current traffic volume about 2 million passengers per year. During the peak period in the afternoon the airport is busy with several major airlines arriving at close intervals. At other times of the day, it is quiet. The airport is open 24 hours a day with flights after midnight.
- The terminal building appeared to have a lot of unused space, particularly offices, but airport staff mentioned that the space allowed for immigration counters was too small and becomes congested. The architectural design of the terminal building includes curved lines which added to the construction cost.
- The new terminal building incorporates a vehicle access ramp to allow passengers to be dropped off at first floor level (departures), avoiding conflict with the pickup of passengers arriving at the ground floor level. The vehicle access ramp (also referred to as a 'viaduct') is about 500 metres long with a construction cost of approximately $22.5 million.

- A new air traffic control facility was provided including a control tower and offices. The facility has not yet been commissioned because the Government must procure traffic control equipment costing about $30 million. Air traffic controllers are using the existing tower.
- The airport development included a new Fire and Emergency Control Centre which provides the high standard of emergency response demanded by international airlines. The facility gives the impression of being under-utilised but was a necessary part of the airport development.
- A new cargo terminal was built but was still not in use at the time of the visit. ZACL is planning to privatise the facility. Meanwhile existing private cargo operators at the airport have their own facilities.
- The development included a new VIP Pavilion. This large double storey structure is set apart from the terminal buildings with its own aircraft parking area. There is also a VIP section within the main terminal building. The building is seldom used and has high operating costs which are subsidized by other airport operations.
- A new 70-room hotel was built to the north of the new terminal parking area. It was unused until 2024 when an agreement was reached with an international hotel group to manage the facility (on behalf of ZACL). It allows airlines to easily accommodate passengers that are stranded due to delayed flights but is unlikely to see high occupancy rates in the short or medium term. Operation of the hotel will likely need to be subsidized from other airport operations, at least in the short and medium term. There is also a fifteen-room hotel inside the main terminal building which will be managed by the same international hotel group.
- A small shopping centre and office building were constructed on the approach road to the airport. The office building was intended for use by airport administration staff and was used by ZACL while the offices in the old terminal building were renovated. ZACL is now moving out of the building which will be available for commercial rental. The shopping centre has been converted for use as an aviation training centre.
- The old terminal building has been renovated for use as a domestic terminal. The changes include raised ceilings, improved surveillance, escalators and security areas. The offices within the old terminal building have been renovated for use by ZACL.

Figure 7-1: Kenneth Kaunda International Airport

Curved architectural design

New Air Traffic Control Building

Vehicle access ramp

New Emergency Control Centre

New cargo facility

Airport hotel

Renovated old terminal building

7.2.2 Investment costs

A breakdown of the capital investment costs of the KKIA development was provided by ZACL (see Annex 8). The breakdown is based on the budget for the construction contract, which included provision for “indirect” costs such as advance payments, geological survey and design. These items

have been pro-rated across the various components by the study team to obtain the approximate cost of each component of the project. The costs are listed in Table 7-1. The actual expenditure on each component would need to be provided by the Department of Public Infrastructure in the Ministry of Housing and Infrastructure Development, but the data provided by ZACL is sufficiently accurate for the current purposes.

Table 7-1: KKIA Investment Costs

Component	Investment cost (US$, nominal)
New Terminal	$170,647,293
Aircraft Area Movement	$75,367,391
Presidential Terminal	$23,373,408
Vehicle access ramp	$22,255,160
Airport Hotel	$19,235,339
Air Cargo Terminal	$15,007,591
Existing Terminal Modifications	$10,761,541
Airport Complex Building	$9,663,425
Car Parking	$4,392,466
ATC and Radar Tower and Equipment	$3,623,784
Emergency Services	$5,673,602
Total investment cost	$360,001,000

Source: ZACL

7.3 Simon Mwansa Kapwepwe International Airport (SMKIA)

7.3.1 Facilities

The study team visited SMKIA on 2nd December 2024. The following observations were made:

- The Terminal Building is impressive in its design and construction but appears over designed for the level of passenger traffic. The quality of the construction works was good.
- The vehicle access ramp allows passengers to be dropped off at first floor level (departures), avoiding conflict with the pickup of passengers arriving at the ground floor level.
- The Air Traffic Control (ATC) tower, offices and equipment were in use at the time of the visit and are a critical part of the investment.
- The new Air Cargo Facility was not in use at the time of the visit. There is, however, a need for cargo handling facilities at SMKIA.
- The VIP area includes three VIP lounges and a Commercially Important Person (CIP) waiting area. It is within the main airport terminal building adjacent to the main departure lounge.
- The Rescue and Fire Service (RFS) facilities and all equipment provide a Category 7 level of International Civil Aviation Organisation (ICAO) Rescue and Fire Fighting capability, which is a necessary requirement for operation of an international airport.
- The Instrument Landing Systems were relatively expensive due to a slope on the natural ground where the runway is located.
- The development of the greenfield site required the provision of all ancillary facilities and services such as electrical substations, water supply, sanitation and stormwater drainage.
- The installation of the airfield ground lighting was a significant part of the project, with two dedicated substations required to provide an uninterrupted power supply.
- The office building (Business Complex) provides facilities for management and administration of the airport.
- The airport hotel building was about 35% complete at the time of the visit, with no work currently in progress.

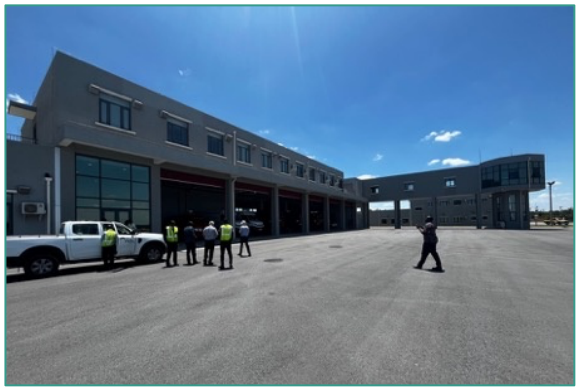
Figure 7-2: Simon Mwansa Kapwepwe International Airport

Entrance to SMKIA International Terminal

Check in counters

Vehicle access ramp

Air traffic control room



Fire and Rescue Service Building

Air cargo facility

Instrument Landing System

Business Complex Building

Electrical Substation

Airport hotel (incomplete)

7.3.2 Investment costs

A breakdown of the capital investment costs of the SMKIA development as provided by ZACL are included in Annex 8. The approximate cost of each principal component of the development after pro-rata of "indirect" costs are listed in Table 7-2.

Table 7-2: SMKIA investment costs

Component	Investment cost (US$, nominal)
New Terminal	$92,705,275
Aircraft Area Movement	$165,223,707
Vehicle access ramp	$23,022,063
Airport Hotel	$9,325,917
Air Cargo Terminal	$6,187,388
Airport Complex Building/Offices	$3,607,991
Car Parking	$2,057,188
ATC and Radar Tower and Equipment	$32,429,716
Emergency Services	$5,622,980
Roads	$35,738,097
Fuel farm	$12,511,921
Other[2]	$8,769,423
Total investment cost	**$397,201,665**

[2] "Other" includes the Aircraft Maintenance Hangar, Aerodrome Maintenance Office and Police station.

8 APPRAISAL OF AIRPORT INVESTMENTS

8.1 Cost Effectiveness of Airport Investments

8.1.1 Introduction and approach

The President of the Republic of Zambia has stated that, in his opinion, the upgrading of KKIA could have been carried out at a cost of $150 million[3]. This hypothesis has been tested in two ways:

1. By considering whether some components of the new airport could have been omitted from the development (or postponed to a later date) and other components modified in scope; but without significantly altering the scale of the investment.
2. By reviewing the cost of similar airport developments in other countries in the region, where a different approach to providing increased passenger capacity may have been adopted.

A similar analysis has been carried out for SMKIA. Possible savings have been identified on a component-by-component basis for SMKIA, but comparison with similar airport developments is limited as greenfield projects are rare in the region.

8.1.2 KKIA

The study team has identified components of the KKIA upgrading project that could have been omitted completely or deferred to a later date when traffic demand has increased, but without compromising the level of service and safety standards provided for passengers and cargo. The identified changes in scope would not have significantly altered the nature of the investment or the final outcome.

The possible cost savings are summarised in the table below. By omitting some components of the project and reducing the scope of others, the total investment cost could have been reduced by about 35% from $360 million to about $236 million.

This analysis does not consider the option of a significant difference in scope and approach to the development. Such options could include, for example, extending the existing terminal building rather than building a completely new facility. Such options are considered in Section 8.1.4.

Table 8-1: Areas for cost savings in the KKIA development

Component	Possible design modifications	Potential Investment Cost Saving
New Terminal	More functional design with less reliance on the curved façade.	20%
Aircraft Area Movement	Necessary part of the development.	0%
Presidential Terminal	Unnecessary part of the development.	100%
Vehicle access ramp	The terminal could have been designed for passenger drop off at ground level with escalators and elevators to carry passengers to the first-floor check-in area.	100%
Airport Hotel	Publicly managed airports operating commercial hotels risk market distortion, reduce competitive neutrality, divert infrastructure resources, and may underperform due to limited expertise in hospitality management	100%
Air Cargo Terminal	Provide only serviced sites for development by private cargo handling companies.	80%
Existing Terminal Modifications	Necessary part of the development.	0%
Airport Complex Building	Omit from the development.	100%
Car park	Necessary part of the development.	0%
ATC and Radar Tower and Equipment	Defer to a later date.	100%
Emergency Services	Necessary part of the development.	0%
	Total potential saving	$124,286648
	Revised investment cost	$235,714,352

Source: Original Costs (ZACL), Savings (researcher's estimates)

[3] https://diggers.news/opinion/2023/08/15/the-kkia-sausage-shape-is-not-a-problem-but-an-audit-is-necessary/

8.1.3 SMKIA

Most of the investment costs for SMKIA were necessary because it is a greenfield site and the airport is required to serve airlines operating on international routes. However, some reductions in scope have been identified that would have resulted in savings to the Government.

The cost savings that could have been considered in the development of SMKIA are summarised in Table 8-2. By omitting some components of the project and reducing the scope of others, the total investment cost could have been reduced by about 15% from $397 million to about $340 million.

Table 8-2: Areas for cost savings in the SMKIA development

Component	Possible design modifications	Possible saving in initial investment cost
New Terminal	Given that land was not a constraint and therefore a single storey structure would have been cheaper.	20%
Aircraft Area Movement	Necessary part of the development.	0
Vehicle access ramp	A single storey structure for the terminal building or the use of elevators and escalators would have avoided the need for the ramp.	100%
Airport Hotel	Could have been deferred to a later date when demand has increased and the hotel development led by the private sector.	100%
Air Cargo Terminal	A smaller investment by ZACL may have been possible to provide only a serviced area for a private sector led development.	80%
Airport Complex Building/Offices	A smaller facility would have been sufficient for foreseeable requirements.	20%
Carpark	Necessary part of the development.	0%
ATC and Radar Tower and Equipment	Necessary part of the development.	0%
Emergency services	Necessary part of the development.	0%
Roads	Necessary part of the development.	0%
Fuel farm	Necessary part of the development.	0%
Other	Necessary part of the development.	0%
	Total potential saving	$56,560,544
	Revised investment cost	$340,641,121

8.1.4 Case studies of similar developments in the region

Economic development in most African countries in recent years has led to increased air travel and the need to upgrade airport facilities. Precise data on airport investments is difficult to obtain and all airport developments are different, but a broad perspective on comparative costs can be established in relation to the designed passenger capacity. The range of costs to achieve a similar objective is surprisingly large, as indicated in Table 8-3.

Table 8-3: Comparative costs of similar airport developments in the region

Airport	Passenger capacity (millions per annum)		Components of the development	Funding[4]	Completion date	Investment cost USD	Cost per increase in passenger capacity ($/passenger)
	Before	After					
KKIA Zambia	2.0	6.0	New terminal building, Aircraft parking areas, New ATC and emergency services, Presidential Pavilion, Renovation of existing terminal for domestic flights, New carpark, Airport hotel	China Eximbank (loan)	2021	$360 million	$90
SMKIA Zambia	Nil	1.0	Greenfield development, Runway, taxiways, aprons, Terminal building, ATC and emergency services, Administration building, Hotel (incomplete)	China Eximbank (loan)	2021	$397 million	$397
Julius Nyerere International Airport, Dar es Salaam	2.0	8.0[5]	New terminal building, Taxiways, aprons, air bridges, Access roads and carpark.	Netherlands (grant)	2021	$314 million[6]	$52
Robert Gabriel Mugabe International Airport, Harare	2.5	6.0[7]	Expansion of the terminal building with the construction of new departures and arrivals buildings, New aprons and four new air bridges, Renovation of air traffic control systems, runway and taxiways, Airfield ground lighting, New fire station, VIP pavilion	China Eximbank (loan)	2023	$153 million[8]	$44
Abeid Amani Karume International Airport Zanzibar	0.6	2.1[9]	New Terminal 3 building, New apron.	China Eximbank (loan)	2020	$99 million[10]	$66
Kilimanjaro International Airport, Tanzania	0.6	1.2[11]	Renovation and expansion of the terminal building. New 1.1 km parallel taxiway, Expansion of existing taxiways and apron, New airfield ground lighting.	Netherlands (grant) and commercial financing	2017	$40 million[12]	$67
Kamuzu International Airport Lilongwe	0.3	0.6[13]	Expansion of the terminal building with the construction of new departures and arrivals buildings, New aircraft surveillance system.	Japan (grant)	2019	$30 million	$100

[4] In addition to Government contributions.
[5] Comprising Terminal 1- 0.5 million, Terminal 2 - 1.5 million and the new Terminal 3 - 6.0 million.
[6] Source: https://aviationweek.com/air-transport/airports-networks/gallery-dar-es-salaam-julius-nyerere-international-airport-terminal
[7] Source: https://www.acz.co.zw/airports/tour/robert-gabriel-mugabe-international-airport
[8] Source: https://www.globaltimes.cn/page/202307/1294435.shtml#:~:text=Starting%20in%202018%2C%20the%20expansion,and%20another%20monument%20of%20friendship.%22
[9] Source: https://lca.logcluster.org/print-preview/1675
[10] Source: Aid Data https://china.aiddata.org/projects/33736/
[11] Source: https://ejatlas.org/conflict/kilimanjaro-international-airport
[12] Source: https://www.airport-technology.com/projects/kilimanjaro-international-airport-kia/
[13] https://archive.times.mw/index.php/2017/02/15/kamuzu-international-airport-capacity-to-increase-by-250000/

8.1.5 Conclusion

The analysis of airport investment costs shows that the KKIA investment was broadly similar to, and SMKIA investment was significantly more expensive than, developments at similar regional airports in terms of the cost of increased passenger capacity. SMKIA was expected to be a more expensive development than the expansion of existing facilities at the other airports due to the greenfield site, but it is evident that more cost-effective solutions could have been considered by the developers.

A reduction in the cost of the KKIA project to $254 million, as suggested in Table 8-1 would have resulted in a reduction in the cost per passenger to $60. This is comparable with the cost of the Abeid Amani Karume International Airport in Zanzibar, but that is a much smaller airport with a capacity of only 2.1 million passengers per annum after the upgrading.

8.2 Ex-Ante Economic Appraisal

The summary ex-ante economic appraisal of the airport projects are presented in Table 8-4. With respect to the KKIA, the feasibility report inaccurately characterises what is fundamentally a financial appraisal as an economic appraisal. A financial appraisal typically assesses the viability of a project from the perspective of cash flows, focusing on revenues, costs, interest rates, and financial sustainability, often from the perspective of a private investor or the implementing agency. In contrast, an economic appraisal evaluates a project's broader impact on national welfare by incorporating non-market benefits and costs, externalities, and using a social discount rate rather than market interest rates. This misclassification suggests a conceptual misunderstanding of the appraisal framework and limits the utility of the report in informing public investment decisions. As this research is concerned with assessing economic efficiency and value for money from a societal standpoint, a detailed critique of the financial appraisal's assumptions and inputs—such as revenue projections, interest rates, and financing structures—falls outside the scope of this study. However it should be noted that the financial appraisal was inaccurate given that the projected number of passengers at both airports was substantially over-estimated (see Figure 8-1, below)

Regarding the Ndola Airport project, the appraisal estimates an Internal Rate of Return of 14 percent and a Net Present Value of $41.2 million (2013 prices), based on a 25 year appraisal period consisting of a 4 year construction phase followed by 21 years of operation. The analysis applies a discount rate of 8% and a total capital expenditure of $397 million. The appraisal adopts a relatively basic level of complexity, with assumptions such as average passenger time savings of 4 hours per passenger trip valued at $12 per hour (a total time savings of $48 per passenger trip), and freight time savings valued at $80 per tonne. Although a separate financial appraisal is included, it appears that revenue streams have also been incorporated into the economic appraisal. This blending of financial and economic perspectives introduces concerns around methodological consistency. In principle, economic appraisals should evaluate a project's contribution to societal welfare, excluding revenues as they are considered transfer payments rather than net economic benefits. The inclusion of revenues in the economic assessment may result in an overstatement of the project's overall economic value.

Table 8-4: Summary Ex-Ante Economic Appraisal of the KKIA and SMKIA Airports

Airport	Economic Analysis	Comments
KKIA	No economic analysis conducted	The report mislabels a financial appraisal as an economic one, reflecting a conceptual error. Since financial appraisals focus on revenues and costs from an investor's perspective, assessing their assumptions is beyond this study's scope.
SMKIA	IRR = 14.0 % NPV = 41.2 million (2013 prices)	Appraisal period 25 years (4 years construction period + 21 years of operation). Discount rate of 8%. CAPEX = $397 million. Basic level of complexity with average time saved to be 4 hours per passenger with an average value of time of $12 / hour. The value of freight transport time is estimated at $80 / tonne. Although a separate financial appraisal is conducted it appears that revenues have also been included in the economic appraisal.

Source: KKIA (The Designing and Construction of the Infrastructure Upgrade at Kenneth Kuanda International Airport, Feasibility Report, July 2013), SMKIA (Ndola International Airport Construction Project in Zambia, Feasibility Study Report, China Airport Construction Group Corporation of CAAC, September 2012).

8.3 Ex-Post Economic Appraisal

An economic appraisal has been conducted of the KKIA and SMKIA based on anecdotal information that the research team received from ZACL regarding some of the benefits to airport customers including:

- Capacity had already been reached for KKIA and the expansion has allowed for additional passengers who would otherwise not have been able to use the airport.
- With respect to the SMKIA, due to expected changes in global regulations, the existing airport at Ndola could not have continued operating as an international airport and therefore in the counterfactual, international bound passengers would have needed to travel from/to KKIA, thereby incurring greater costs.
- The new airports reduced the likelihood and impact of delays (reduced waiting time for planes queueing to land, choking to clearance time, etc.) with the resultant value of travel time savings (VTTS).

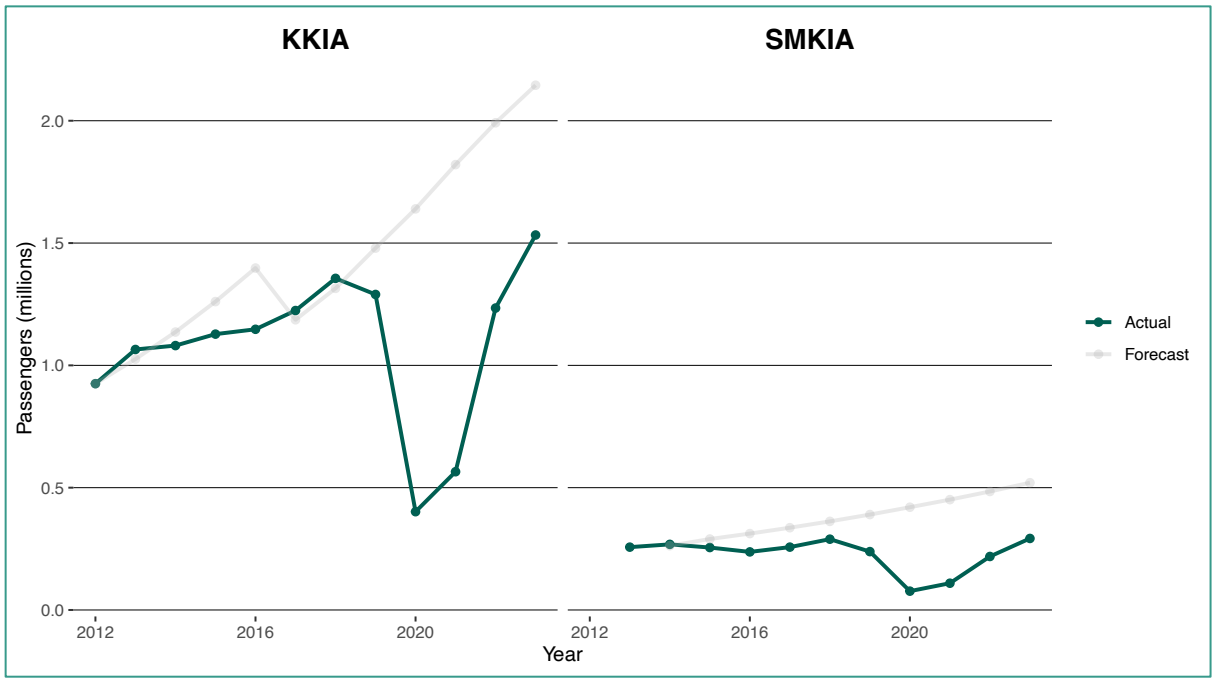
It should be noted that the research team was unable to verify the accuracy of the above statements. Nevertheless, in the absence of an alternative ex-ante situational assessment, these statements have been adopted as parameters for the operational assumptions.

The assumptions for the economic analysis are based on actual traffic (see Figure 8-1) and forecast traffic which is estimated using exogenous variables (see Figure 2-1). There are no reliable data to verify the assumed time and cost savings and the analysis is reliant on ZACL's professional observations. Whilst there is no reason to question the accuracy of such observations, the absence of actual data should caution any expectation regarding the confidence of the estimated CBA.

8.3.1 Airport Passenger Data

The Zambia Airports Corporation Limited (ZACL) has provided actual airport passenger numbers for 2012 – 2023 and presented them in Figure 8-1, below. Forecast passenger values from the Kenneth Kaunda International Airport (KKIA, Lusaka) and Simon Mwansa Kapwepwe International Airport (SMKIA – Ndola) Feasibility Studies have been added for comparison. For KKIA the forecast traffic was similar to actual traffic until 2018. As expected, the Covid pandemic resulted in a divergence and so far, traffic has not fully recovered and the number of passengers is slightly over 1.5 million per annum. For SMKIA, traffic has not recovered from the Covid pandemic and the number of passengers is approximately 0.3 million per annum. The forecast traffic as per the Feasibility Report, 2014, was consistently overestimated.

Figure 8-1: Airport Passenger Numbers (2012 – 2023), Actual vs (Ex-Ante) Forecast



Source: Actual (ZACL), Forecast (Feasibility Study, 2013 [KKIA], Feasibility Study, 2014 [SMKIA])

8.3.2 Regression Modelling

To estimate the elasticity of air traffic with respect to exogenous macroeconomic indicators, four distinct double-log linear regression models were specified. The dependent variable in each model captured passenger volumes disaggregated by airport (KKIA, SMKIA) and passenger segment (domestic, international). The sole explanatory variable across all specifications was Gross Domestic Product (GDP), with domestic traffic regressed against Zambian GDP, international traffic at KKIA against global GDP, and international traffic at SMKIA against regional GDP for Eastern and Southern Africa.

The elasticity estimates highlight meaningful differences in how passenger traffic at KKIA and SMKIA responds to changes in GDP. For domestic passengers, the elasticity at KKIA is estimated at 0.85, suggesting that a 1% increase in Zambia's GDP is associated with a 0.85% increase in domestic passenger volumes. At SMKIA, the elasticity is lower, at 0.55, indicating a more muted response of domestic traffic to national economic activity. This contrast may reflect KKIA's broader route network, higher traffic base, and greater integration into the national economy, while SMKIA's domestic market appears less responsive, possibly due to limited-service offerings or a narrower economic catchment.

International passenger traffic is considerably more elastic at both airports, with KKIA registering a GDP elasticity of 1.87 and SMKIA reaching 2.97. These values imply that international traffic is highly sensitive to changes in external economic conditions. In the case of KKIA, international passenger volumes increase by approximately 1.87% for every 1% increase in global GDP, whereas SMKIA exhibits an even stronger relationship with regional GDP, with nearly a 3% increase in international passengers for every 1% rise in regional output. The elevated elasticity at SMKIA may reflect a greater dependence on discretionary or growth-sensitive international travel, such as tourism and cross-border commerce within the Southern and Eastern African region. All four elasticity estimates are statistically significant at the p = 0.01 level, as indicated by their high t-values, ranging from 7.15 to 19.51. This confirms a very low probability that the observed relationships between GDP and passenger volumes are due to random chance.

The adjusted R-squared values, which measure the proportion of variation in the dependent variable explained by the model (adjusted for degrees of freedom), are also relatively high. For international traffic, the adjusted R^2 exceeds 0.91 in both KKIA and SMKIA, indicating an excellent model fit. This implies that a large share of the variation in international passenger volumes is explained by movements in GDP. The adjusted R^2 values for domestic traffic are lower, 0.86 at KKIA and 0.67 at SMKIA, but still suggest a moderate to strong relationship, especially at KKIA. These results support the overall robustness of the elasticity estimates while also highlighting the relatively greater predictability of international traffic volumes compared to domestic ones.

Table 8-5:Double Log Model to Estimate Elasticity of Passenger Demand to GDP

Dependant Variable	Regressor	Elasticity estimate	std. error	t-value	Adj. R^2
$KKIA_{DOM}$	GDP (Zambia)	0.84982	0.06458	13.16***	0.8558
$KKIA_{INT}$	GDP (global)	1.8660	0.1023	18.25***	0.9197
$SMKIA_{DOM}$	GDP (Zambia)	0.54551	0.07633	7.146	0.667
$SMKIA_{INT}$	GDP (regional)	2.9718	0.1523	19.51	0.9382

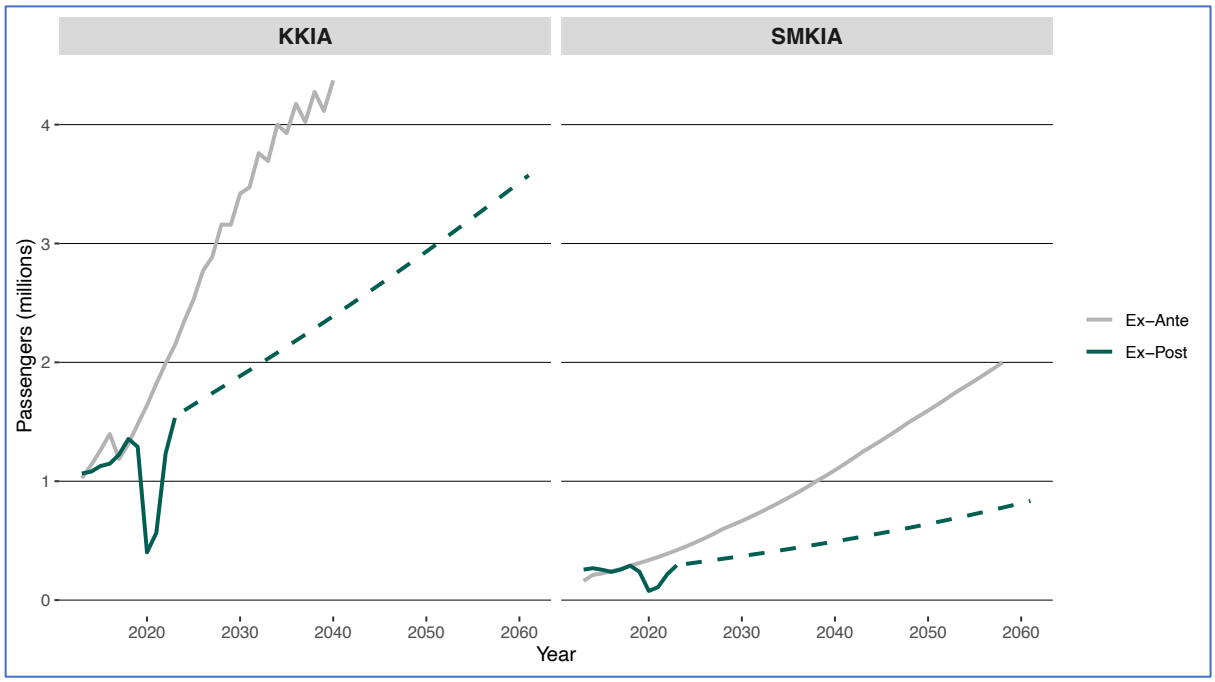
**** = significance at 0.01, ** = significance at 0.05, * = significance at 001, Model form: $ln(Y) = ß_1 ln(GDP)$*
Source: Researcher's estimates

8.3.3 Forecast Passenger Traffic

Utilising the elasticity estimates detailed in Table 8-5 in conjunction with the macroeconomic indicators illustrated in Figure 2-1, updated passenger volume projections have been generated for the period from 2024 onward. For the years 2013 through 2023, actual passenger data has been incorporated to replace previous estimates, thereby enhancing forecast accuracy for both KKIA and SMKIA airports. The resulting ex-post forecasts, alongside the original ex-ante projections, are depicted in Figure 8-2.

A comparative analysis reveals that, for both KKIA and SMKIA, ex-post forecasts consistently indicate lower passenger traffic than the earlier ex-ante projections. Specifically, for KKIA, the ex-post forecast estimates passenger throughput of approximately 3.6 million in 2061, contrasting with an ex-ante forecast of 4.3 million in 2040. Similarly, for SMKIA, the ex-post forecast projects 830,000 passengers in 2061, substantially below the ex-ante forecast of 2.0 million for the same year.

Figure 8-2: Airport Passenger Numbers (2013 – 2061), Ex-Ante vs Ex-Post



Source: Ex-Ante Forecast (Feasibility Study, 2013 [KKIA], Feasibility Study, 2014 [SMKIA]), Ex-Post Forecast (Researcher's estimates), Actual (ZACL)

8.3.4 Summary Economic Results

The following are the benefits streams for estimating the economic impact of the airports.

- Clearance times: reduced the likelihood and impact of delays (reduced waiting time for planes queueing to land, choking to clearance time, etc.).
- Journey ambience: it is clear from the site visits that the new airports offer passengers an enhanced journey experience, with less crowding, more comfortable and available seating areas, more aesthetic surroundings and improved passenger information systems. It has been assumed that the disutility of wait time is reduced by approximately 30%.
- Accessibility Savings: this benefit stream is only relevant for domestic airport travel such that demand beyond capacity is not able to use the airport and has to travel to the intended destination using other modes of transport.
- Avoided foregone trips: this benefit is only relevant for international travel such that demand beyond capacity is unable to use the airport and the trip is foregone. The value of foregone trip is based on the destination and ticket prices for routes serving the airport.

The ex-post economic evaluation of the KKIA and SMKIA infrastructure projects, as presented in Table 8-6, reveals a marked divergence in realised performance. KKIA demonstrates strong ex-post viability, with an IRR of 13.1%, above the assumed social discount rate, indicating that the project is on track to deliver economic returns exceeding the opportunity cost of capital. Its real NPV of $152 million confirms that the project is expected to generate positive net economic benefits and contribute meaningfully to social welfare.

In contrast, SMKIA's actual passenger throughput and revised forecasts from 2024 onward point to economic underperformance. The IRR of 4.7%, significantly below the 12% benchmark, combined with a large negative NPV of -$490 million, reflects a substantial net economic loss. On this basis, KKIA appears to have been economically justified, whereas SMKIA fails to meet economic viability thresholds. Absent compelling strategic, political, or non-monetised social benefits not captured in this analysis, the economic rationale for SMKIA's implementation appears weak in hindsight.

It is worth noting that the NPV for both airport projects could have been higher had certain unnecessary expenditures been avoided (see Section 8.1.2 for KKIA, and Section 8.1.3 for SMKIA), suggesting room for greater cost optimisation in future projects.

Table 8-6: Summary Economic Indicators (Airport Projects 2010 – 2020)

Project	Contract Value (nominal)	Contract Value (Real, 2023)	IRR	NPV	BCR
KKIA	360.00	442.85	13.1%	151.6	1.21
SMKIA	397.20	472.69	4.7%	-489.7	0.24

Source: Researcher's estimate

9 SUMMARY AND CONCLUSIONS

9.1 Overall Assessment of the Economic Analysis and its Limitations

This research has largely succeeded in addressing the core research questions.

An individual evaluation of the 27 road infrastructure projects reveals that ten, alongside the Kenneth Kaunda International Airport (KKIA) upgrade, are projected to generate positive net economic returns, with estimated Net Present Values (NPVs) exceeding zero. Conversely, the remaining 17 road projects, as well as the construction of the new Simon Mwansa Kapwepwe International Airport (SMKIA), are expected to yield negative economic returns, as indicated by negative NPVs.

When analysed in aggregate, the collective investment in all 27 road projects and the two airport projects is projected to deliver a marginally positive economic return, with a combined real NPV (2023 prices) of approximately $600 million. However, the following two critical economic principles warrant consideration.

- **Opportunity Cost and Budgetary Trade-offs**: Evaluating project viability in isolation is insufficient without accounting for the opportunity cost of capital allocation. While definitive attribution is challenging, the substantial decline in road maintenance expenditure between 2010 and 2020 provides compelling evidence that maintenance was likely deprioritised to accommodate large-scale capital upgrades. This reallocation of fiscal resources likely contributed to the deterioration of the overall road network, with adverse macroeconomic implications due to reduced transport efficiency and asset longevity.
- **Inefficiency of Cross-Subsidisation**: From a public investment efficiency perspective, high-performing projects should not be used to offset or justify the inclusion of low-return or economically unviable projects. The bundling of economically inefficient projects, such as SMKIA and the 17 road projects with negative NPVs, within the broader investment portfolio dilutes overall economic returns. Excluding these poorly performing projects from the investment program would have resulted in a significantly higher return on public capital.

In light of the opportunity cost of diverted maintenance expenditure and the inefficiencies arising from the inclusion of economically unviable projects, this analysis concludes that the transport expansion programme is expected to generate a cumulative net economic loss, with an estimated Net Present Value (NPV) of $6.7 billion over the appraisal period 2010–2061. The appraisal horizon reflects the full lifecycle of the investments, extending approximately 20 years beyond completion for the road projects and up to 60 years for the airport projects, in line with their respective economic lifespans

While the economic findings, both at the aggregate and project levels, are based on sound methodology, they rely heavily on secondary data, particularly traffic counts. For the airport analysis, the appraisal was informed by qualitative assessments from ZACL executives and project managers regarding operational conditions before and after the interventions.

As such, although the appraisal can be considered objective and systematic, it lacks the precision required for use in ex-ante funding decisions. Readers are therefore advised to exercise caution and apply appropriate discretion when interpreting and using these results, depending on their intended purpose

9.2 Ex-Ante Economic Appraisal of Roads Projects

After a concerted period of data collection, the researchers obtained nine design or feasibility studies for the 27 selected road projects. However, seven of these included any form of cost-benefit analysis, representing just 28% of the total CAPEX value. A key finding of the research is that economic appraisals were not consistently conducted. Nonetheless, (with the notable exception of Sesheke – Senanga) where ex-ante appraisals were undertaken, despite variations in frameworks, such as differing benefit streams, discount rates, and appraisal periods, the results were generally consistent with ex-post analyses. This suggests that ex-ante economic appraisals provide a reasonably accurate estimate of economic returns, likely because some essential data parameters (such as traffic counts, users, vehicle operating costs, roughness etc) influencing economic performance were at least collected and analysed in a scientific manner.

Table 9-1: Ex-Ante versus Ex-Post Economic Analysis

Project	Ex-Ante					Ex-Post				
	CAPEX	r	years	IRR	BCR	CAPEX (2023, real)	r	years	IRR	BCR
Kazungula Bridge	$259.3 (2011)	12%	30	23%	1.21	$375.7	12%	20	16.1%	1.61
Kitwe - Chingola	$141.0 (2009)	10%	20	10.2%	2.83	$170.2	12%	20	17.5%	2.29
Lusaka Decongestion Project	$56.8 (2009)	12%	20	23%	n/a	$344.53	12%	20	21.4%	2.23
Mufuchani Bridge	$8.0 (2009)	10%	20	14.1%	n/a	$10.8	12%	20	17.3%	1.44
Sesheke - Senanga Road (Lot 1)	$132.7	12%	25	11.5%	n/a	$72.1	12%	20	3.7%	0.29
Sesheke - Senanga Road (Lot 2)						$65.8	12%	20	2.5%	0.25
Sesheke - Senanga Road (Lot 3)						$55.2	12%	20	3.8%	0.30

Source: Ex-Ante (specific project design / feasibility reports), Ex-Post (Researcher's estimates)

9.3 Ex-Post Economic Appraisal of Roads Projects

The table below summarises the outcomes of the road projects. The dataset presents the updated ex-post economic performance of various road and bridge infrastructure projects across Zambia, assessed in real 2023 currency values. Each project is evaluated in terms of its length (where applicable), contract value (both nominal and real), unit cost, Internal Rate of Return (IRR), Net Present Value (NPV), and Benefit-Cost Ratio (BCR).

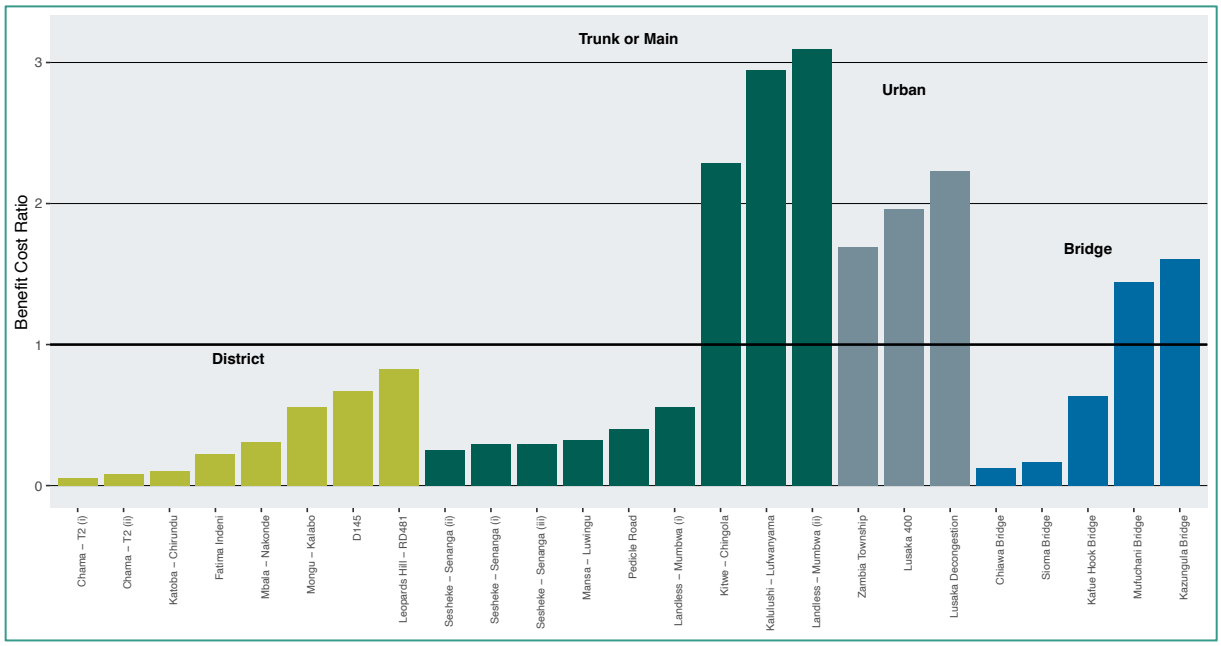
Table 9-2: Summary Economic Indicators (Roads Projects 2010 – 2020)

Project	Km	Contract Value ($ millions, Nominal)	Contract Value ($ millions, Real, 2023)	Unit Cost $million/km (Real, 2023)	IRR	NPV	BCR
Chama - T2 (Lot 1)	30.0	29.81	39.31	1.3	-2.0%	-59.4	0.05
Chama - T2 (Lot 2)	47.0	24.09	34.80	0.7	-1.6%	-87.1	0.08
Chiawa Bridge Construction	0.1	9.69	14.31	102.2	-0.7%	-37.7	0.12
D145 (T4 - Feira)	91.0	42.56	61.17	0.7	8.4%	-52.9	0.67
Fatima Indeni Road	14.6	8.97	12.95	0.9	1.6%	-27.2	0.23
Kafue Hook Bridge	0.3	17.45	23.09	85.5	7.9%	-13.5	0.64
Kalulushi - Lufwanyama	60.0	10.53	14.01	0.2	22.2%	45.1	2.95
Katoba - Chirundu	10.0	23.73	31.70	3.2	-1.1%	-55.9	0.10
Kazungula Bridge	0.9	274.48	375.70	407.0	16.1%	449.1	1.61
Kitwe - Chingola Dual Carriageway	45.5	117.53	170.22	3.7	17.5%	435.0	2.29
Landless Corner - Mumbwa (Lot 1)	30.6	9.87	14.63	0.5	6.2%	-26.1	0.56
Landless Corner - Mumbwa (Lot 2)	54.4	8.00	9.92	0.2	27.1%	27.9	3.10
Leopards Hill Road to Jct RD481	58.5	92.92	137.59	2.4	10.2%	-71.3	0.83
Lusaka Decongestion Project	95.7	289.11	344.53	3.6	21.4%	573.7	2.23
Lusaka 400 (Phase 1)	357.6	348.29	445.65	1.2	18.6%	912.4	1.96
Lusaka 400 (Phase 2)	172.8	241.18	290.68	1.7	19.0%	398.7	1.96
Lusaka 400 (Phase 3)	136.0	241.11	274.80	2.0	19.0%	300.5	1.96
Mansa - Luwingu Road	205.0	284.13	399.83	2.0	4.7%	-540.4	0.32
Mbala - Nakonde	171.9	180.00	233.38	1.4	3.3%	-449.1	0.31
Mongu – Kalabo	35.0	286.94	374.42	10.7	7.4%	-483.5	0.56
Mufuchani Bridge	0.2	7.73	10.83	67.7	17.3%	12.1	1.44
Pedicle Road	61.2	30.22	45.98	0.8	6.8%	-54.8	0.40
Sesheke - Senanga Road (Lot 1)	85.0	48.51	72.07	0.8	3.7%	-166.0	0.29
Sesheke - Senanga Road (Lot 2)	70.0	44.18	65.78	0.9	2.5%	-176.5	0.25
Sesheke - Senanga Road (Lot 3)	66.0	37.13	55.15	0.8	3.8%	-126.4	0.30
Sioma Bridge	0.3	20.39	29.31	116.3	-0.1%	-65.7	0.16
Zambia Township Roads	160.0	232.23	273.92	1.7	17.4%	277.8	1.69

Source: Researcher's estimates

District road projects consistently exhibit BCRs below 1, raising critical concerns about the economic justification for paving roads in low-demand, rural areas. These results underscore the need for scrutiny before committing to costly upgrades in districts with limited traffic volumes or economic activity. In contrast, trunk or main roads display a wide range of BCRs, reflecting the variation in demand, connectivity benefits, and implementation efficiency across corridors. Bridge projects similarly show mixed performance, likely influenced by localised factors such as strategic importance and construction cost intensity. Urban infrastructure projects, on the other hand, uniformly demonstrate positive economic returns, largely attributable to higher population densities, greater traffic volumes, and improved accessibility benefits, characteristics that typically enhance the economic viability of urban transport investments.

Figure 9-1: Benefit Cost Ratio (Roads Projects 2010 – 2020)



Source: Researcher's estimates

At an aggregate level, the overall portfolio is expected to produce a moderately positive outcome, with $3.87 billion in 2023 spending and a combined NPV of $0.93 billion (BCR of 1.12). While this suggests positive returns, the analysis excludes opportunity costs. As noted in Section 6.6, greater investment in maintenance would have delivered higher returns, indicating capital expansion may not have been the most efficient use of funds. This is further expanded in Section 9.7.

Table 9-3: Economic Analysis of the Roads Sector Investments, Years 2010 - 2020

Indicator	Value
Total CAPEX (nominal)	$2,961 million
Total CAPEX (real, 2023 prices)	$3,856 million
NPV CAPEX ($, 2023)	$8,017 million
NPV of Road Projects	+$939 million
BCR of Road Projects	1.12
IRR of Road Projects	12.9%

Source: Researcher's estimates

9.4 Ex-Ante Economic Appraisal of Airport Projects

The KKIA feasibility report incorrectly labels a financial appraisal as an economic appraisal, reflecting a misunderstanding of appraisal frameworks and limiting its usefulness for public investment decisions. Financial appraisals focus on cash flows and investor returns, while economic appraisals assess broader societal impacts. For the Ndola Airport, the economic appraisal estimated a 14% IRR and a $41.2 million NPV (2013 prices) over 25 years but blends financial and economic elements by including revenue streams. This methodological inconsistency risks overstating the project's true economic value, as economic appraisals should exclude revenues, which are transfer payments rather than net benefits.

A major finding of the research is that no fit-for-purpose ex-ante economic appraisals were conducted for either KKIA or SMKIA. This may be because ZACL is less familiar (vis-à-vis RDA) with welfare economics principles, and instead evaluates projects primarily from a commercial perspective.

Table 9-4: Summary Ex-Ante Economic Appraisal of the KKIA and SMKIA Airports

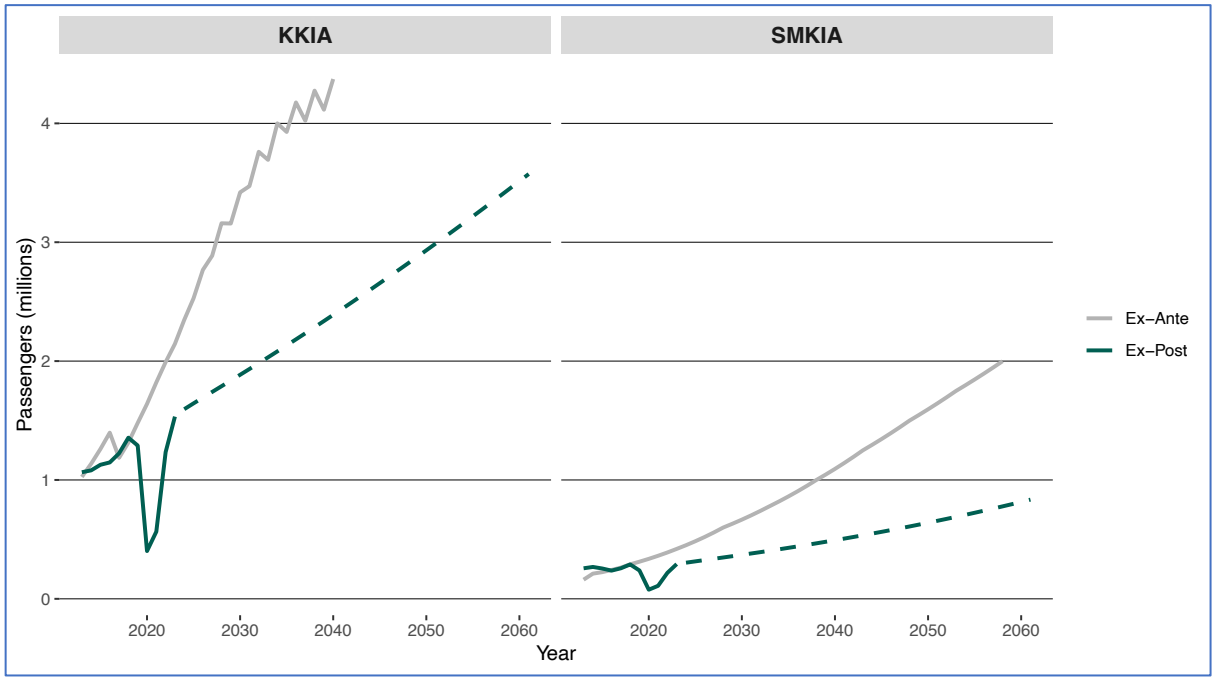
Airport	Economic Analysis	Comments
KKIA	No economic analysis conducted	The report mislabels a financial appraisal as an economic one, reflecting a conceptual error.
SMKIA	IRR = 14.0 % NPV = 41.2 million (2013 prices)	Appraisal period 25 years (4 years construction period + 21 years of operation). Discount rate of 8%. CAPEX = $397 million. Basic level of complexity with average time saved to be 4 hours per passenger with an average value of time of $12 / hour. Although a separate financial appraisal is conducted it appears that revenues have also been included in the economic appraisal.

Source: KKIA (The Designing and Construction of the Infrastructure Upgrade at Kenneth Kuanda International Airport, Feasibility Report, July 2013), SMKIA (Ndola International Airport Construction Project in Zambia, Feasibility Study Report, China Airport Construction Group Corporation of CAAC, September 2012).

9.5 Ex-Post Economic Appraisal of Airport Projects

It can be confirmed that the ex-ante forecasts for the period 2013 – 2023 turned out to be substantially over-estimated (see Figure 8-1). Therefore, passenger forecasts were revised in the Ex-Post analysis using updated elasticity estimates and actual passenger data from 2013–2023. Revised passenger volume forecasts for KKIA and SMKIA show consistently lower traffic than original ex-ante projections. For example, KKIA's ex-post forecast projects 3.6 million passengers by 2061, compared to the ex-ante estimate of 4.3 million by 2040. SMKIA's ex-post forecast is 830,000 passengers in 2061, significantly below the ex-ante forecast of 2 million. It is important to highlight that the feasibility studies, including traffic forecasts, were undertaken by the contractor, presenting a potential conflict of interest. This represents a significant finding. Going forward, feasibility assessments should be conducted by independent consultants who are operationally and institutionally separate from contractors and decision-makers to ensure objectivity and credibility in project appraisal

Figure 9-2: Airport Passenger Numbers (2013 – 2061), Ex-Ante vs Ex-Post



Source: Ex-Ante Forecast (Feasibility Study, 2013 [KKIA], Feasibility Study, 2014 [SMKIA]), Ex-Post Forecast (Researcher's estimates), Actual (ZACL)

The ex-post evaluation shows KKIA is economically viable with a 13.1% IRR and a positive NPV of $152 million, indicating strong returns above the social discount rate. Conversely, SMKIA underperforms, with a 4.7% IRR and a negative NPV of -$490 million, reflecting significant economic loss. KKIA is justified economically, while SMKIA lacks clear economic viability unless supported by non-monetised benefits.

Table 9-5: Summary Economic Indicators (Airport Projects 2010 – 2020)

Project	Contract Value (nominal)	Contract Value (Real, 2023)	IRR	NPV	BCR
KKIA	360.00	442.85	13.1%	151.6	1.21
SMKIA	397.20	472.69	4.7%	-489.7	0.24

Source: Researcher's estimate

9.6 The Claim that KKIA Could Have Been Upgraded for $150 Million

It has been claimed that KKIA could have been upgraded for $150 million (nominal prices) instead of the $360 million (nominal prices). This reflects a reduction of $210 million (nominal prices) or 58%. To assess this, the researchers conducted a Cost Effectiveness Analysis identifying parts of the upgrade that could be deferred or omitted without impacting service or safety, potentially reducing costs by about 35%, from $360 million (nominal prices) to $236 million (nominal prices).

Therefore, the researchers acknowledge that KKIA could have been upgraded for significantly less, but not to the extent of the claimed reduction.

Table 9-6: Areas for cost savings in the KKIA development

Component	Possible design modifications	Potential Investment Cost Saving
New Terminal	More functional design with less reliance on the curved façade.	20%
Aircraft Area Movement	Necessary part of the development.	0%
Presidential Terminal	Unnecessary part of the development.	100%
Vehicle access ramp	The terminal could have been designed for passenger drop off at ground level with escalators and elevators to carry passengers to the first-floor check-in area.	100%
Airport Hotel	Publicly managed airports operating commercial hotels risk market distortion, reduce competitive neutrality, divert infrastructure resources, and may underperform due to limited expertise in hospitality management	100%
Air Cargo Terminal	Provide only serviced sites for development by private cargo handling companies.	80%
Existing Terminal Modifications	Necessary part of the development.	0%
Airport Complex Building	Omit from the development.	100%
Car park	Necessary part of the development.	0%
ATC and Radar Tower and Equipment	Defer to a later date.	100%
Emergency Services	Necessary part of the development.	0%
	Total potential saving	$124,286648
	Revised investment cost	$235,714,352

Source: Original Costs (ZACL), Savings (researcher's estimates)

9.7 The Impact of the Overall Transport Infrastructure Programme on Zambia's Economy

Between 2010 and 2020, annual expenditure on road maintenance in Zambia averaged approximately US$106 million (in 2023 prices). Maintenance spending declined sharply over the decade, from about US$200 million per year between 2010 and 2014 to only US$50 million annually between 2014 and 2020.

In contrast, capital expenditure on road upgrades during the same period totalled at least US$3.85 billion (2023 prices), reflecting a pronounced fiscal shift away from routine and periodic maintenance toward capital-intensive network upgrade.

Based on available loan and financial data, approximately US$2.83 billion (2023 prices) of this amount was financed through external borrowing, complemented by an estimated US$1.08 billion (2023 prices) in Eurobond proceeds allocated to the road sector. Although the precise disbursement of Eurobond resources cannot be fully verified due to their integration into the central budget, it is

reasonable to infer that a total of about US$3.91 billion (2023 prices) was borrowed for road infrastructure upgrades. This figure aligns closely with the US$3.85 billion in identified capital expenditure corresponding to the 27 projects that met the inclusion criteria for this study

To assess the long-term economic implications of this investment imbalance, an HDM-4 Strategy Analysis was undertaken. Unlike project-level HDM-4 analyses, which assess discrete investment alternatives, a strategy-level analysis operates at a network-wide or programme level. It evaluates alternative maintenance strategies and funding scenarios under specified budgetary and policy constraints, in order to optimise resource allocation and maximise economic returns across the entire road network.

The results indicate that the economically optimal level of annual maintenance expenditure is $264 million, exceeding the historical average by $159 million. At this optimal level, maintenance interventions yield a benefit-cost ratio (BCR) of 3.04, significantly higher than the BCR of 1.12 for capital road projects (upgrading). Reallocating funding to align with this optimal maintenance strategy would generate a net present value (NPV) of $4.1 billion (due to increased road maintenance) and an additional $2.6 billion (due to reduced capital expenditure and selecting the highest performing projects), highlighting the substantial opportunity cost of prioritising road expansion over maintenance.

In the aviation sector, economic assessments produced divergent outcomes. The KKIA (Kenneth Kaunda International Airport) upgrade project generated a positive NPV of $152 million, whereas the SMKIA (Simon Mwansa Kapwepwe International Airport) upgrade resulted in a negative NPV of -$490 million, implying a combined opportunity cost of -$339 million to the Zambian economy.

In aggregate, the transport investments actually undertaken generated an NPV of $939 million across the road portfolio and -$330 million across the two airport projects, yielding a combined NPV of $609 million. By contrast, had the investment portfolio been optimised, by selecting only the nine highest-performing road projects, redirecting the savings to road maintenance, and omitting the SMKIA upgrade, the combined NPV would have reached $7,830 million.

Taken together, the inefficient allocation of resources across both the road and airport infrastructure portfolios is projected to result in a total economic loss of $7.22 billion over the relevant appraisal periods. For the road investments, the appraisal horizon spans 2010 to 2043, including construction and 20 years of operation across a portfolio of 27 projects. For the airport investments, the appraisal period extends from 2015 to 2061, incorporating construction and a 40-year operational life.

This constitutes the headline conclusion of the analysis. Had the investment portfolio been rationalised, by selecting only the 9 highest-performing road projects, thereby saving $1.66 billion (2023 prices) between 2010 and 2020, and redirected the savings to increased maintenance, and omitting the SMKIA upgrade, would have yielded an increase in expected NPV of $7.22 billion over the 2010–2061 period, representing a significant gain in economic efficiency and public value.

Table 9-7: NPV of Transport Expansion Project (real 2023 prices)

Projects	Actual	Optimal	Δ NPV
Roads Upgrading	Landless Corner - Mumbwa (Lot 2) Kalulushi - Lufwanyama Kitwe - Chingola Dual Carriageway Lusaka Decongestion Project Lusaka 400 (Phase 1) Lusaka 400 (Phase 3) Lusaka 400 (Phase 2) Zambia Township Roads Kazungula Bridge Mufuchani Bridge Leopards Hill Road to Jct RD481 D145 (T4 - Feira) Kafue Hook Bridge Mongu – Kalabo Landless Corner - Mumbwa (Lot 1) Pedicle Road Mansa - Luwingu Road Mbala - Nakonde Sesheke - Senanga Road (Lot 3) Sesheke - Senanga Road (Lot 1) Sesheke - Senanga Road (Lot 2) Fatima Indeni Road Sioma Bridge Chiawa Bridge Construction Katoba - Chirundu Chama - T2 (Lot 2) Chama - T2 (Lot 1)	Landless Corner - Mumbwa (Lot 2) Kalulushi - Lufwanyama Kitwe - Chingola Dual Carriageway Lusaka Decongestion Project Lusaka 400 (Phase 1) Lusaka 400 (Phase 3) Lusaka 400 (Phase 2) Zambia Township Roads Kazungula Bridge n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a n/a	+$2,623 million
Roads Maintenance	$105 million expenditure on maintenance per annum (or $1,165 million over 2010 – 2020)	$264 expenditure on maintenance per annum (or $2,908 over 2010 – 2020)	+$4,108 million
Airport Upgrade	KKIA Airport SMKIA Airport	KKIA Airport n/a	+$490 million
Combined (roads upgrading + roads maintenance + airports)	+$609 million	$7,830 million	**+$7,221 million**

Source: Researchers estimates

9.8 External Finance and Debt

While Section 4.1 provides an in-depth analysis of external funding and debt specific to the roads sector, in this section we expand on the analysis by considering the additional borrowing for the KKIA and SMKIA projects. In total, we identified 18 projects (road plus airport projects) that were either partially or fully funded through external borrowing from eight international lenders. On an aggregate level approximately 70% was financed with loans from EXIM Bank of Chine and 11% from the China Development Bank.

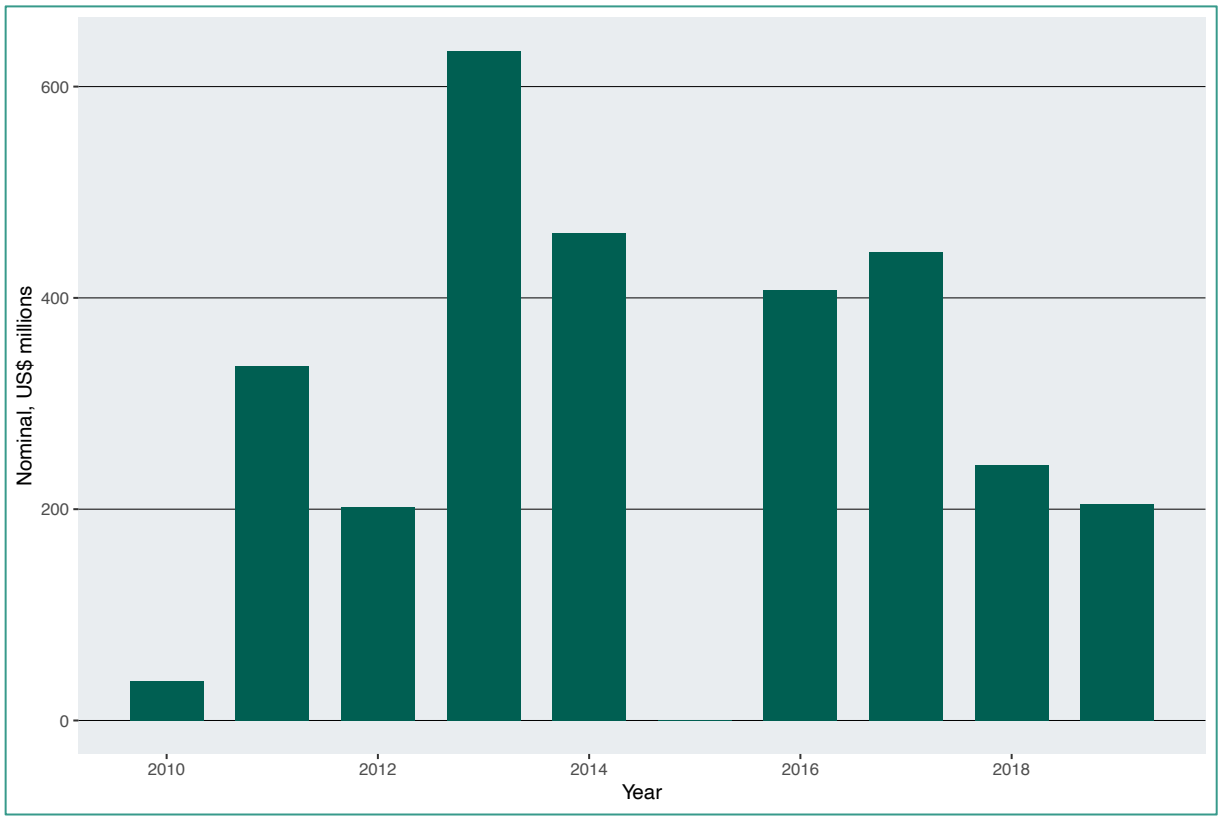
Table 9-8: Projects Funded From External Borrowing (nominal values in stated currencies)

Road Project	Borrow Amount	Borrow Currency	Funder
Lusaka 400 (Phase 1)	295,798,237	USD	EXIM Bank of China
Lusaka 400 (Phase 2)	197,877,928	USD	EXIM Bank of China
Lusaka 400 (Phase 3)	204,940,175	USD	EXIM Bank of China
Zambia Township Roads	197,391,778	USD	EXIM Bank of China
Zambia Township Roads	44,000,000	USD	Poly Technologies
Kazungula Bridge	51,000,000	SDR	African Development Fund
Kazungula Bridge	1,557,179,536	JPY	Government of Japan
Mansa - Luwingu Road	120,225,783	USD	China Development Bank
Mansa - Luwingu Road	202,393,785	USD	China Development Bank
Mufuchani Bridge	5,860,400	SDR	IDA (World Bank)
Chiawa Bridge Construction	14,307,580	USD	IDA (World Bank)
Mbala – Nakonde	1,182,846,760	CNY	EXIM Bank of China
Mongu – Kalabo	242,722,247	USD	EXIM Bank of China
Sesheke - Senanga Road (Lot 1)	48,511,412	USD	Development Bank of South Africa (DBSA)*
Sesheke - Senanga Road (Lot 2)	44,183,780	USD	Development Bank of South Africa (DBSA)*
Sesheke - Senanga Road (Lot 3)	37,125,396	USD	Development Bank of South Africa (DBSA)*
Kalulushi - Lufwanyama	10,529,158	USD	Development Bank of South Africa (DBSA)*
Sioma Bridge	15,176,634	USD	Development Bank of South Africa (DBSA)*
Lusaka Decongestion Project	245,739,817	USD	Exim Bank of India
KKIA	360,000,000	USD	EXIM Bank of China
SMKIA	397,201,694	USD	EXIM Bank of China

*Source: MOFNP (Lusaka 400 Ph 1-3, Zambia Township Roads, Kazangula Bridge, Mansa – Luwingu, Mbala – Nakonde, Mongu – Kalabo), *Assumed for Sesheke – Senanga Lots 1 – 3 , Kalulushi – Lufwanyama based on consultant's research and discussions with stakeholders. Table*

A financial model was developed to assess the loan portfolio, incorporating key variables such as loan tenor, interest rate structures (fixed and variable), and contractual terms including grace periods, capitalised interest, and service charges. The model projects future debt servicing requirements—covering both interest and principal repayments—and forecasts outstanding loan balances. Results are presented in shows nominal loan disbursements (USD) for projects, from 2010 to 2020, highlighting year-on-year variations in external borrowing. The largest disbursement occurred in 2013, exceeding $600 million. Figure 9 3 shows nominal loan disbursements (USD) for projects, from 2010 to 2020, highlighting year-on-year variations in external borrowing. The largest disbursement occurred in 2013, exceeding $600 million.

Figure 9-3: Aggregate Borrowing for Project Investments (2010-2020) (millions US$, nominal)



Source: Researchers estimates

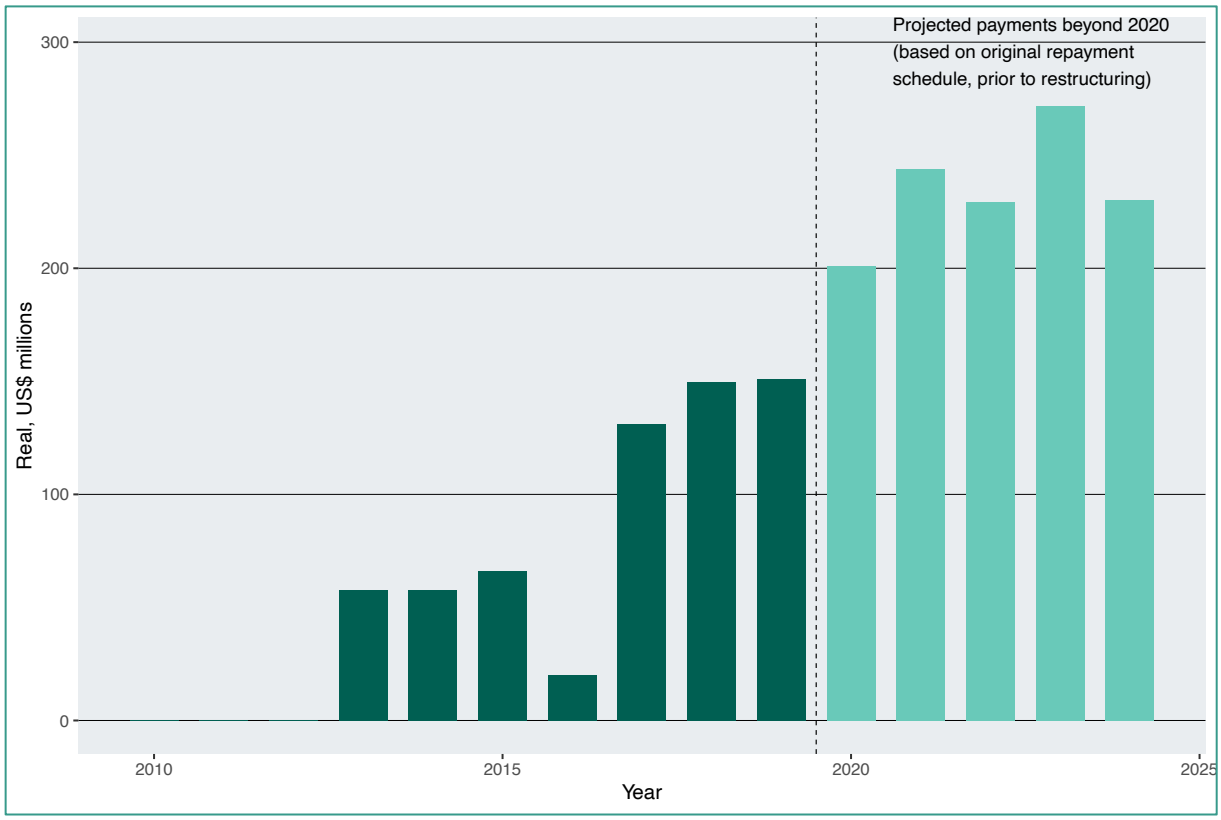
Figure 9-4 and Figure 9-5 present the scheduled debt service obligations and projected outstanding loan balances for transport projects, based on original loan terms and assuming full compliance with repayment schedules. Zambia's 2020 sovereign default, however, marked a pivotal moment in external debt management, triggering the suspension of most external debt payments (excluding preferred creditors) and the launch of restructuring efforts under the G20 Common Framework.

While pre-2020 data reflect actual cash outflows, post-2020 figures represent contractual obligations largely unmet, underscoring rising arrears and deepening fiscal stress. Debt service costs for transport projects rose to about US$160 million (2023 real terms) by 2019 and were projected to exceed US$260 million annually by 2023. Outstanding balances peaked at $2.88 billion in 2019, with a projected decline to US$1.3 billion by 2024 under original assumptions.

To place this in context, Zambia's total external public and publicly guaranteed debt stock stood at roughly US$14.7 billion in 2019 (Ministry of Finance 2020) which corresponds to about US $17.30 billion in 2023 real prices. The transport sector alone therefore accounted for approximately 15-20% of total external debt, making it one of the largest single contributors to the country's overall debt exposure. The heavy concentration of borrowing in transport infrastructure, particularly roads and airports, thus played a significant role in escalating Zambia's debt vulnerability and reducing fiscal space for maintenance and other priority expenditures.

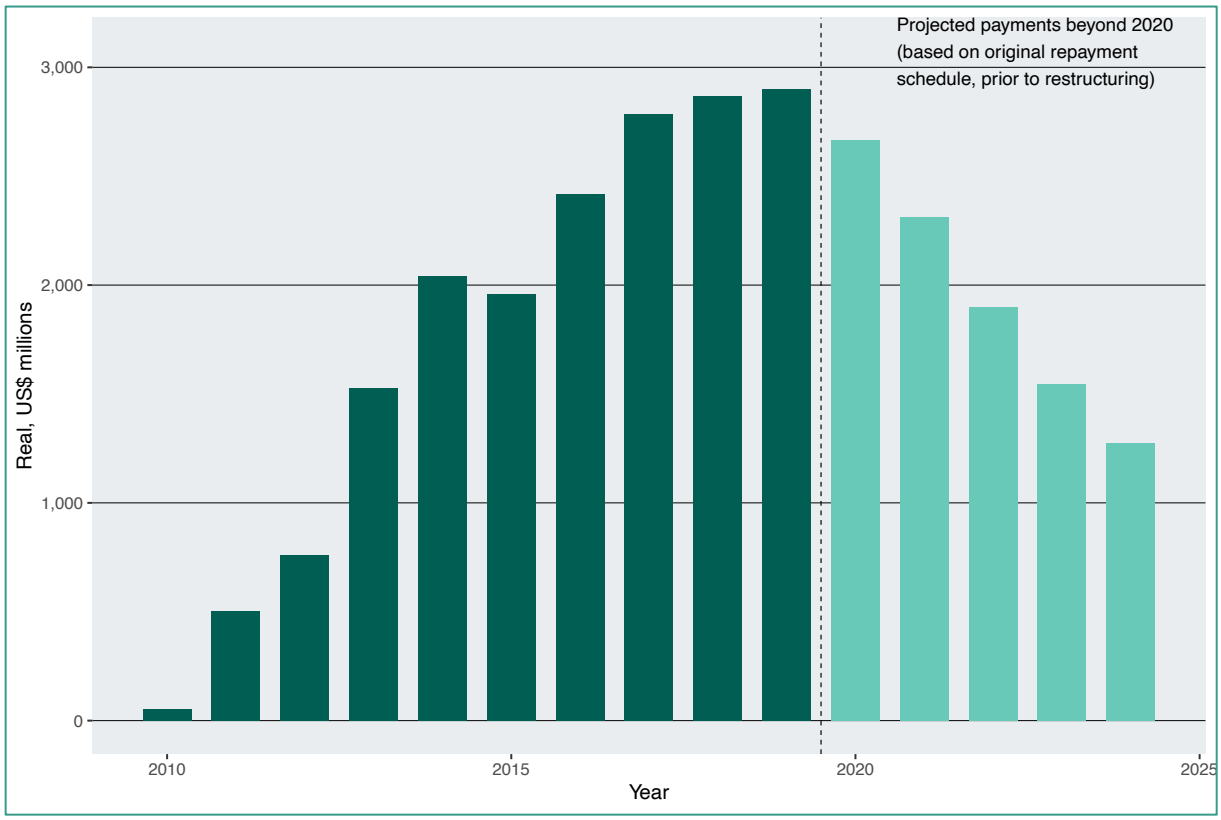
These trends highlight the growing unsustainability of Zambia's debt burden prior to restructuring and underscore the importance of comprehensive debt resolution to restore fiscal stability and safeguard infrastructure investment capacity.

Figure 9-4: Scheduled Debt Service Obligations (2010-2024) (millions US$, real)



Source: Researchers estimates

Figure 9-5: Projected Outstanding Project Loan Balance (2010-2024) (millions US$, real)



Source: Researchers estimates

9.9 Further Recommendations

9.9.1 Routine Ex-Ante Economic Appraisal

Since 2020, Zambia has made substantial progress in promoting responsible infrastructure investment. Key milestones include the publication of the National Public Investment Strategy (2024–2026), the General Appraisal Manual for Public Investment Projects, and the Public Investment Project Prioritisation and Financing Option Mapping Criteria (2024). These developments reflect a concerted effort to strengthen the policy and legislative framework, enhance information systems, and build institutional capacity for more efficient public investment management.

A notable reform is the introduction of a Multi-Criteria Analysis (MCA) framework for prioritising new projects which is replicated in Table 9-9, below. Under this system, project efficiency, defined by the Internal Rate of Return (IRR) and time to completion, accounts for 25% of the total project score. Consequently, the maximum influence an ex-ante economic appraisal can have on a project's approval is capped at 25%.

Table 9-9: Prioritisation Framework for New Projects

Criteria	Indicator(s)	Weight (%)
National Strategic Priorities (NSP)	Qualitative Assessment (very low, low, medium, high, very high)	30
Sector Policy Priority (SPP)	Qualitative Assessment (very low, low, medium, high, very high)	15
Project Efficiency	- Internal Rate of Return (IRR) - Time to Completion	25
Potential Risks and Mitigation Measures	Qualitative Assessment (e.g. Climate change, Technology, Design, Financial risk)	10
Number of Jobs Created	Quantitative Assessment (>100; 50–100; <50)	10
Environmental/Climate Consideration	Qualitative Assessment (Considered: Yes or No)	10
TOTAL		100

Source: Public Investment Project Prioritisation and Financing Option Mapping Criteria (2024), MOFNP

While the respective MCA variable weightings reflect the normative judgements of Zambian stakeholders, the researchers consider the 25% weighting assigned to economic efficiency to be unjustifiably low. While this issue lies beyond the scope of the current research, several recommendations can be made:

- Mandating ex-ante economic appraisal is a welcome and necessary step toward improving investment quality.
- Reconsidering the weighting of economic efficiency within the MCA framework could better reflect its importance in ensuring value for money.
- Introducing a minimum threshold score for economic efficiency could help disqualify projects that fail to meet basic viability standards, thereby safeguarding public resources.

9.9.2 Sector Specific Manual for Economic Appraisal of Transport Projects

This research has demonstrated that when ex-ante economic appraisals are conducted, they generally do not exhibit systematic bias. However, there is considerable variation in the methodologies applied—particularly in the choice of discount rates, appraisal periods, and the identification and valuation of benefit streams. These inconsistencies hinder comparability across projects and reduce the objectivity of investment decisions.

To address this, the development of a standardised economic appraisal framework is essential. Harmonising input assumptions and analytical approaches would enhance transparency, enable more robust comparisons between projects, and support evidence-based decision-making.

Despite recent progress in strengthening Zambia's Public Investment Management (PIM) system, there remains a critical gap: the absence of a transport sector-specific economic appraisal manual. Currently, no unified guidance exists to ensure consistency in the economic evaluation of transport projects across sub-sectors.

This research recommends the development of such a manual—either tailored specifically for the Road Development Agency (RDA) or designed to cover the broader transport sector, including aviation, township and feeder roads, urban transport, rail and maritime. A comprehensive manual

would not only improve the quality of project appraisals but also align with international best practices and reinforce the credibility of public investment decisions in the sector.

9.9.3 Clarifying Appraisal Practices in the Aviation Sector

It is important to note that both airport projects, KKIA and SMKIA, were, at least in principle, intended to undergo ex-ante economic appraisals However, no independent analysis was undertaken, and the feasibility studies were conducted by prospective contractors. Allowing contractors to influence both design and programme appraisal introduces a clear risk of conflict of interest. Going forward, public procurement policy should explicitly exclude any service provider involved in project or programme design from participating in subsequent implementation stages.

Furthermore, upon closer examination, significant methodological issues were identified in the economic appraisals that were conducted. The appraisal for the KKIA project was, in fact, a financial appraisal, mislabelled as an economic one. This distinction is critical, as financial appraisals focus on cash flows and investor returns, whereas economic appraisals assess broader societal costs and benefits. Similarly, the SMKIA appraisal included benefit streams such as revenue, which are not typically consistent with a pure economic appraisal framework.

These discrepancies highlight a broader issue: the lack of a sector-specific economic appraisal manual for transport infrastructure, particularly in aviation. Developing such a manual could help standardise methodologies, clarify conceptual distinctions, and prevent similar misclassifications in future projects.

Moreover, this raises a pertinent question: Are project managers at Zambia Airports Corporation Limited (ZACL) and the supervising ministries fully aware of the differences between financial and economic appraisal? Given the commercial orientation of airport operations, it would not be surprising if financial metrics are prioritised. However, when managing large-scale projects funded by public resources, it is essential to understand the purpose and mechanics of economic appraisal to ensure value for money and alignment with national development goals.

9.9.4 Strengthening RDA's Project Management and Information Systems

The successful completion of this research was made possible through extensive collaboration with the Road Development Agency (RDA). Their cooperation was instrumental, particularly in providing access to contract values for the selected road projects. However, several data limitations were encountered that affected the comprehensiveness of the analysis.

While contract values were made available, the RDA was unable to provide critical supplementary data, including payment schedules, procurement details (such as the number of bidders and procurement methods), and complete traffic count data. Although traffic data was shared for some roads, it was not available for all 27 projects under review. In addition, efforts to obtain aggregate data on road upgrading and maintenance expenditures from the National Road Fund Agency (NRFA) proved challenging, further constraining the ability to assess overall sectoral investment patterns.

It is reasonable to assume that design reports were prepared for all 27 projects, as is standard practice. However, the RDA was only able to share documentation for ten projects, and of these, only seven included an ex-ante economic appraisal. This suggests that additional documentation may exist but could not be retrieved due to inefficiencies in archiving and document management systems within the agency.

These challenges highlight a broader institutional issue: the need for improved project documentation, archiving, and retrieval systems. To enhance transparency, accountability, and the quality of future evaluations, it is strongly recommended that the RDA and NRFA invest in strengthening its project management and information systems. This would ensure that critical project data is systematically recorded, stored, and made accessible for future planning, monitoring, and evaluation efforts.

9.9.5 Institutional Capacity for Economic Appraisal within the RDA

The Road Development Agency (RDA) possesses both the institutional knowledge and technical tools required to conduct robust economic appraisals. Notably, the agency holds a fully licensed version of the Highway Development and Management Model (HDM-4), a globally recognised tool for evaluating road infrastructure investments. In addition, the RDA has at its disposal two fully functioning Road Measurement Data Acquisition System (ROMDAS) vehicles, which are capable of collecting the road condition data necessary for calibrating HDM-4 models. These assets position the agency well to undertake in-house economic evaluations.

Given this capacity, it would be reasonable to expect that economic appraisals are routinely conducted internally. However, this is not currently the case. The RDA remains heavily reliant on external consultants and donor funding to carry out such analyses. This dependence not only increases the cost of appraisals but also limits their frequency and integration into early-stage project planning.

This research assesses that with modest investment in refresher training and capacity-building, the RDA could fully operationalise its HDM-4 capabilities. Doing so would enable the agency to conduct more frequent, cost-effective, and timely economic appraisals, thereby enhancing the quality and credibility of its investment decisions. Strengthening internal capacity would also reduce reliance on external expertise and promote greater institutional ownership of the appraisal process. It is therefore recommended that the RDA prioritise targeted training programmes for relevant staff and integrate economic appraisal more systematically into its project cycle management.

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ANNEX 1 LONG LIST OF ROADS PROJECTS

No.	Project Name
1	(Great East Road) from Arcades to Airport Junction in Lusaka Province
2	(Lusangazi Bridge) RUT Petauke
3	[Kitwe] - Kalulushi - Lufwanyama
4	Access Road and Landing Bay at Lukulu Pontoon
5	Access Road to Kawambwa Sugar Plantation
6	Access Roads to the New Independence Stadium
7	Access Roads to the New Independence Stadium - Design & Supervision
8	Amapande Bridge
9	Chabboboma - Sinazeze
10	Chalala Roads
11	Chamba Valley /Rememberance Park/Zambezi Road
12	Chambeshi - Chikwenda
13	Chambeshi - Mpika
14	Chembe - Matanda
15	Chembe - Milenge
16	Chembe Bridge - Mansa
17	Chewe Bridge
18	Chiawa Bridge Construction
19	Chibalashi- Bridge (13m) Release of Retention
20	Chibuluma Road Rigid Pavement
21	Chibuna Bridge
22	Chienge - Kaputa Road via Lambwe Chomba
23	Chifubu - Kaniki - Kawama - Penridge - Misundu
24	Chifumpa Bridge
25	Chifunda Road
26	Chikuni Bridge
27	Chimula Senka - Loop-Chilundumuzi (Release of Retention)
28	Chingola Kasumbalesa PPP road Project GRZ support
29	Chingola to Mutanda via Solwezi (T005), approximately 205 Km
30	Chingola Urban Roads
31	Chinsali - Isoka
32	Chinsali Safwa - Kasama
33	Chipata - Mfuwe
34	Chipata and Katete Agricultural Feeder Roads
35	Chipata to Msoro
36	Chipata-Chadiza-Katete (Link Zambia) Upgrading

No.	Project Name
37	Chisanzu Bridge
38	Chitambo - Katikula
39	Chitokoloki - M8
40	Chiwoza Bridge
41	Chiyuni - Makoka
42	Choma - Chitongo
43	Choma Agricultural Feeder Roads
44	Chongwe River Crossing
45	Community Access Improvements Programme
46	Construction / Upgrading of 10km of Luangwa Township Roads to Bituminous Standard & Construction of 3 Bridges on D145 Luangwa-Feira Rd - Supervision
47	Construction for the Lunsemfwa and Chipaba Bridges in lower
48	Construction of 10km of access road from M4 to the new Ndola international Airport.
49	Construction of 20km of Urban Roads in Chipata
50	Construction of a Bridge across the Zambezi River connecting the East and West Banks in North Western Province
51	Construction of a bridges across the Zambezi River connecting the West
52	Construction of bridge across Luanginga river in Kalabo District to provide access to Liuwa National Park
53	Construction of Chibombe Bridges in Chongwe District
54	Construction of Gumba Bridge
55	Construction of Lilayi Roads Project
56	Construction of Lumezi Crossing Points
57	Construction of Lundazi Bridge
58	Construction Of Lwamala Road In Ngabwe District
59	Construction of Lwela River Bridge (30m) and Installation of 2 (2x1200 dia Pipe Culverts)
60	Construction of Mbesha bridge
61	Construction of Msuzi Bridge
62	Construction of Mumbi Mfumu Bridge
63	Construction of Mvuvye bridge
64	Construction of Mwangala Bridge
65	Construction of Namwala Crossing Points
66	Construction of Ngabwe Bridge across the Kafue River
67	Construction of the damaged Lunzuwa Bridge along the Mbala Mpulungu Road
68	Construction of the Kabwe- Ngabwe Road, D817 (167km)
69	Construction of the Kafue and Lusaka Bypass from Mazabuka to RD556/RD555 to M009 to M20 to T2
70	Construction of the Luombwa, Lukusashi and Fukwe Bridges in Serenje District

No.	Project Name
71	Construction of the Makasa Village to Junction D3/D1 to Chtimukulu Chimba Lot 2
72	Construction of the Mazabuka bypass
73	Construction to Bituminous Standard of Solwezi Southern By-pass Road
74	Construction to Dual Carriageway of Great East Road (T4) from KKIA to Chongwe and Rehabilitation of Chongwe to Luangwa Bridge - Supervision
75	Construction to Dual Carriageway of the Chilanga to Chirundu 118KM
76	Construction/Upgrading of 38 Km of Sioma-Nangweshi Road M10 in the
77	Contract -Nakonde Mbala Road
78	Contract for the Rehabilitation of 3.635 Km of Livingstone Zaf Base
79	Contract No. RDA/CE/026/14:The Construction of the Luangwa and Kampemba Bridges in Chama District of Muchinga
80	D020 Kapatu - Kasama (From Kandondo - Tamina at jnc to Luwingu & Kasama)
81	D036 From Mununga via - Nkhoshya to Musunga
82	D039 Chitoshi - Zachariah Chanda
83	D180 Namwala - Baanga Pontoon Road
84	D181 Kasempa - Lunga Pontoon
85	D181 Lubungu Pontoon - Mumbwa
86	D181 Lunga Pontoon - Lubungu Pontoon
87	D224 - Lusiwasi Power Station
88	D240 Commando to M6
89	D375 Chisekesi - Gweembe
90	D417-Chikokomene-Chamuka - Chisamba
91	D482 from end of R110 - Chiawa in Lusaka
92	D536 - D534
93	D566 - Palabana
94	D623 - D817
95	Design and Construction of the Great East Road UNZA Barrier
96	Design and Construction Supervision of Luanshya - Fisenge - Masangano/
97	Emergency Detailed Investigations and Rehabilitation of 4 No. Bridges (Kabompo Bridge, Chiseng'a Bridge, Lukanka Bridge and Lumwana West Bridge) along the Solwezi to Mwinilunga T005 Road
98	EngineeringDesign, Rehabilitation, Upgrading and Construction of Approximately 152km of Selected Township Roads in Kitwe, Chingola and Mufulira in the Copperbelt Province - Lot 1
99	G.E.R - Mwalumina
100	Great East Road Rehabilitation
101	Hamapande Bridge
102	Holding maintenance of Lusaka to Kabwe Lot 2 T2

No.	Project Name
103	Holding Maintenance of 185km of Katunda to Lukulu Road D792
104	Holding maintenance of Serenje Mpika under the chinsali nakonde project
105	Holding Maintenance of the Katunda-Lukulu- Watopa Road - Force Account
106	Holding Maintenance of the M9, Lusaka to Mongu
107	Holding Maintenance of the T2, Chisamba to Kapiri
108	Ilunda - Ikabako-Nang'ondi
109	Improved Rural Connectivity Project OPRC Country Wide Roll Out - Works (Counterpart Funding)
110	Ipongo - Itumbwe-Mumbwa
111	Isoka - Chibale
112	Isoka - Nakonde
113	Isoka-Muyombe Chama Lundazi (Lot 2)
114	Isoka-Muyombe Chama Lundazi (Lot 3)
115	JICA Bridge Maintenance Capacity Building Project (Pilot Projects)
116	Kabompo - Kayombo
117	Kabwe - Chisamba via Kasavasa
118	Kabwe - Mulungushi Hydro Power
119	Kabwe/Kapiri Mposhi T2 (Release of Retention)
120	Kachilulu Bridge
121	Kafubashi - Pwele (Manonokola Embarkment)
122	Kafue National Park Spinal Road Lot 2
123	Kafue Bridge (Sabina-Mufulira Road)
124	Kafue Hook Bridge Repair/construction
125	Kalabo - Sikongo - Angola Border
126	Kalomboshi Bridges
127	Kalomo - Dundumwezi
128	Kalomo Minning Roads
129	Kalomo- - Kabanga Mission
130	Kalulushi - Sakala Farm
131	Kalungu Bridge
132	Kampemba/Luangwa Bridges on Chama - Matumbo Road
133	Kanyonje Bridge in Shikabeta
134	Kaoma to Kasempa
135	Kapiri Mposhi to Nakonde (T002), approximately 855 Km
136	Kasaba to Luwingu via Chungu Lot 2
137	Kasama - Luwingu
138	Kasama - Mbala (Mpulungu)Lot1
139	Kasama - Mbala (Mpulungu)Lot2

No.	Project Name
140	Kasama - Mbesuma (Lot 1)
141	Kasama Mpika - Supervision [Lot 1+2]
142	Kasama to Mporokoso (D19/D20) (151KM) Mporokoso to Kawambwa
143	Kasama-Chambeshi
144	Kasama-Chambeshi Lot 2
145	Kasempa U8 - U8
146	Kasempa to Kaoma
147	Kasempa Turn-off - Kabompo
148	Kashikishi-Chienge-Lambwechomba
149	Kasisi - Kasenga
150	Katete -Chanida (55Kms)
151	Katima Mulilo Road - from Great East Road
152	Katima Mulilo Rounabout-Airport Turnoff (T004)
153	Katunda/Lukulu Road junction-Mongu Zesco junction (Release of Retention)
154	Kaumba Road
155	Kawambwa - Mansa
156	Kawambwa - Mushota -Luwingu
157	Kazungula Bridge Construction
158	Kazungula Urban Roads
159	Kazungula via Livingstone to Turnpike (M10/T001) approximately 488
160	Kenneth Kaunda International Airport to Kasisi to GER, Ngwerere Road
161	Kisasa - Mwinilunga Lot 2
162	Kisasa - Ntambu - Makangu
163	Kitwe - Chingola Dual Carriageway
164	Kitwe - Kalulushi Roads - Lot 3 (Release of Retention)
165	Kitwe- Chibuluma - Mindolo Road
166	Limulunga - Namitome Clinic
167	Linda turnoff to Kafue Estates (D162) Road
168	Livingstone - Sesheke Road
169	Lochnivar Gate - Chunga Lagoon
170	Londwe - Mabokunda
171	Lot 1- Isoka (T2/D790 Junction) to Km 90+000 (D790), (90 Km)
172	Lot 1: Upgrading of the Leopards Hill Road (D152) to jnc RD481
173	Lot 2: Katoba to Chiawa
174	Luangwa (Mporokoso) on D39 Bridge
175	Luanshya - Kafulafuta
176	Luanshya Town Roads - Lot 4 (Release of Retention)
177	Luanya - Mano

No.	Project Name
178	Luena Bridge
179	Luena Farm Block Roads
180	Lufubu Bridge on Mbala- Kasaba Bay Road
181	Lukulu River - Chinsali
182	Lukulu River - Mpika
183	Lumena - Nyengo-Kaluwe
184	Lundazi - Lusuntha Border Post
185	Lupande bridge
186	Lusaka - Chirundu Link 1 & 2 (Non-Escarpment Section) T002
187	Lusaka - Chirundu Link 3 (Non-Escarpment Section) T002
188	Lusaka - Chirundu Link 4 (Non-Escarpment Section) T002
189	Lusaka - Northmead / Chipata /Mandevu Roads - Lot 8
190	Lusaka South MFEZ - Extension of Chifwema Road
191	Lusaka South MFEZ - Phase II
192	Lusaka to Kapiri to Ndola Dual Carriageway
193	Lusangazi - Luamfwa
194	Luwingu - Nsombo-Choba
195	Lwenge Bridge
196	M10 - Mulobezi
197	M8 - Kalengwa Mine
198	M8 - Kamivonde School Junction
199	M8 - Kashima West Tobacco Scheme
200	M9 - Makeni (D167)
201	Machulila Camp-Lumangwe Falls
202	Machulila Camp-Lumangwe Falls (Slave Trade Route)
203	Maintenance of the Katete to Kagoro Road
204	Maintenance of National Park Roads
205	Maintenance of the Sir Otto Beit Bridge
206	Makeni Road
207	Malama (Samukota) - Ndanda - Sitoya Road
208	Malondo - Tuwa
209	Mansa - Luwingu Road (EXIM)
210	Mansa - Milambo
211	Mansa - Nchelenge
212	Mansa to Matanda
213	Mansa-Chembe (Retention)
214	Masamba-Kavumbo - D001 jnc Kamuswazi
215	Matebele - Shangombo

No.	Project Name
216	Matebele Bridge Construction
217	Mayukwayukwa Bridge
218	Mbala - Nsumbu - Kasaba Bay
219	Mbereshi - Kawambwa
220	Mbesuma - Isoka
221	Mbesuma Bridge
222	Mbonge Bridges
223	Mining Access Roads
224	Mkushi Farm Block Roads
225	MLG 2018 Budget - Upgrading and Rehabilitation
226	MLGH 2015 Budget - Rehabilitation (All projects)
227	MLGH 2015 Budget - Upgrading
228	Mongu - Kalabo
229	Monze - Chivuna
230	Monze - Shinanansa
231	Monze to Pemba Lot 1
232	Monze turnoff to Lochinvar Gate
233	Moshi/Treetops Junction - Kabanga Road
234	Mpamadzi Farm Block
235	Mpanshya Mission - (VO to Raubex Contract)
236	Mpika - Chinsali
237	Mpika - Nabwalya - Lot 1 (Link Zambia)
238	Mpika Urban road project (7.5km dual carriageway)
239	Mpulungu - Kapoko
240	Mufuchani Bridge
241	Mufulira - Chililabombwe Link
242	Mukunta - Kayambi-Chosi
243	Mulekatembo - Mwenewisi-Mwenempangala
244	Mulobola/Nkolefumu - Kasala
245	Mumbwa - Baanga Pontoon
246	Mumbwa - Landless Corner (Lot 1)
247	Munda Wanga - Mkushi Road [Force Account]
248	Mung'anga - Kawambwa
249	Munkulungwe Bridge (D240)
250	Mutumbi Cemetary to Zambezi Road
251	Mwanawasa Bridge - Mansa
252	Mwiliya Farm block
253	Nabwalya - Mfuwe - Lot 2 (Link Zambia)

No.	Project Name
254	Nacala Road Corridor (Phase II) (114.7km) sections 2 and 3 (GRZ
255	Naminwe Bridges in Namwala
256	Namuseba & Namilongwe Bridges/Hamapande Bridge
257	Namwela Bridge
258	Nasanga Farm Block Roads
259	National Feeder Roads Programme Phase I
260	National Feeder Roads Programme Phase II
261	National Feeder Roads Programme Phase III
262	Nchelenge, Chienge, Kaputa, Lunchinda - Lot 1
263	Nchelenge, Chienge, Kaputa, Lunchinda - Lot 2
264	Ndola City Roads
265	Ndola to Kasumbalesa Border (T003), approximately 150 km
266	Ndola-Kitwe
267	Nemfwe Bridge
268	Ngoma loop roads
269	Nkamba Chomba wa Kasaba
270	Nkosha - Park Gate
271	Nkoshya - Nswana [DMMU]
272	Nsadzu Bridge
273	Nseluka via Kayambi (Design and Build)
274	Nteme - Munyenze
275	Old Kafue - Balmoral/Chikupi/Mungu
276	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 1 in Central Province
277	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 10 in Luapula Province
278	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 11 in Southern Province
279	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 12 in Southern Province
280	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 13 in Copperbelt Province
281	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 14 in Muchinga Province
282	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 15 in Muchinga Province
283	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 16 in Western Province

No.	Project Name
284	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 17 in Luapula Province
285	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 17 in Luapula Province
286	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 17 in Western Province
287	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 18 in Copperbelt Province
288	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 19 in Lusaka Province
289	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 2 in Central Province
290	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 20 in Lusaka Province
291	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 3 in Eastern
292	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 3 in Eastern Province
293	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 4 in Eastern Province
294	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 5 in North-western Province
295	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 6 in North-western Province
296	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 8 in Northern Province
297	Output and Peformance Based Road Contract (OPRC, Asset Management Contract) for Design, Rehabilitation/Improvement, Routine and Periodic Maintenance Works of Package 9 in Luapula Province
298	Periodic Maintenance of Mutanda- Kasempa (M8/D181) Road (90 Km) Lot 1&2- Supervision
299	Periodic Maintenance of (T4) from Kamilulu to Luangwa Bridge
300	Periodic Maintenance of 12Km of T2S to Kafue Gorge Road in Kafue District
301	Periodic Maintenance Of 25km of the Changalubwe Road (D104-M12)
302	Periodic Maintenance of Approximately 288km of the T5 Road from Solwezi to Mwinilunga in Northwestern Province
303	Periodic Maintenance of Approximately 50km of Agricultural Feeder Roads in Kaputa District
304	Periodic Maintenance of Approximately 52km of Agricultural Feeder Roads in Mungwi District
305	Periodic Maintenance of Chikwela to Kapuka (U7) Road in Chongwe District

No.	Project Name
306	Periodic Maintenance of Chimbotela to Shibuyunji (D536) Road in Shibuyunji District
307	Periodic Maintenance of Chingola - Kasumbalesa Road (T3) from T5 /T3 Junction (40 Km)
308	Periodic Maintenance of Chipata-Lundazi KM0 to KM90, including construction of Lundazi and Msuzi Bridge
309	Periodic Maintenance of Corner Bar to Water Green (U6) Road in Chongwe District
310	Periodic Maintenance of D451 from Mukuku Bridge to Musaila (Junction with D94) - Supervision
311	Periodic Maintenance of D469 from D486 Junction (Mpongwe) to Luanshya (60 Km)- Supervision
312	Periodic Maintenance of Kabwe - Chibombo, T2 [Km 0+000 to 30+000] L1 (Project Termination Cost)
313	Periodic Maintenance of Kabwe-Kapiri Mposhi Road
314	Periodic Maintenance of Kalulu to Mwapatisha (U14) Road in Chongwe District
315	Periodic Maintenance of Kapiri Mposhi - Serenje Road (T2) (210 Km)
316	Periodic Maintenance of Kasama Mbala Mpulungu (M1/M3) Roads
317	Periodic Maintenance of Kasubanya (U15) Road in Chongwe District
318	Periodic Maintenance of Katete-Chanida Road (T6)
319	Periodic Maintenance of M009 of Selected Sections from Nalusanga Gate to Mongu
320	Periodic Maintenance of M9 from km 10 to km 142
321	Periodic Maintenance of M9 from km 10 to km 277
322	Periodic maintenance of M9,Km142+000 from Lusaka to Km277+000
323	Periodic Maintenance of Madombe to Kamowa (U2) Road in Luangwa District
324	Periodic maintenance of Mongu - Senanga (M10) Road
325	Periodic Maintenance of Mutumbisha (U3) Road in Chongwe District
326	Periodic Maintenance of Namushakende Nalikwanda 60km
327	Periodic Maintenance of Ndola - Kapiri Road
328	Periodic Maintenance of Old Chitope (RD217) Road in Luangwa District
329	Periodic Maintenance of Road T2, Section between Lukulu Bridge and Chinsali Turnoff (300 Km), including access road to Chinsali D55 (14 Km) in Muchinga Province
330	Periodic Maintenance of Shachete to Shibuyunji (D534) Road in Shibuyunji District
331	Periodic Maintenance of Sipopa (RD215) Road in Luangwa District
332	Periodic Maintenance of T2 Junction (Mukando) to Mukuku Bridge on D235
333	Periodic Maintenance of T2 to Siavonga (M15) Road including Township Roads in Siavonga District
334	Periodic Maintenance of T4 to Kagwila (U18) Road in Chongwe District
335	Periodic Maintenance of the Choma - Namwala Road M011, from Km 82+000 to Km 169+000

No.	Project Name
336	Periodic maintenance of the Kalulushi-Lufwanyama (M18) Road
337	Periodic Maintenance of the Livingstone - Zimba, T001, Road
338	Periodic Maintenance of the M11 - Ngabo - Ichila - Musemu
339	Periodic maintenance of the Mpongwe-Luansobe Road
340	Periodic Maintenance of U4/U5/U7 (Chilimanga, Chamitando and Kaunga) Roads in Luangwa District
341	Periodic Maintenance pf RD219/RD220/U6 Chief Mpuka's Palace and Kavalamanja Road in Luangwa District
342	Petauke - Mfuwe
343	Petauke to Chilongozi
344	Petauke, Vubwi and Mambwe Bridges (Release of retention)
345	Phase 1: Zambia Army Barracks Roads
346	Phase II: Zambia Army Barracks Roads
347	Phase III: Zambia Army Barracks Roads
348	R133 - R135
349	R135 - M20
350	RDA/CE/001/013 -KZN: Contract for Road Spot Improvement Works
351	RDA/CE/012/013 - GWB: Road Improvements on U9, Mukuyo-
352	RDA/CE/015/013: Contract for Spot Improvement Works on Road No.
353	Rehabilitation & upgrading of selected Mongu Urban Roads PhaseII 32km
354	Rehabilitation and upgrading of D315 Mongu Limulunga and Mouyo roads
355	Rehabilitation of section of the Serenje to Mpika Road
356	Rehabilitation of 13.5km of Roads in Chingola and Chililabombwe
357	Rehabilitation of 131.5 km of the Bottom Road (Lot1; from Munyumbwe to Chaanga and from Chaanga to Njami (D500/D501) in Southern Province
358	Rehabilitation of 14 Km of Road M016/M004 from Kalulushi to Sabina
359	Rehabilitation of 168km of the Mpika to Chinsali Road in Northern
360	Rehabilitation of 180Km from Km 9+400 of Lusaka to Mongu (M9) to Nansanga Gate (Lot 1&2)
361	Rehabilitation of 400km of Copperbelt Urban Roads - Design & Build
362	Rehabilitation of 50 km of feeder roads – Civil Works on the Chinsali to Nakonde Road
363	Rehabilitation of 80km of Selected Township Roads on the Copperbelt
364	Rehabilitation of approx.80km of Ndola Mufulira Mokambo (M4/M5) Road on the Copperbelt Province
365	Rehabilitation of Central/Chibuluma road in Kitwe District
366	Rehabilitation of Chibawo - Kasonde - Kampamba via Chinongolwela
367	Rehabilitation of D273/D274 West Lumwana - Ntambo - Makango
368	Rehabilitation of Kabwe - Chibombo, T2

No.	Project Name
369	Rehabilitation of Musele - Mano/Mwewa - Mushimba via Chief Chibaye's village
370	Rehabilitation of Ndola - Mufulira - Mokambo Border Road
371	Rehabilitation of Road D298 from M008 to D299 (31.8km) and Road
372	Rehabilitation of Road D773 from M008 to D301 Junction via Kalengwa
373	Rehabilitation of Roads in the Kafue Sub-basin [OPRC - Climate
374	Rehabilitation of Selected Urban Roads by RRU under the AURRP
375	Rehabilitation of Serenje - Lukulu River
376	Rehabilitation of the Batoka to Maamba Road - D775
377	Rehabilitation of the Chingola to Solwezi
378	Rehabilitation of the Chinsali access road under the chinsali nakonde project
379	Rehabilitation of the Great North Road from Chinsali - Isoka - Nakonde Lot 1
380	Rehabilitation of the Great North Road from Chinsali - Isoka - Nakonde Lot 2 - Including Construction of a fixed Electronic Weighbridge at Nakonde
381	Rehabilitation of the Kafue - Mazabuka
382	Rehabilitation of the Kafue - Mazabuka Lot 1
383	Rehabilitation of the Kafue - Mazabuka Lot 2
384	Rehabilitation of the Kaoma to Mongu Road in Western Province
385	Rehabilitation of the Kitwe to Chingola Road
386	Rehabilitation of the Luanshya - Fisenge - Masangano/ Lamba-Lima / Kafubu
387	Rehabilitation of the Luanshya - Kafulafuta
388	Rehabilitation of the Monze to Kazungula (Dual Carriageway)
389	Rehabilitation of the Nacala Corridor from Luangwa to Nyimba Road
390	Rehabilitation of the Nacala Corridor from Mutenguleni to Mwami
391	Rehabilitation of the Nacala Corridor from Nyimba - Sinda Road [T004]
392	Rehabilitation of the Nacala Corridor from Sinda to Mutenguleni 95.5km
393	Rehabilitation of the Serenje to Mpika
394	Rehabilitation of the Sesheke to Kazungula
395	Rehabilitation of the T2 - Kamaila & T2 - Chombela School in Chisamba
396	Rehabilitation/Upgrading of the Mungwi Road to link to the Lusaka-Mongu Road at Situmbeko
397	Road Improvement Works On Road No. 503b from Sinangilile to Kawila
398	Road M018 from Sakala Farm via - Lufwanyama to Ingwe Road
399	Roma Industrial Park to the Kenneth Kaunda International Airport
400	Safwa Bridge
401	Sakanya - Kamfinsa
402	Samfya - Katansha
403	Samfya Via Lubwe - Kasaba Lot 1
404	Selected Lusaka City Road Projects (45km including 4km of the Kafue

No.	Project Name
405	Senanga - Luambe
406	Senga - Chinakila
407	Sesheke -Kalongola to - Kalabo
408	Shiwangandu - Chinsali
409	Sinazongwe - Sinazeze
410	Sioma Bridge Construction
411	Solwezi - Kisasa Lot 1
412	Solwezi - Mwinilunga
413	St. Marys - Namilongwe
414	T001-Chikankanta Road
415	T2 - Chilonga
416	T2 - Chuindaponde
417	T2 - D774
418	T2 - Masansa
419	T2 - Mukungule - Katibunga
420	T2 - U10
421	T2 - U9
422	T2 -Ngwerere - Lusaka International Airport
423	T2 Junction Mukuku Bridge - Samfya - Mansa
424	T5 Solwezi - Lumwana
425	Tateyoyo - Katunda/Lukulu junction
426	The Upgrading of 11Km of the Pedicle Road and Spot Improvement of 60Km of the Pedicle Road in the Democratic Republic of Congo and Luapula Province of Zambia..
427	The Upgrading To Bituminous Standard Of Approximately 76km Of Urban Roads In New Chinsali Town In Muchinga Province - Lot 2
428	Tourist and National Park Roads
429	Tug Argan - Kapiri Mposhi
430	Tuwa - Mambolomoka
431	U21 - Mita Hills Dam
432	Upgrade of Mfuwe Airport Access Road
433	Upgrading and Re-alignment of D301 from Muyombe Junction to Chama
434	Upgrading and Re-Alignment of R231 from Great North Road at
435	Upgrading and Realignment to bitumous standard of Safwa to Mulilansolo
436	Upgrading Kanakantapa (RD480) to Kasisi to Katende (75KM)
437	Upgrading of of the Lundazi Chama Road Lot 5 - 40km of the Lundazi to
438	Upgrading of the Lundazi Chama Road Lot 4 and 5 - 40km of the Lundazi to
439	Upgrading of 107.5 Km of the Bottom Road (Lot 2-Rs19, Rs7 & R5) From
440	Upgrading of 122km of Kawambwa Mporokoso (D019) Road in Luapula and Northern Province.

No.	Project Name
441	Upgrading of 124km of the Lufwanyama to Kankolonkolo (M18) Road in
442	Upgrading of 128.9km of the Mpongwe Machiya Road (D468) to D817
443	Upgrading of 270km of Katunda (M9 Junction)-Lukulu-Watopa in Western
444	Upgrading of 70km of the Pedicle Road
445	Upgrading of 9.3km of the Fatima Indeni Road in Ndola
446	Upgrading of a total 65km of gravel roads to bituminous standard of Lamba Lima 32km (RD470), Kafunu Farm Block 15km (D770) and Commando 18km (D240) Roads in Copperbelt Province
447	Upgrading of Approx 50km of Chiwala Road in Copperbelt
448	Upgrading of approx. 80km Mpika via Katibungu through Chief Mungule
449	Upgrading of D249 Kamfinsa road from Kamfinsa prison to M4 junction
450	Upgrading of D319 Kalabo -Kalongola- Sitoti to Matebele road(Link Zambia) 190km
451	Upgrading of Kapatu Mission(Kandondo) - Nondo road
452	Upgrading of Kasempa to Mumbwa (266km)
453	Upgrading of Lundazi to Chama Road Lot 4 - 80km of the Lundazi Chama
454	Upgrading of Lunte Zachriah Chand (D39) road and Mukunsa Kaputa
455	Upgrading of Mbala - Kaseshya Border to Kalambo Road
456	Upgrading of Mbala to the Kasaba Bay Road Lot 1 (Km 0+000 to 62+000)
457	Upgrading of Mbala to the Kasaba Bay Road Lot 2
458	Upgrading of Monze - Niko Road
459	Upgrading of Mporokoso-Kaputa via Mutundu gate (D037) Road in Northern
460	Upgrading of Mumbwa (M009) - Itezhi tezhi, D769
461	Upgrading of Mununga -Nsama road
462	Upgrading of RD149 and D151 from Great East Road at Chongwe
463	Upgrading of roads M008 & D293 from Kabompo to Chavuma [Zambezi -
464	Upgrading of selected Roads in New Kasama
465	Upgrading of the Katete to Chipata via Msoro (D598/U23/D123) Roads
466	Upgrading of the Mbala - Lumi Road
467	Upgrading of the Chipata to Chadiza to Katete Vubwi Road including
468	Upgrading of the D145 (T4 - Feira)
469	Upgrading of the Kabwe to Picadily Circus (D200/D207/D214) Roads including the Mpula to Masansa Road(306Km)
470	Upgrading of the Kaoma to Kasempa Road in North Western Province
471	Upgrading of the Kasempa to Kaoma to Luampa to Machile to Simungoma (M010)
472	Upgrading of the Kasomeno to Mwenda
473	Upgrading of the Kawambwa - Kala - Marine Barracks - Mulwe road (204Km)
474	Upgrading of the Luwingu to Chilubi Island (D043, RD044 and RD 045)
475	Upgrading of the Mbala to Kasaba Bay Road Lot 3 (Km 122+000 to
476	Upgrading of the Mongu to Limulunga Road

No.	Project Name
477	Upgrading of the Mpulungu - Lunzua Road
478	Upgrading of the Nakonde-Kanyala -Sansamwenje Road - Lot 1
479	Upgrading of the Nakonde-Kanyala -Sansamwenje Road -Lot 2 including the Mbesuma to Isoka Road
480	Upgrading of the Pemba Mapanza Road [D361]
481	Upgrading of the Sakambinda (Kolowezi) to Mwinilunga to Solwezi
482	Upgrading of the Sesheke to Senanga Road M10 [Sesheke to Km 70]
483	Upgrading of the Solwezi - Kipushi road
484	Upgrading of the T4 to Minga Road
485	Upgrading of Twin Palm Road to Dual Carriageway
486	Upgrading to Bituminous Standard of 235km of T005 Road from Manyinga to Mwinilunga and 5 km Urban Roads in Manyinga in Northwestern Province
487	Upgrading to Bituminous Standard of approximately 275Km of D169/D534/RD536 from M09 at Napundwe Junction to M09 at Situmbeko to Chabota and Kasalo to Keezwa in Shibuyunji District, Lusaka Province
488	Upgrading to Bitumionus standard 80km of Kasanka - Milenge LINK ZAMBIA
489	Upgrading to Dual Carriageway of the Chingola to Kasumbalesa Border
490	Vumbo Bridge
491	Vyamba Chinakila
492	Watopa Bridge on Katunda Lukulu Watopa mumbezi (Link Zambia)
493	Zambezi - Chinyama Litapi
494	Zambezi - Chitokoloki - Mpidi

ANNEX 2 STAKEHOLDER CONSULTATIONS

As part of the data collection and stakeholder consultation mission undertaken from 25th November to 6th December 2024, stakeholder meetings were conducted with key government ministries and agencies in the transport sector as summarised below.

GOVERNMENT MINISTRIES

Ministry Of Finance and National Planning

In Zambia, the MOFNP has the overall mandate to oversee national planning, resource mobilisation, and debt and public finance management (MOFNP 2024). Specifically, for the transport sector, MOFNP's role includes coordinating long-term planning, overseeing the operations of the NRFA, and facilitating funding for other road sector agencies like the RDA and the RTSA. Given this strategic role in the sector, a stakeholder meeting with MOFNP took place on 25th November 2024 with the Department of Public Investment Planning (DPIP), where the consulting team met the Assistant Director and his colleagues. A debrief was also conducted on 6th December 2024.

Besides providing more background information on the study, key updates from the meeting included the pending development and approval of sector specific socio-economic investment appraisal procedures and guidelines. Once approved, MOFNP argues these will significantly reduce investment in non-economic viable projects, including roads. The Assistant Director, DPIP, confirmed Zambia's weak Public Investment Management (PIM) framework contributed to uneconomic investment over the last decade, and the excessive accumulation of total public debt estimated at approximately USD 15 billion as at June 2024.

Ministry of Transports and Logistics

The MTL is tasked with the central role of transport policy planning, formulation, regulation, and overall development of Zambia's transport system *(MTL 2021)*. In addition, MTL establishes frameworks for a safe and sustainable transport system, with the road safety mandate executed through RTSA.

As such, a stakeholder meeting was held with MTL through the Department of Planning, with the substantive Director and his team present. Besides the consulting team paying a courtesy call and providing the overall goal of the study, the Office of Director, Planning, provided further background on the project, specifically the conceptualisation and finalisation of the Link Zambia 8000 project. Using the example of the current Lusaka-Ndola dual carriage way, the consulting team was informed that over-pricing of projects was one of the issues which led to high project costs, as well as the subsequent debt accumulation. As the ministry responsible for overall transport policy planning, MTL cited other challenges such as political interference and corruption as key issues affecting cost-effective planning and implementation of projects in the sector.

Ministry of Infrastructure, Housing and Urban Development

Finally, the MIHUD is responsible for leading the design, construction, maintenance, and management of public infrastructure in Zambia, including transport infrastructure such as roads and airports *(MIHUD 2024)*. In addition, MIHUD oversees the operations of the RDA and the NCC. Under the government of President Sata, which ran from 2011 to 2015, the RDA was required to report directly to the Office of the President, though remaining under the institutional responsibility of the Ministry of Works (later to become the MIHUD). RDA reverted back to normal reporting procedures with the new government of President Lungu in 2015.

As part of the stakeholder consultation process, a meeting was held on 25th November 2024, with MIHUD through the Office of the Director Planning and his team. During the meeting, the consulting team was informed that MIHUD, supported by a multi-sectoral committee, was responsible for overseeing the contracting and project management for KKIA and SMKIA. This included the approval of original design standards as well as inclusion of new components, where necessary. However, it should be noted that the feasibility studies for the airports were undertaken by the contractor, thereby highly influencing the overall justification and cost of the projects through various passenger and cargo projections assumed. As discussed below, project management for roads is mainly the purview of RDA.

ROADS SECTOR STAKEHOLDERS

Road Development Agency (RDA)

The RDA was established by the Public Roads Act No. 12 of 2002 under the responsibility of the Ministry of Works and Supply, now known as the Ministry of Infrastructure, Housing and Urban Development (MIHUD). The RDA has the mandate to plan, construct, and maintain public roads, while recognising the MLGRD and Local Authorities (Councils)'s responsibility for managing urban and rural roads *(RDA 2024)*. As such, RDA was responsible for planning, construction, and maintenance of most road projects undertaken by the country between 2010 to 2020, with the Link Zambia 8000 project being the flagship project.

A consultative meeting was held with the RDA through the office of the Chief Executive Officer (CEO) on 26th November 2024. The main purpose of the meeting was to introduce the study and reiterate the consultant's data request including provision of summary data for the draft final list of projects. Through a reiterative process, the consultant managed to obtain a final list of projects. RDA also facilitated site visits for roads through its regional offices. A second working meeting was also arranged on 4th December 2024, with the senior management team to follow up on data requests. It should be noted that RDA's manual and rudimentary data archiving system has made this process difficult and time consuming.

National Road Fund Agency (NRFA)

Overseen by the MOFNP, NRFA was established under the National Road Fund Act No. 13 of 2002, to manage the Road Fund, mobilize financial resources, and implement the National Road Tolling Programme as a tolling agent on behalf of RDA *(NRFA 2022)*. This entails that most road projects in Zambia are financially managed by NRFA, with RDA being the overall contract manager.

In that regard, a stakeholder meeting with NFRA was held on 27th November 2024, to introduce the project and outline data requirements. Key data obtained from NRFA include traffic volumes from toll stations, RSAWP funding profile, including capital expenditure and lastly, summary list of road projects undertaken between 2010 and 2020. Relative to RDA, data requirements from NRFA have been forthcoming.

AIRPORTS

Zambia Airports Corporation Limited (ZACL)

Finally, ZACL is the institution responsible for management of all airports in Zambia, including KKIA and SMKIA. Legally, ZACL is a limited company by shares wholly owned by the Government of the Republic of Zambia and registered under the Companies Act No. 10 of 2017.

To facilitate data collection for KKIA and SMKIA as well as conduct site visits for the two airports, a planning and introductory meeting was held with ZACL on 26th November 2024. The meeting was led by the Managing Director together with other senior management personnel. During the meeting, the conceptualisation process behind the upgrading of KKIA and the construction of a new SMKIA in Ndola was discussed, with Zambia's ambition to become a regional hub of transport and logistics appearing to largely influence the decision. After the meeting, feasibility studies for the two airports were shared, with other data requirements still outstanding. ZACL also facilitated site visits in Lusaka and Ndola, with the Managing Director promising to support the study wherever necessary.

ANNEX 3 ROAD SITE VISITS

Leopards Hill Road (D152 and Rd149/D151/D150)

The road was upgraded to paved standard under Link Zambia 8000. The length of road upgraded was 39 km with asphalt concrete surfacing from State Lodge Junction to Katoba School. The road pavement is in very good condition with average IRI less than 1.5 but off-carriageway maintenance could be improved, for example to prevent standing water in the side drains.

The traffic volume on the road is moderate (approximately 2,500 per day, see Annex 6). The intention was to upgrade the RD481 road from the D152/RD151 intersection (Katoba School) towards Chirundu, the border post with Zimbabwe in order to establish an alternative all weather paved road from Lusaka to the lower Zambezi valley area and Chirundu. The existing trunk road from Lusaka to Chirundu (T2) is vulnerable to landslides.

The route from Katoba to Chirundu involves a tortuous descent of about 800 metres in elevation into the Zambezia valley. According to the RDA Regional Engineer the engineering designs for the escarpment section took a long time to finalise. Meanwhile the project was abandoned due to lack of finance after construction of about 10 km of paved road. The sections of the RD149 that were completed are in good condition but the road has very little traffic and there were no signs of maintenance.

Traffic on the D152 would increase if the D151 link from Katoba School to Chongwe on the T4 Great East Road was also upgraded. The D151 includes a 27 km unpaved section which is in poor condition. Upgrading of the D151 was part of Link Zambia 8000 but the project was not completed.

Leopards Hill Road – start of the project at State Lodge Junction in Lusaka

End of the completed works on the RD149

Landless Corner to Mumbwa (M20)

This road is located in Central Province. It provides an important road connection between Western Zambia and the productive farming areas around Chibombo and Chisamba, the northern suburbs of Lusaka, and the Copperbelt Province. The existing road includes paved sections at either end (Section 1 and 3) with unpaved Section 2 in between. Sections 1 and 2 were part of a construction contract that was terminated prior to completion of the works. The three sections are summarized below..

Landless Corner to Mumbwa – sections

#	Section Start and End Points	Length (km)	Road standard
1	Landless Corner on the T2 to Keembe Farms Institute	30.6	Paved approx. 10 meters wide
2	Keembe Farm Institute to Namakolongo School	35.0	Unpaved
3	Namakolongo School to Mumbwa (junction with D809)	50.7	Paved approx. 10 meters wide
Total		116.3	

The paved sections of the road have a double bituminous surface dressing (DBST). The surfacing has defects including potholes and edge break. Vegetation on the shoulders is overgrown and the drainage system is blocked in places. On section 1, which is in flat terrain, the road level gives the appearance of being too low and therefore vulnerable to moisture damage in the pavement and surfacing. Hydrological analysis carried out in 2024 for the development of the United States Millennium Challenge Corporation (MCC) Compact II found that most of the larger cross drainage structures on the road are probably under-designed particularly considering the higher intensity rainfall expected with climate change. On section 3 a culvert was washed out and has subsequently been replaced. Typical photos are given below.

M20 Landless Corner to Mumbwa – typical photos

Section 1

Section 2

New culvert on Section 3 under construction in November 2023

Indeni to Fatima School Road

This road is close to Ndola. It starts and ends on the T3 highway, providing access to a few small holder farmers and Fatima Secondary School. The road was constructed with asphalt concrete surfacing and in generally is good condition with a few defects, which have been repaired by the RDA. The road level gives the appearance of being too low on some sections, with water standing in the side drains. This is probably the cause of pavement defects seen on the road. The traffic volume on the road is low (approximately 280 per day, see Annex 6).

Indeni to Fatima School Road

Copperbelt 400 / Zambia Township Roads - Kitwe

The township road visited in Kitwe starts at the Freedom Avenue/Chiwala Avenue roundabout and follows Freedom Avenue to the Kwacha market area (6.5 km). It includes a section of Freedom Avenue that was upgraded to two lane dual carriageway, paving of the existing earth road through Kwacha Market and other urban sections in the Kwacha area. Part of Freedom Avenue was upgraded under a previous project and was not part of the C400 project. All sections that were visited have asphalt concrete surfacing and were in good condition (IRI 2.5). The traffic volume on the road is high (approximately 6,500 per day, see Annex 6). Paving of the road through Kwacha Market has made a huge difference to the lives of the people that live and work in that area.

Township Road Improvement at Freedom Avenue (left) and Kwacha Market (right)

On the single lane sections of Freedom Avenue, the road cross-section provides inadequate space for pedestrians. This shortcoming in design the observed on other roads upgraded under Zambia Township Roads.

Inadequate provision for pedestrians on Freedom Avenue Kitwe

Copperbelt 400 / Zambia Township Roads - Kalulushi

The C400 project in Kalulushi involved the rehabilitation of existing paved roads and upgrading of gravel roads. Three different sections of road were visited, forming a continuous length of about 1.6 km. The surfacing is asphaltic concrete and the roads were found to be in good condition apart from a few defects. The traffic volume on the road is high (approximately 3,900 per day, see Annex 6). The project made a significant difference to living conditions in these high-density residential areas.

Urban road upgrade Kalulushi

Copperbelt 400 / Zambia Township Roads - Ndola

The C400 project in Ndola involved the rehabilitation of existing paved roads. One road was visited, Nyali Avenue near Lubuto High School. The road is 900 metres long. Rehabilitation and upgrading involved the construction of concrete lined stormwater drains and asphalt concrete surfacing. Some cracks were seen in the surfacing and residents complained that the narrow pedestrian sidewalk next to a deep stormwater drain was dangerous. Apart from this the road was in good condition. The traffic volume on the road is moderate (approximately 2,100 per day, see Annex 6). A heavy truck was seen on the road, possibly indicating that it is being used as an alternative route to avoid congestion in Ndola city centre.

Nyali Avenue Ndola with narrow pedestrian walkway alongside deep lined drain

Mufuchani Bridge At Kitwe

A new bridge was built over the Kafue River at Kitwe. The bridge provides access to part of the city that was previously inaccessible and therefore undeveloped. Crossing of the river was by pontoons, which were unreliable and could only carry pedestrians and bicycles. The crossing point was about 700 m metres downstream of the new bridge. When the pontoons broke down, services were provided by canoes, and the trips were very dangerous

The new bridge is a reinforced concrete structure 160 metres long with four spans of different lengths. The carriageway width is 6 metres and there is a 1.5 metre with pedestrian walkway either side. Users of the bridge complained that the carriageway is too narrow and the pedestrian walkway is set too high above the road level, resulting in accidents on the bridge. Cyclists and motorbikes are particularly vulnerable as they must share the road with motorized vehicles.

Since the construction of the bridge considerable development has taken place on the east bank of the river, with the establishment of a new residential township. The traffic volume on the road is high (approximately 4,000 per day, see Annex 6). Congestion on the bridge will worsen as development on the east bank of the river increases and traffic from the south potentially uses the bridge as part of a new route to avoid Kitwe city centre.

The concrete structure of the bridge appeared to be in good condition though a structural assessment was not carried out as part of the visit. The asphalt surfacing of the bridge desk is cracked in some areas and water was seen ponding on the deck, possibly due to blocked drainage ducts. There was no sign of maintenance on the bridge.

Mufuchani Bridge at Kitwe

Narrow bridge deck with cracked surfacing and ponding of water (left), view eastwards showing new residential areas since construction of bridge (right)

Kalulushi to Lufwanyama Road

This 58 km section of road is part of the M18 road linking Kitwe to the M8 and western Zambia. The total length of the M18 is about 250 km. The road was being upgraded from gravel to paved standard in the early 2010s but the work was not complete. The road surfacing is DBST which now has significant potholes. The standard adopted in appropriate to the class of road and traffic, but requires maintenance. The traffic volume on the road is moderate (approximately 2,000 per day, see Annex 6). Most of the economic activity along the road involves commercial forestry with sawmills processing pine and eucalyptus from local plantations. There is some small holder farming.

Kalulushi Lufwanyama showing potholes (left) and end of paved section at Lufwanyama (right)


Kitwe to Chingola Dual Carriageway

The existing paved road between Kitwe and Chingola was upgraded to a dual carriageway (46km). The traffic volume on the road is high (approximately 5,800 per day, see Annex 6) with a particularly high proportion of heavy vehicles, and likely justifying a dual carriageway. The section visited was from Kitwe to the turnoff to Kalulushi (11 km). The section visited was generally in good condition though with some surfacing defects and poor drainage of the median which should be rectified by the RDA to prevent pavement failures.

Kitwe – Chingola Showing Poor Drainage of the Median and Surfacing Cracks


ANNEX 4 HDM4 CALIBRATION AND INPUTS

Given that all the projects involve upgrading from unpaved to paved standards, road widening, or both, the Highway Development and Management Model (HDM-4) is the most appropriate methodology for forecasting the economic benefits of these interventions. HDM-4 enables a comprehensive evaluation of road investment strategies by simulating the performance, maintenance requirements, and associated costs of different road types over time. It takes into account factors such as traffic volumes, pavement deterioration, maintenance strategies, and vehicle operating costs, making it particularly well-suited for analysing long-term infrastructure impacts.

HDM-4 carries out economic and technical appraisals by comparing the costs of road works against the benefits derived from reduced road user costs, vehicle wear and tear, time savings, and accident reductions. These outputs are critical for evaluating the Net Present Value (NPV) and Economic Internal Rate of Return (EIRR) of each project, ensuring that investments are prioritised based on their overall economic efficiency.

A calibrated HDM-4 model had already been developed for Zambia, providing a solid foundation for this research. However, some unit cost parameters—such as construction, maintenance, and vehicle operating costs—have been updated to reflect the time horizon of the study, which spans project start dates from 2010 to 2020, with 2040 used as the potential final appraisal year. These updates ensure that the model remains reflective of current and projected conditions, allowing for more accurate and relevant economic forecasts.

The table below presents the calibration inputs for the HDM4 maintenance regimes.

HDM4 Maintenance Regimes (Paving Project)

Scenario	Maintenance Regime	Unit Cost ($, 2023 prices)
Without Project (Do Minimum)	Routine cleaning and clearing (once / year) Grading (once / year) Regravelling (once every two years)	$300 / km $1,000 / km $16.67 / m^3
With Project	Routine cleaning and clearing (once / year) Pothole repair (potholes ≥ 5/km) Patching (ravelling ≥ 5/km) Crack sealing (structural cracks ≥ 1%) Edge repair (edgebreaks ≥ 10m^2/km Single dressing (IRI ≥5 and interval ≥8 years)	$1000 /km $17.65 / m^2 $17.65 / m^2 $7.60 / m^2 $20.5 / m^2 $6.80 / m^2

Source: Researcher's estimates

HDM4 Maintenance Regimes (Widening Project)

Scenario	Maintenance Regime	Unit Cost ($, 2023 prices)
Without Project	Routine cleaning and clearing (once / year) Pothole repair (potholes ≥ 5/km) Patching (ravelling ≥ 5/km) Crack sealing (structural cracks ≥ 1%) Edge repair (edgebreaks ≥ 10m^2/km Single dressing (IRI ≥5 and interval ≥8 years)	$1000 /km $17.65 / m^2 $17.65 / m^2 $7.60 / m^2 $20.5 / m^2 $6.80 / m^2
With Project	Routine cleaning and clearing (once / year) Pothole repair (potholes ≥ 100/km) Patching (ravelling ≥ 5%) Crack sealing (structural cracks ≥ 2%) Edge repair (edgebreaks ≥ 100m^2/km Single dressing (IRI ≥5 and interval ≥8 years)	$1000 /km $17.65 / m^2 $17.65 / m^2 $7.60 / m^2 $20.5 / m^2 $6.80 / m^2

The table below presents the calibration inputs for the HDM4 vehicle operating cost parameters.

HDM4 Vehicle Operating Cost Parametres

Input	Cars	Pick up / 4WDs	Buses (<25 pax)	Buses (>25 pax)	Trucks (2 Axle <3 tonnes)	Trucks (2 Axle >3 tonnes)	Trucks (3/4 Axle)	Trucks (>=5 Axle)	Tractor	Motorcycle
Economic Purchase Cost ($/#)	$22,953	$62,466	$63,437	$80,057	$49,447	$88,298	$91,830	$148,341	$22,953	$3,979
Tyre Cost ($/#)	$94	$164	$206	$234	$234	$417	$417	$427	$94	$132
Fuel Cost ($/litre)	$1.52	$1.51	$1.51	$1.51	$1.51	$1.51	$1.51	$1.51	$1.52	$1.52
Lubrication Cost ($/litre)	$2.94	$2.94	$2.94	$2.94	$2.94	$2.94	$2.94	$2.94	$2.94	$2.94
Av. Cost Maintenance Labour (/hr)	$4.79	$4.79	$4.79	$4.79	$4.79	$4.79	$4.79	$4.79	$4.79	$4.79
Total Wage Cost ($/hr)	$0.00	$0.00	$2.39	$2.39	$4.28	$4.28	$4.28	$4.28	$0.00	$0.00
Real Annual Interest Rate (%)	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Av. Cost of Passengers Working Time ($/hr)	$0.57	$0.57	$0.57	$0.57	$0.00	$0.00	$0.00	$0.00	$0.57	$0.28
Av. Cost of Passengers Non-Working Time ($/hr)	$0.28	$0.28	$0.28	$0.28	$0.00	$0.00	$0.00	$0.00	$0.28	$0.14
Average Cost of Cargo Delay ($/hr)	$0.00	$0.00	$0.00	$0.00	$0.20	$0.59	$0.79	$2.37	$0.20	$0.00
PCSE	1.0	1.0	1.2	1.5	1.3	1.4	1.6	3.0	1.0	0.5
No. Wheels	4	4	4	4	4	6	10	22	4	2
No. Axles	2	2	2	2	2	2	3	6	2	2
Av. Km driven (/year)	15,000	25,000	30,000	34,000	25,000	35,000	86,000	86,000	2,500	10,000
Av. Working hours (/year)	250	400	500	500	400	600	1,500	1,500	1,000	200
Average Service Life (years)	13.0	9.5	12.0	12.0	8.0	14.0	14.0	14.0	13.0	10.0
% Vehicle Trips Private Use	75%	38%	75%	0%	0%	0%	0%	0%	75%	75%
Av. No. of Passengers	3.4	3.2	9.0	19.5	5.3	5.1	2.7	2.2	3.1	1.5
% Passenger Trips Work Related	25%	25%	25%	25%	0%	0%	0%	0%	25%	25%
Av. Operating Weight (tonnes)	1.4	2.7	2.7	6.1	4.7	15.0	21.2	60.7	1.4	0.2
ESAL	0.0	0.0	0.0	0.0	0.0	6.9	4.1	4.4	0.0	0.0

Source: Researcher's estimates

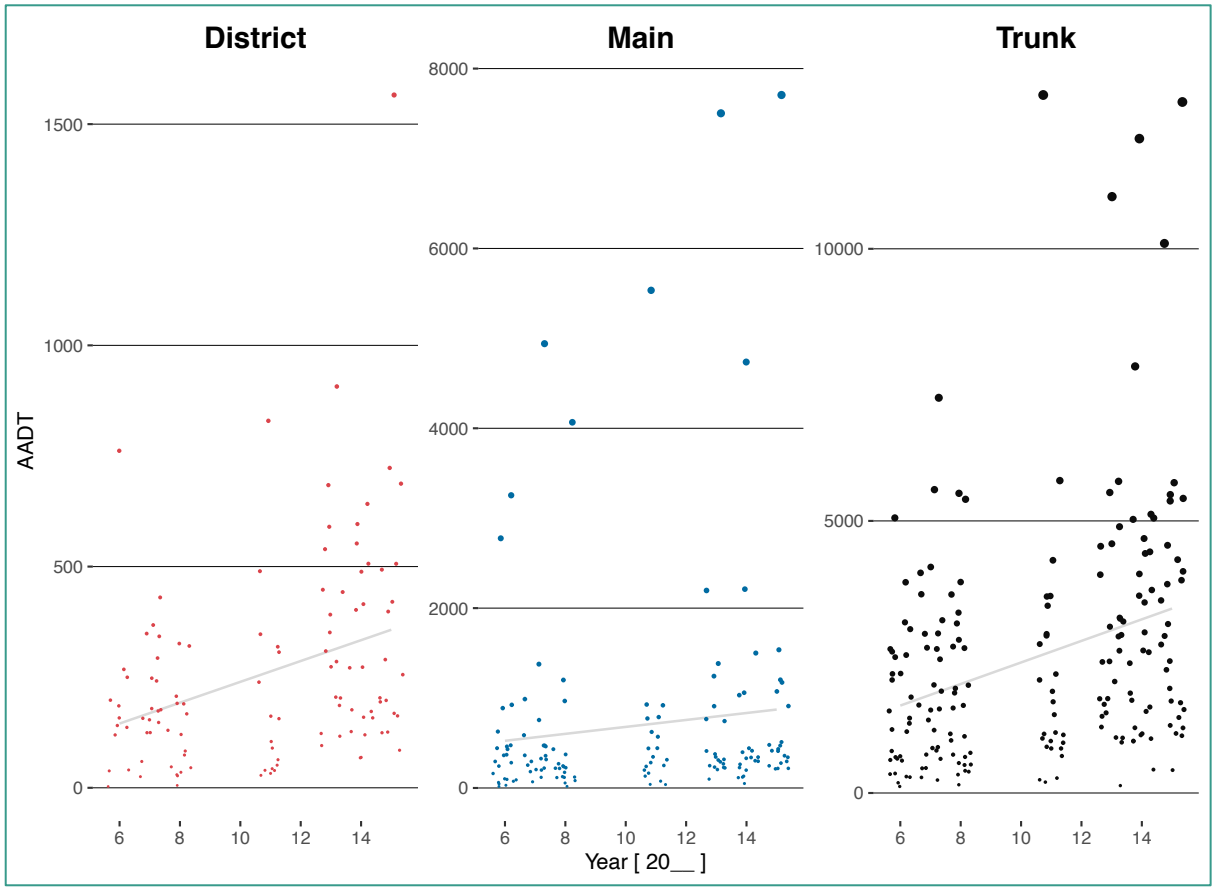
ANNEX 5 RDA TRAFFIC COUNTS AND NRFA TOLL ROAD DATA

RDA Counts Data

The Roads Development Agency (RDA) has provided traffic count data across 73 separate locations in Zambia for the period 2006 – 2015. The traffic profile covers light vehicles, buses, small trucks and large trucks. The geographical spread and time series data will allow for regression modelling in subsequent analysis.

The figure below presents the traffic count data disaggregated by road classification (district, main and trunk roads). Not surprisingly district roads are characterised by lower traffic levels (AADT 200 – 400), followed by main roads (AADT 400 – 1000) and trunk roads having the highest volume of traffic (AADT 1000 – 3000).

RDA Traffic Counts Across 73 locations by Classification (2006 – 2015)



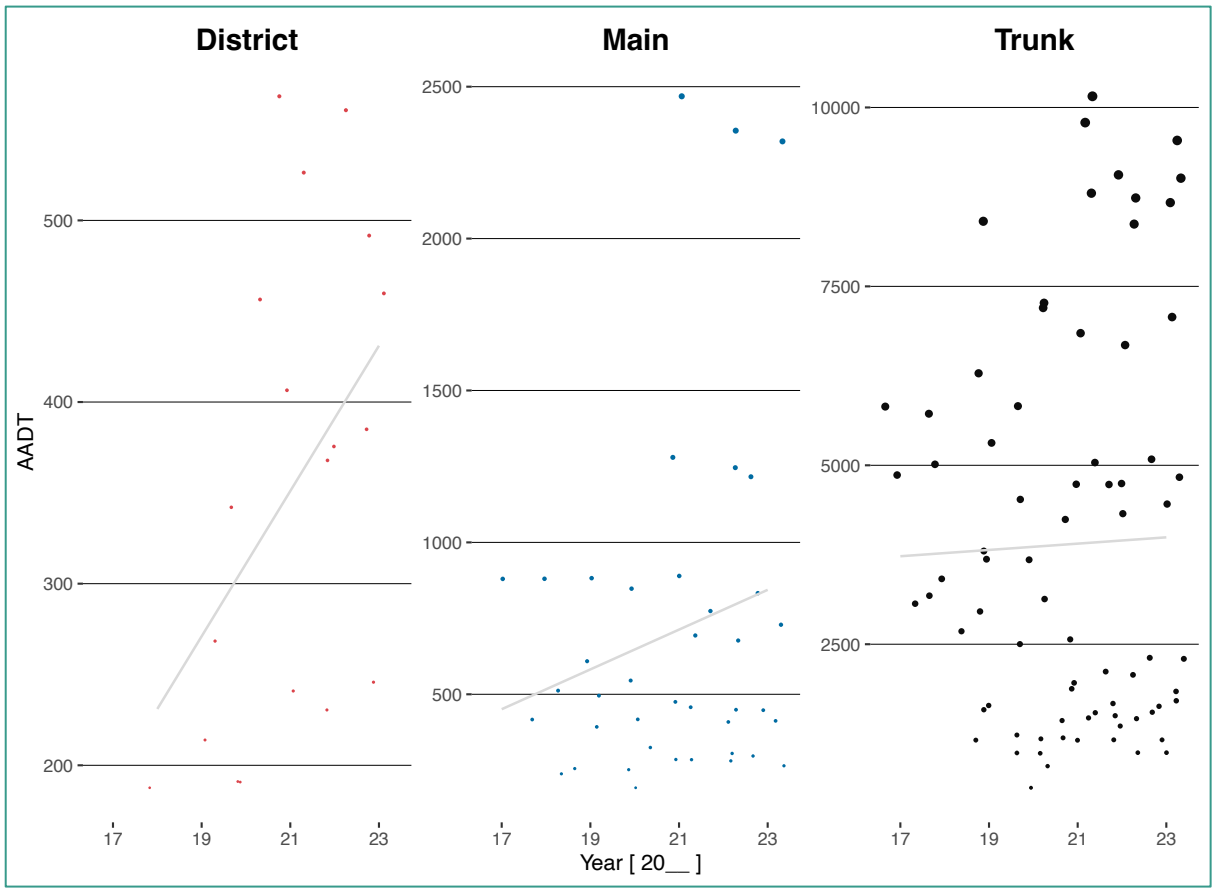
Source: RDA

NRFA Toll Data

The National Road Fund Agency (NRFA) provided traffic count data across 27 toll stations across Zambia for the period 2017 – 2024. The traffic profile covers light vehicles, small buses, small trucks / large trucks and large trucks. This database has been supplemented with the RDA traffic data for regression modelling.

The figure below presents the traffic count data disaggregated by road classification (district, main and trunk roads). The counts are a little higher than the RDA traffic data for trunk (AADT can be up to 10,000)– this is not surprising given the incentive for NRFA to toll higher volume roads.

NRFA Traffic Counts Across 27 Toll Stations by Classification (2017 – 2024)



Source: NRFA

ANNEX 6 MOVING TRAFFIC COUNTS

During the site visits, the research team conducted moving traffic counts along the project roads. An actual 30-minute count was conducted on Mufuchani Bridge.

It should be noted that moving counts are not as accurate as conventional stationary traffic counts, because they usually cover a much shorter time duration (the average duration of counts conducted by the research team was 35 minutes). Stationary traffic counts are typically conducted over 12 – 24 hours and a seven-day period. This constraint has been mitigated by converting the moving count estimates into a 24-hour daily average using known 24-hour time traffic profiles in Zambia. The result is to provide an Annual Average Daily Count (AADT). In addition, the counts (conducted in 28-30 November) have been converted to an annual average using known monthly conversion factors. Moving traffic counts do have one significant benefit over stationary traffic counts in that they represent a longer section of the road, whereas stationary traffic counts are carried out at a single location.

The 24-hour count, VOL, is estimated by the following equation:

- $VOL = \frac{1440(x+y)}{t}$, where;
- x = the number of vehicles passing in the opposite direction;
- y = the number of vehicles which overtake minus those which are overtaken; and
- t = the time taken to drive the road minutes.

Q can be can be converted into ADT by the following equation:

- $ADT = Q * HEF$, where;
- $HEF = Hourly\ Expansion\ Factor$
- HEF = Hourly Expansion Factor (a factor to convert a one-hour average into 24-hour average)

ADT can be converted into AADT by the following equation:

- $AADT = ADT * SAF$, where;
- SAF = Seasonal Adjustment Factor (a factor to convert a monthly average into a yearly average)

Summary AADT Along Project Roads

Road	Motorised					NMT	
	Cars	MC	Bus	Truck	AADT	Peds	Bikes
[Kitwe] - Kalulushi - Lufwanyama	1,160	154	218	431	**1,962**		
Copperbelt 400, Kalulushi	2,610	463	592	227	**3,893**		
Kitwe - Chingola Dual Carriageway (T3)	3,303	-	742	1,721	**5,766**		
Mufuchani Bridge*	1,199	2,067	459	265	**3,990**	2,522	447
Copperbelt 400, Kitwe	4,679	141	1,398	286	**6,504**		
Fatima Indeni Road	190	-	-	92	**282**		
Leopards Hill Road (D152) to junction RD481	1,928	110	32	430	**2,499**		
RD481 - Katoba	58	-	54	111	**224**		
Copperbelt 400, Ndola	1,502	82	474	91	**2,149**		

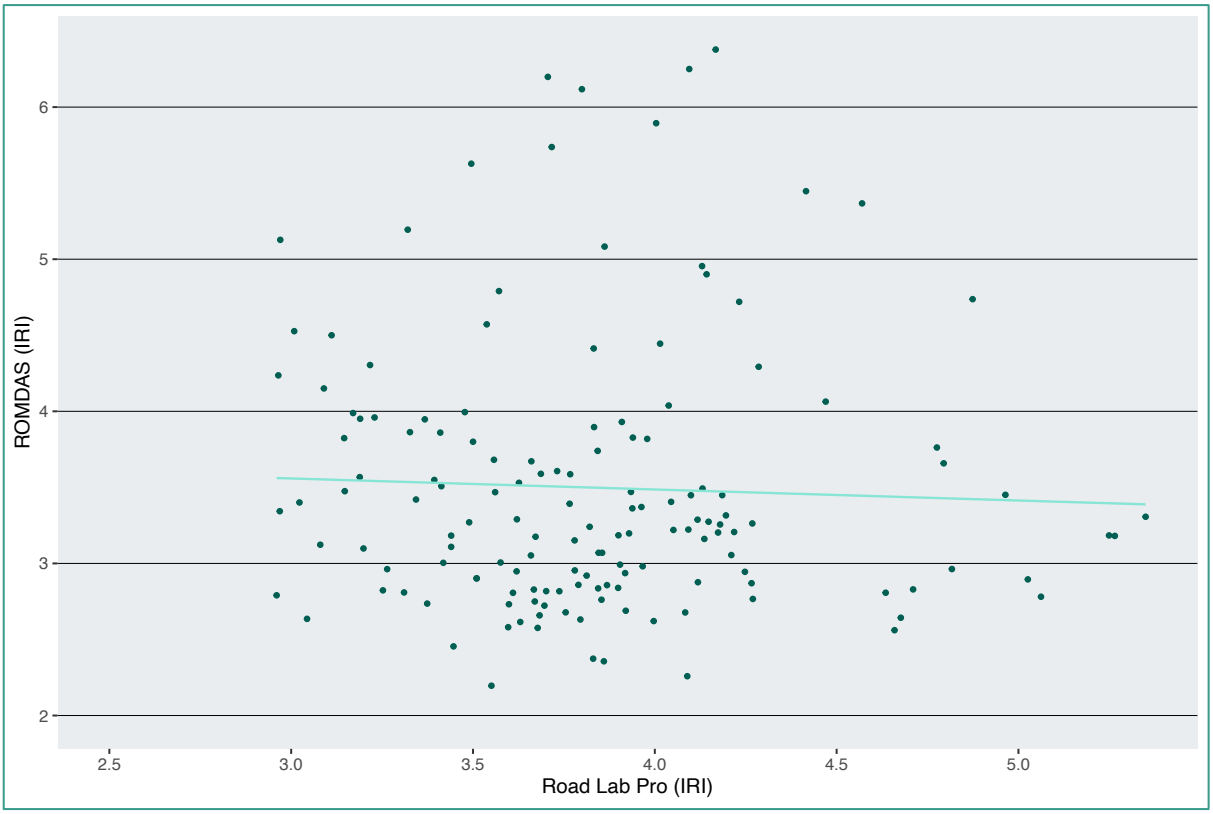
*Source: Consultant's estimates. * Actual (30 mins) count conducted on Mufuchani Bridge*

ANNEX 7 ROUGHNESS MEASUREMENTS

The research team collected roughness measurements using the World Bank Developed Road Lab Pro mobile application. Before using the Road Lab Pro results, it is recommended that the application is correlated/calibrated against a known Type 1 measuring device which can measure the 'true roughness' of the road. The research team has been provided access to known actual roughness values as measured by the RDA's ROMDAS along the Landless Corner – Mumbwa road(M20). The comparison between the two measuring devices is presented in the plot below.

A rational relationship is characterized by a positive slope, however, as can be seen with the line of best fit, which is downward sloping, the Road Lab Pro measurements cannot be used reliably to measure the RDA ROMDAS measurements. This does not conclude that the Road Lab Pro is inaccurate, and the divergence could be due to a multitude of reasons, including, that the ROMDAS baseline measurements are not an accurate measurement of the 'true roughness'. Nevertheless, without further comparison tests, it is prudent to discard the Road Lab Pro roughness measurements collected during the site visits.

Comparison of Roughness Measurements (Road Lab Pro versus ROMDAS)



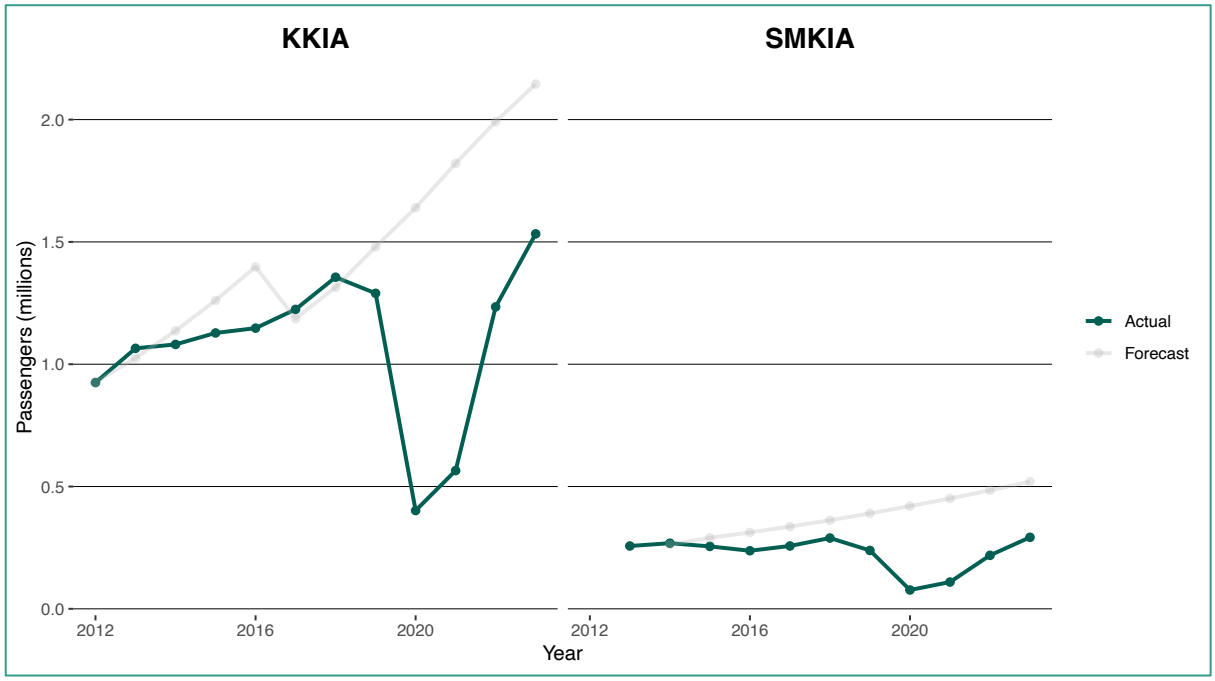
Source: RDA (ROMDAS), Research Team (Road Lab Pro)

ANNEX 8 AIRPORTS SECONDARY DATA

Airport Passenger Data

The Zambia Airports Corporation Limited (ZACL) has provided actual airport passenger numbers for 2012 – 2023 and presented them in the figure below. Forecast passenger values from the Kenneth Kaunda International Airport (KKIA, Lusaka) and Simon Mwansa Kapwepwe International Airport (SMKIA – Ndola) Feasibility Studies have been added for comparison. For KKIA the forecast traffic was similar to actual traffic until 2018. As expected, the Covid pandemic resulted in a divergence and so far, traffic has not fully recovered and the number of passengers is slightly over 1.5 million per annum. For SMKIA, traffic has not recovered from the Covid pandemic and the number of passengers is approximately 0.3 million per annum. The forecast traffic as per the Feasibility Report, 2014, was consistently overestimated.

Airport Passenger Numbers (2012 – 2023), Actual vs Forecast



Source: Actual (ZACL), Forecast (Feasibility Study, 2013 [KKIA], Feasibility Study, 2014 [SMKIA])

Airport Cargo Data

Besides moving passengers, air transport is also important for moving cargo. Between 2012 and 2022, total cargo volumes for Zambia's international airports, especially KKIA, remained fairly stagnant, increasing from 13,929 metric tonnes (MT) in 2012 to 16,570 MT in 2022, representing a total average growth of 3.6% over the period. This is a negligeable increase compared to volumes moves by other modes such as road, rail and water, which recorded 34.3 million, 894,117 and 185,802 MT, respectively, by 2022 (MOFNP 2023). Zambia's low manufacturing base and lack of cargo dedicated planes operating within the country account for this limited amount of cargo hauled, especially for air. Source: Constructed by author from ZACL Annual Reports

Stakeholder consultations with ZACL revealed that the construction of a new airport in Ndola (SMKIA) was mainly intended to create a cargo hub targeting the mining Copperbelt Province in Zambia and Katanga province in the Democratic Republic of Congo. Whether or not that vision will be realised depends on several factors, including competition from other transport modes such as road and rail (as highlighted), and the ability to attract dedicated air cargo operators taking into account regional competition.

As of 2023, the total cargo volume moved by air (mainly through KKIA) remains low, at 18,054 MT. The key cargo operators include Emirates, Qatar Airways, Astral Aviation, Ethiopian Airways and Kenyan Airways (ZACL 2024).

Airport Revenue And OPEX

ZACL provided data on revenue and expenditures for KKIA and SMKIA. Full annual data is available for 2023, while the year 2024 covers the months January to October. For both airports there is a net surplus, however, the CAPEX of the airport expansion (KKIA) and construction (SMKIA) is not accounted for in the costs borne by ZACL. Therefore the data below does not include debt services for the airport projects (this is presented below).

Summary Revenue and Costs (2023, full year), ZMK millions

Category	KKIA	SMKIA
Revenue	725,606,617	94,538,776
Costs	386,355,913	85,440,381
Net	339,250,704	9,098,395

Source: ZACL

Summary Revenue and Costs (2024, Jan - Oct), ZMK millions

Category	KKIA	SMKIA
Revenue	841,624,434	111,952,590.5
Costs	383,812,180	88,340,591
Net	457,812,254	23,611,999.5

Source: ZACL

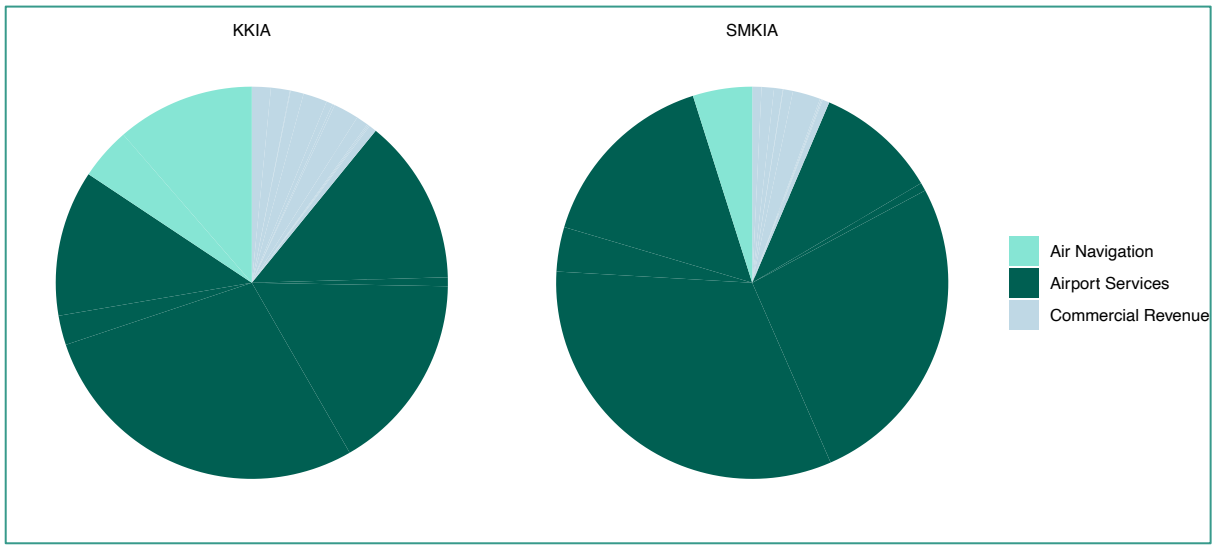
For both airports, the vast majority of revenue is derived from airport services which are comprised of the core airport activity (landing fees, parking fees, ground handling, passenger service charges, and infrastructure fees). For KKIA there is a significant proportion of the revenue derived from navigation revenue, however, this is partially because overflight fees from the provincial airports (including SMKIA) are charged through KKIA.

Revenue Split for KKIA and SMKIA (2023), ZMK

2023	KKIA	SMKIA
Landing Fees	99,199,117	9,541,710
Parking Fees	5,315,441	642,891
Ground Handling	118,960,756	24,820,646
Passenger Service Charge	204,582,158	30,688,917
Cute & CUSS Process Fees	17,629,633	3,468,739
Infrastructure Fees	87,324,350	14,680,799
Total Airport Services	**533,011,455**	**83,843,702**
Fuel Throughput	11,301,979	718,699
Adverts	11,345,991	967,155
Kiosks	382,124	677,018
Warehouses	7,859,865	39,052
Offices	14,323,671	756,903
Car Parks	3,852,419	2,158,545
Houses/Hangar	1,372,262	-
Restaurants	5,107,382	104,610
Bars	-	30,232
D/Free Shops	7,229,865	-
Coldroom Conc.	3,755	-
Elect/Water	829,176	-
Land and Cell Sites	768,627	76,637
Miscellaneous	4,586,063	545,583
Total Commercial Revenue	**78,963,180**	**6,074,432**
Navigation Fees	31,101,363	4,620,642
Overflight Fees	82,530,619	-
Total Air Navigation Revenues	**113,631,982**	**4,620,642**

Source: ZACL

Revenue Split for KKIA and SMKIA (2023)



Source: ZACL

The expenditure split for the KKIA and SMKIA is presented in the table below. For both airports, the biggest cost component is staff costs (62% for KKIA and 71% for SMKIA). There are significant repair and maintenance-related costs for KKIA (7%) while this is minimal for SMKIA given that it is a newly constructed facility. For SMKIA, the electricity costs are significant (7%).

OPEX Split for KKIA and SMKIA (2023), ZMK

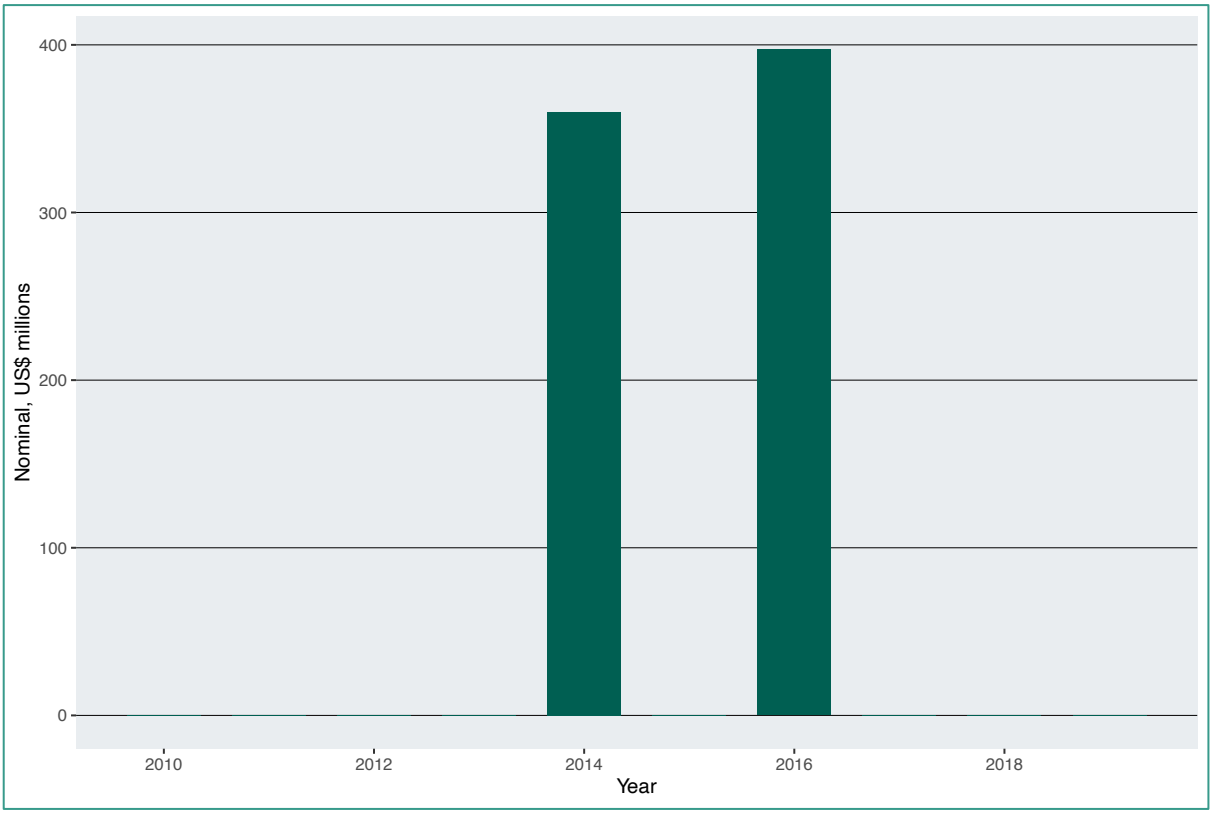
OPEX Category	KKIA	SMKIA
Salaries and Wages	192,114,883	54,142,696
Other Staff Costs	47,469,570	7,028,930
Cargo and Mail	5,211,518	1,043,879
Postage	256,834	48,705
Hire of Transport	9,763,177	3,717,594
Rates	13,154,733	3,968,849
Security Charges	680	119,248
Aviation Security Charge	22,922,965	2,920,788
Uniforms and P/clothing	4,681,340	21,900
Printing and Stationery	3,083,336	398,092
Motor Vehicle Expenses	3,573,880	1,468,327
Insurance	4,164	0
Travelling Local	1,512,583	792,529
Travelling Overseas	871,056	21,885
Repairs & Maintenance/infrastructure Expenses	26,379,731	665,677
Finance Charges	4,578,429	0
Bank charges	22,934	26,153
IATA Fees	13,707,381	0
Electricity	9,365,558	6,337,265
Water	22,480	19,610
Communication	1,769,293	95,553
SITA Bills	17,027,221	395,363
Cleaning Services	3,384,420	847,620
Cleaning Expenses	1,379,351	206,985
Customer service & Corporate Affairs	192,060	52,300
Office Expenses	1,125,303	176,713
Licences	134,288	135,223
Fire Fighting Foam	571,603	612,884
Total Costs	**386,355,913**	**85,440,381**

Source: ZACL

Airport Borrowing Costs

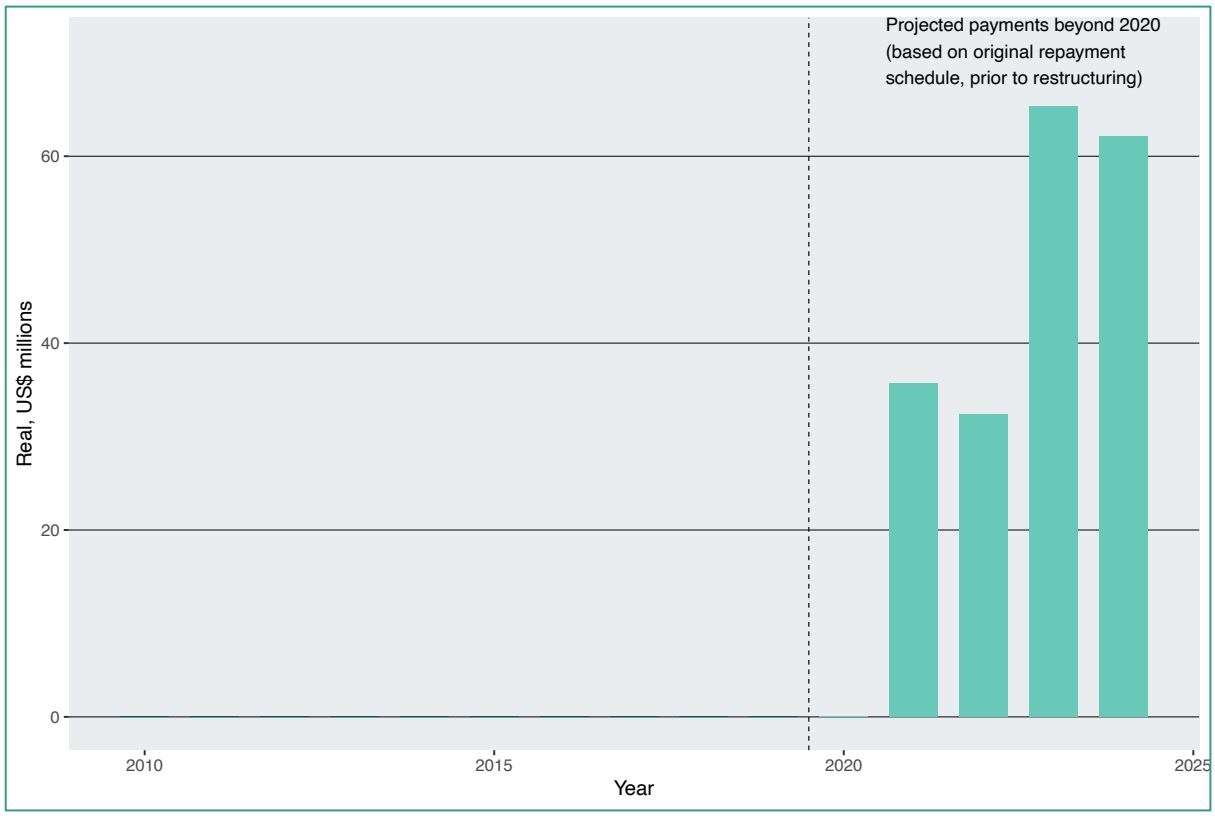
Airport sector borrowing is summarised in the diagram below. In 2014, a total of US$360 million (nominal) was contracted for the Kenneth Kaunda International Airport (KKIA) expansion, and a further US$397 million (nominal) for the construction of the Simon Mwansa Kapwepwe International Airport (SMKIA). Both loans were financed by the Export–Import Bank of China (China Exim Bank).

Airport Borrowing, Nominal US$

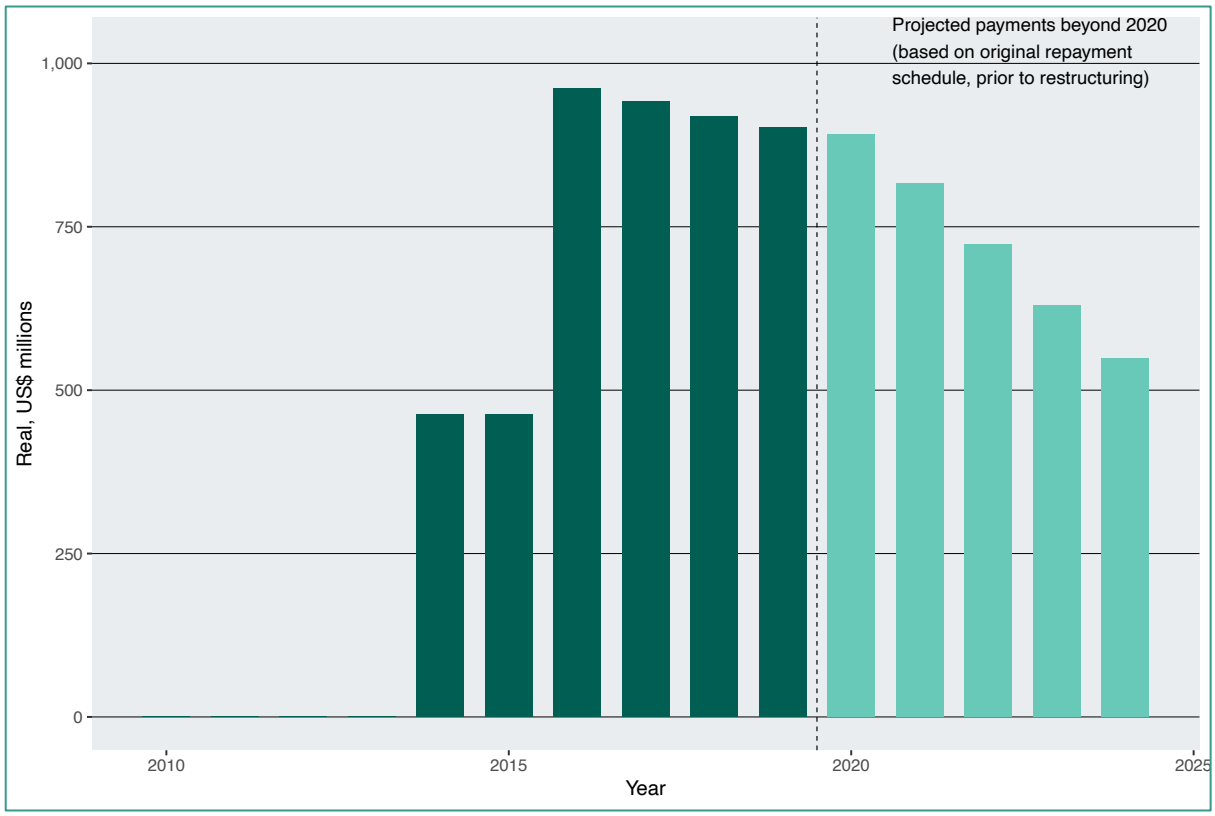


Each facility carried an eight-year grace period, with debt servicing commencing in 2021. Under the original repayment schedule, annual debt service obligations were projected to peak at approximately US$65 million (in 2023 real terms), before gradually declining over the remaining amortisation period.

Scheduled Debt Service Obligations (2010-2024) (US$, real 2023 prices)



Projected Outstanding Airport Project Loan Balance (2010-2024), Real US$ 2023 Prices



SMKIA and KKIA Costs

The capital investment costs of the KKIA and SMKIA have been provided by ZACL as $360 million and $397 million respectively. A breakdown of the individual component costs has been estimated based on the contract values (actual expenditure can only be accessed from the Department of Public Infrastructure, Ministry of Housing and Infrastructure Development). The contract data have been

analysed and categorised accordingly based on the research team's best assessment. In both projects the majority of the costs (almost 70%) was for the terminal building and aircraft movement areas (runway, apron, taxiway etc.). The major differences are that the KKIA project included a Presidential Terminal and the SMKIA included higher allocation for the Air Traffic Control (as it included the traffic control equipment) and allocations for roadways and a fuel farm. SMKIA included a completely new runway, taxiways and aircraft parking areas.

Disaggregated Cost Components for Airport Projects (US$, millions)

Component	KKIA		SMKIA	
	Cost	%	Cost	%
New Terminal	$170.6	47%	$92.7	23%
Aircraft Area Movement	$75.4	21%	$165.2	42%
Presidential Terminal	$23.4	6%	$0.0	0%
Vehicle access ramp	$22.3	6%	$23.0	6%
Airport Hotel	$19.2	5%	$9.3	2%
Air Cargo Terminal	$15.0	4%	$6.2	2%
Existing Terminal Modifications	$10.8	3%	$0.0	0%
Airport Complex Building	$9.7	3%	$3.6	1%
Parking	$4.4	1%	$2.1	1%
ATC and Radar Tower and Equipment	$3.6	1%	$32.4	8%
Emergency Services	$5.7	2%	$5.6	1%
Roadways	$0.0	0%	$35.7	9%
Fuel Farm	$0.0	0%	$12.5	3%
Other	$0.0	0%	$8.8	2%
Total	$360.0	100%	$397.2	100%

Source: Consultants estimates based on ZACL data

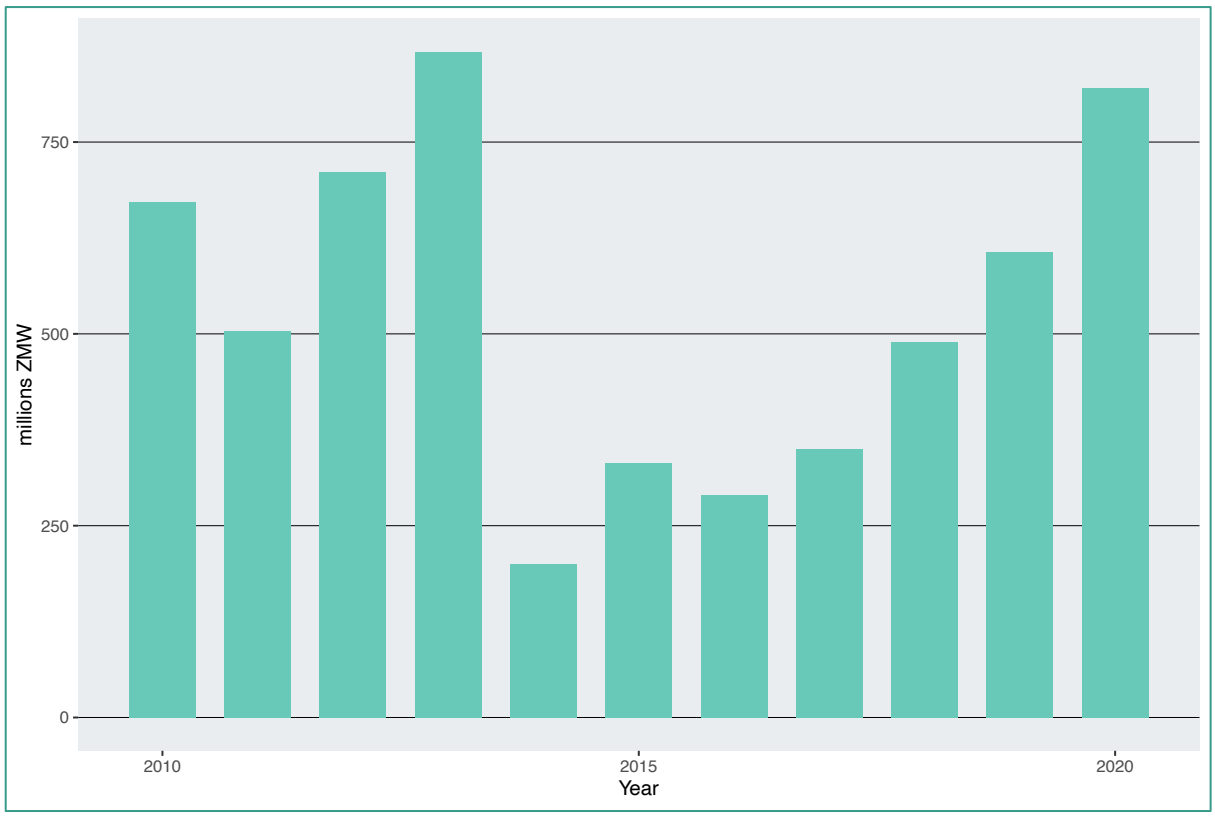
ANNEX 9 ALTERNTIVE TABLES AND FIGURES

Zambia's Road Maintenance Funding (2010-2020) (millions ZMW, nominal)

Year	Maintenance Expenditures
2010	672.0
2011	504.1
2012	711.3
2013	868.0
2014	200.6
2015	331.6
2016	290.4
2017	350.0
2018	489.0
2019	606.5
2020	821.1

Source: Years 2010 – 2012 estimated from National Roads Fund Agency. Years 2014 – 2020 provided by National Roads Fund Agency. *Year 2013 interpolated by research team. Conversion to real values estimated by research team.*

Zambia's Road Sector Maintenance Allocations (2010-2020) (millions ZMW, nominal)



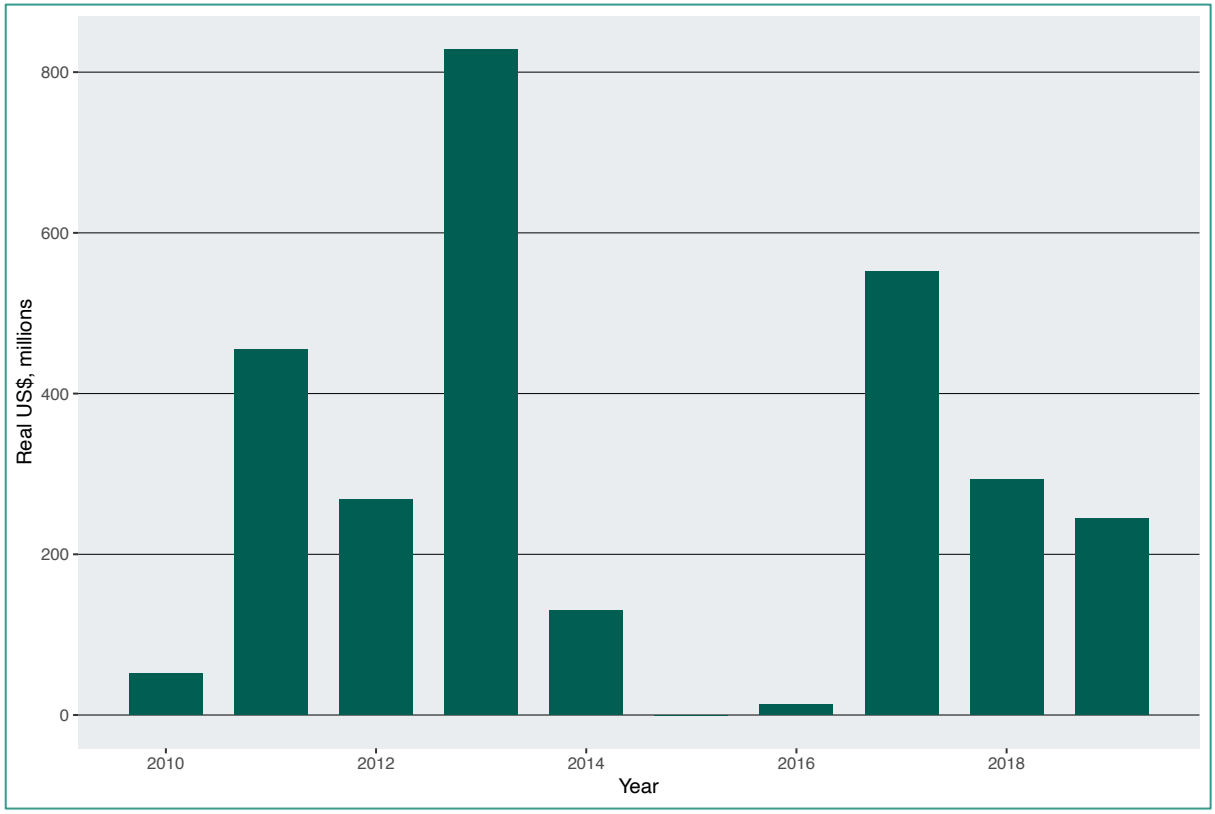
Source: Years 2010 – 2012 estimated from National Roads Fund Agency. Years 2014 – 2020 provided by National Roads Fund Agency. Year 2013 interpolated by research team.

Eurobonds Issuance and Expenditure (nominal terms)

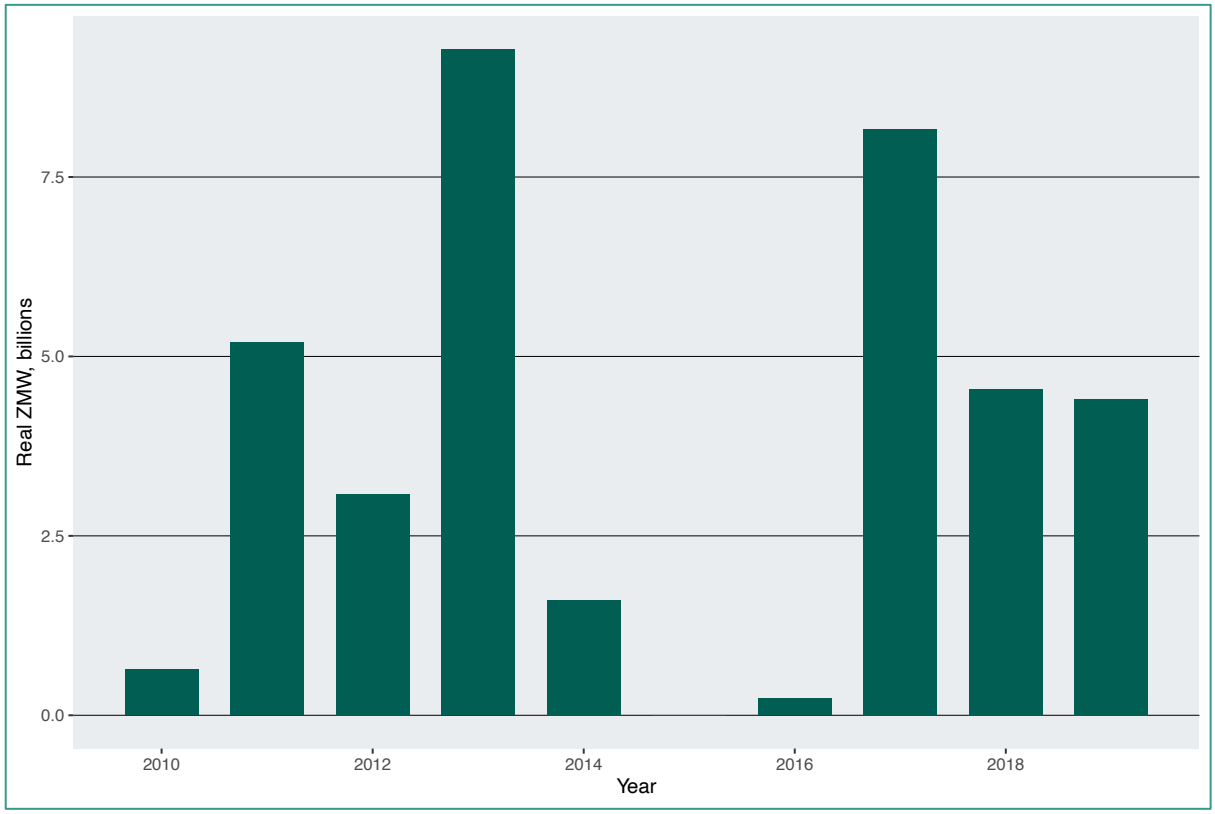
Year	Eurobond (US$, millions)	Sub - Exp roads (US$, millions)	Sub Exp roads (ZMW, millions)	Exp Eurobond source
2012	$750.0	$155.0	-	Eurobond I
2013	-	$155.0	-	Eurobond I
2014	$1,000.0	-	ZMW 900.0	Eurobond II
2015	$1,250.0	-	ZMW 2,200.0	Eurobond III
2016	-	-	ZMW 900.0	Eurobond II
Total	$3,000.0	$310.0	ZMW 4,000.0	-

Source: Finance Minister to Parliament, 2018 (https://diggers.news/business/2018/02/26/mwanakatwe-explains-eurobond-interest-payment/

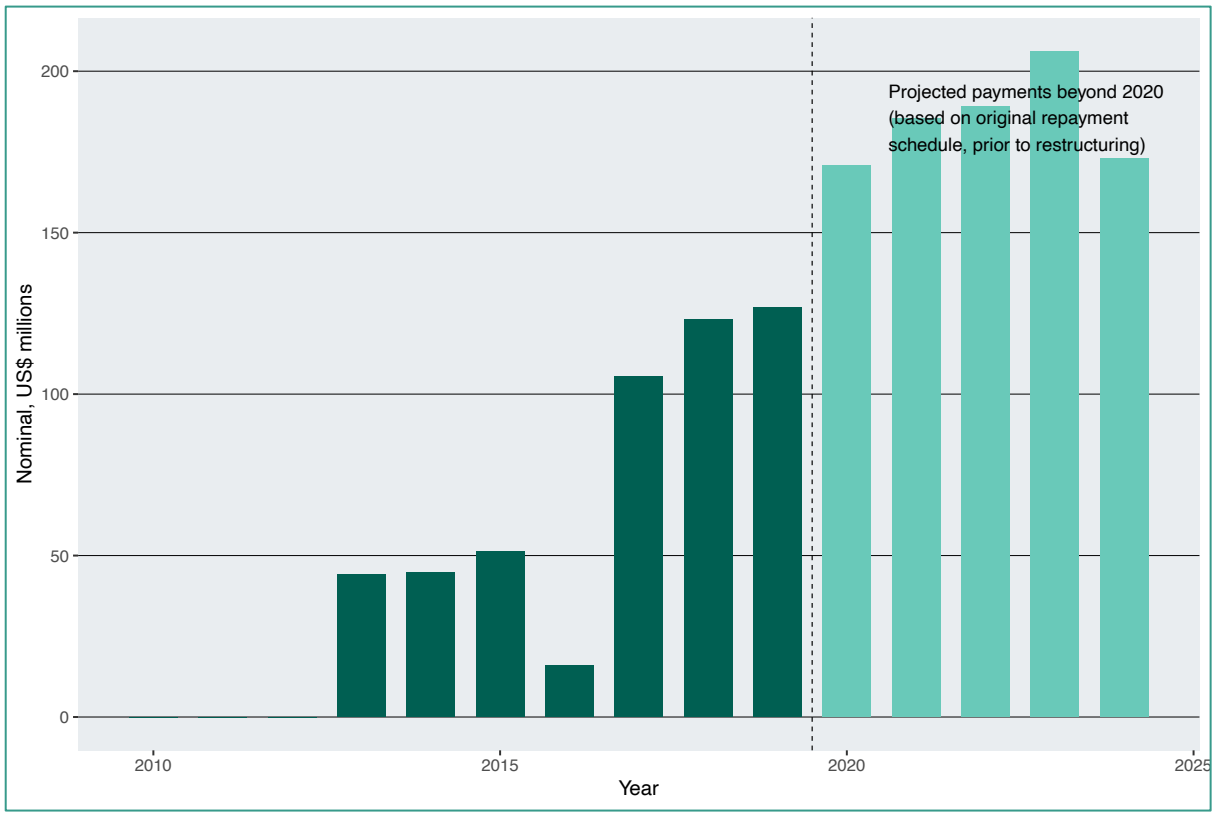
Roads Project Aggregate Principal Loan Amounts (2010-2020) (millions US$, real 2023 prices)



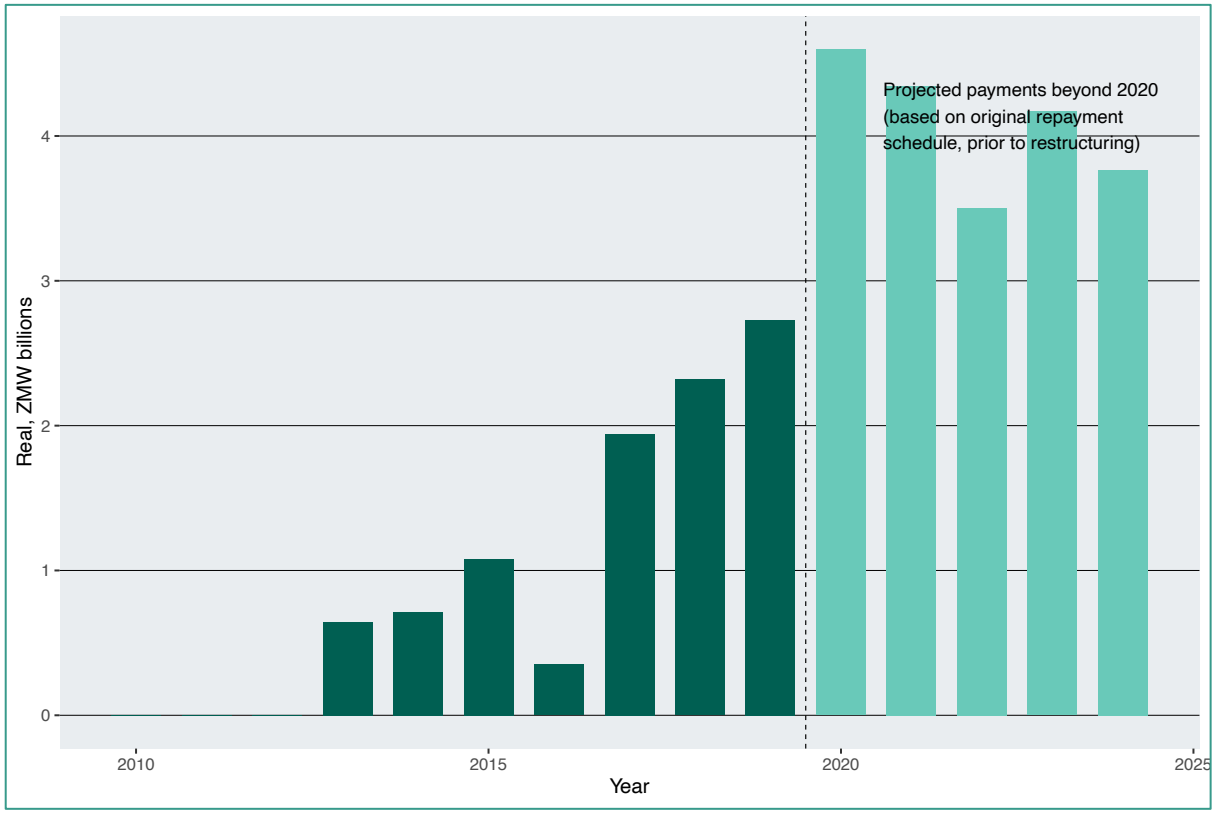
Roads Project Aggregate Principal Loan Amounts (2010-2020) (billions ZMW, real 2023 prices)



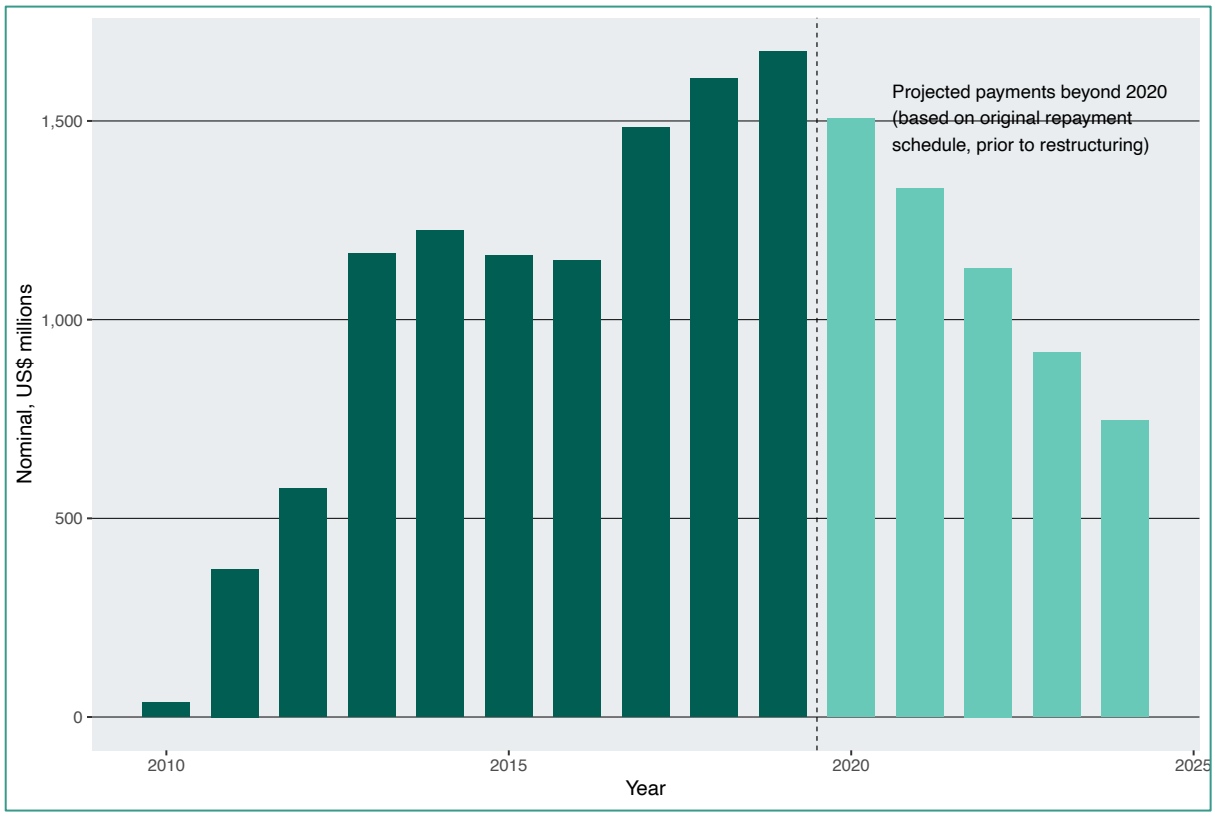
Roads Project Scheduled Debt Service Obligations (2010-2024) (millions US$, nominal)



Roads Project Scheduled Debt Service Obligations (2010-2024) (billions ZMW, real 2023 prices)

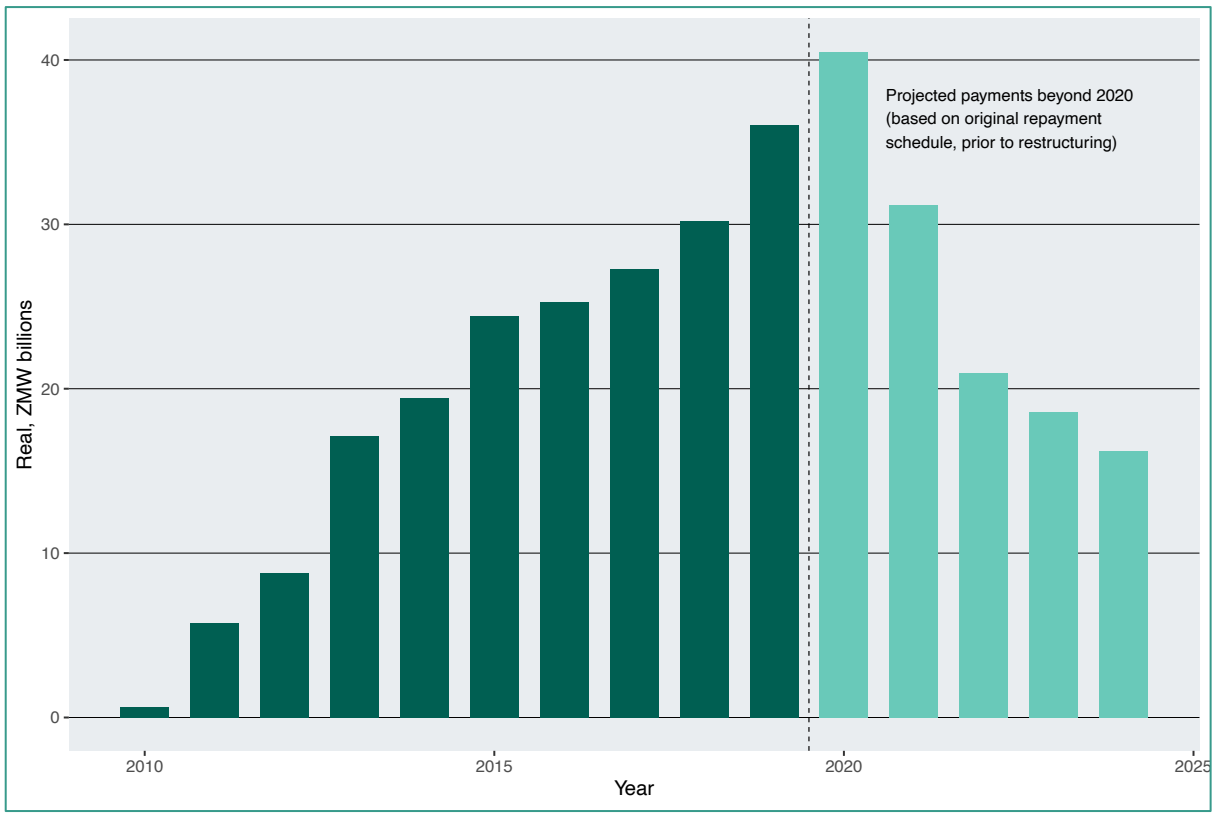


Roads Project Projected Outstanding Loan Balance (2010-2024) (millions US$, nominal)

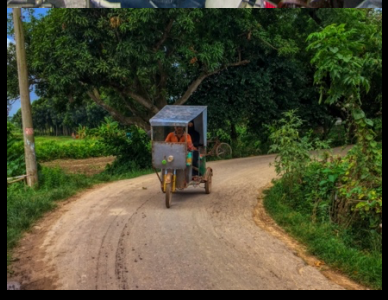


Source: Researchers estimates

Roads Project Projected Outstanding Loan Balance (2010-2024) (billions ZMW, real 2023 prices)



Source: Researchers estimates



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