ZIPAR
Zambia Institute for Policy Analysis & Research

Optimization Study for Core Road Network Planning to Link Zambia

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The reported research was undertaken by ROM Transportation Engineering Ltd, Jerusalem, Israel, for and on behalf of the Zambia Institute for Policy Analysis (ZIPAR). The research was commissioned by ZIPAR under the mandate of the Road Sector Programme Support 2 – Institutional Support Component of the Danish International Development Agency (DANIDA). In commissioning this research, ZIPAR partnered with the Ministry of Finance and the Ministry of Transport, Works, Supply and Communications (MTWSC)

Executive Summary

The Zambian road network is undergoing significant improvements which will increase the total length and improve the condition of some of the existing sections. Among the major projects going on are those encompassed by the Link Zambia 8000, Lusaka-Copperbelt Corridor, and Pave Lusaka 400. The Link Zambia 8000 programme for construction and rehabilitation of road infrastructure is expected to increase access to markets, enhance social inclusion and reduce travel time and cost to the benefit of local communities and the whole economy. The Programme has so many projects to be implemented in three phases.

Our report presents an assessment of the importance of different road sections and corridors ("projects") prioritized based on transportation efficiency, accessibility and socio-economic characteristics. To do that, a simplified nation-wide travel demand model (TDM) coupled with a post-processor tool for project evaluation was developed. A TDM is used to support decision-making in the development of different transport facilities and land uses. A TDM makes the projection and analysis of future transportation patterns and comparison of different settings more practical. In the development of the national TDM for Zambia, the entire road network was considered with special attention being given to major trunk roads that connect major urban centres and those that support regional linkages.

A comprehensive national TDM that could not be developed in this study could support enhanced decision making such as identification of major transportation relationships between areas, prioritization and comparison of road investments, road tolling decisions, transportation land use planning, intercity public transport, traffic and freight volume projections and fuel consumption needs. The entire evaluation process in this study delivers a sufficient instrument for project prioritization even though the TDM employed may not be unconditionally policy responsive.

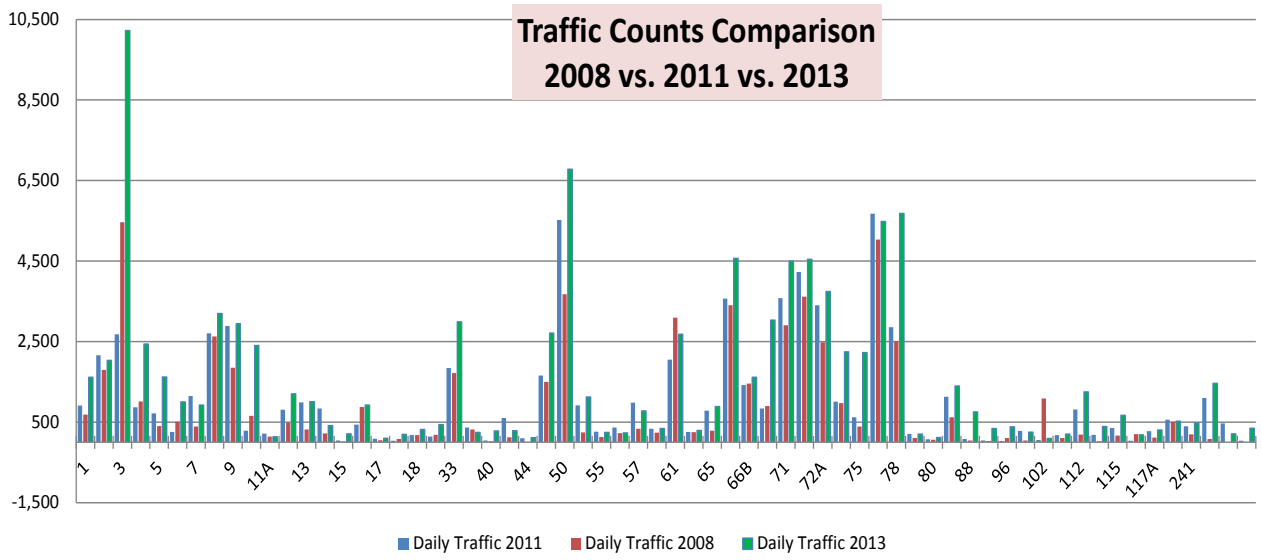
With the foregoing we are convinced that this report delivers a coherent project evaluation tool for the prioritization of road transport infrastructure projects. This is in spite of the data limitations that could only permit development of a simplified TDM for this study. The evaluation tool can be upgraded, updated and used on any set of road transport projects. In this report we analysed existing and projected traffic patterns as well as various socio-economic and demographic datasets. The final priority project list and its attributes might not be very precise due data limitations, but they can be revised at any time should new and higher quality data be available.

Population Projections

The study observed that Zambia's total population is projected to grow by 78%, to 25.09 million people through 2030. However, some areas are expected to more than double their population while others will only marginally grow. Considering that transportation needs derive from human activity, places with higher projected populations are expected to have higher demand for transport services. Population projections are therefore important considerations in the development of a Travel Demand Model (TDM).

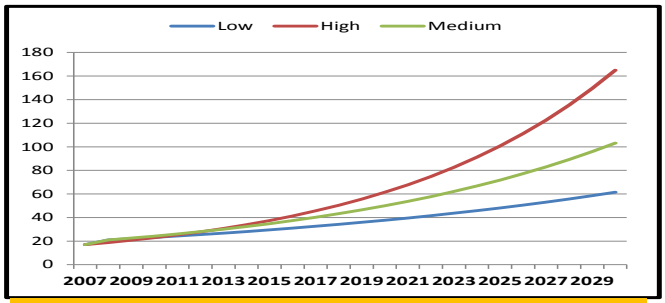
Traffic Projections

Despite the existence of multiple major commercial and population centres, and an overall increase of 73% in road traffic between 2008 and 2013, interurban traffic volumes are still very low. This is in part a result of poor road infrastructure, causing extended travel times, increased overall transport costs and reduced traveling/freight incentives. The expected improvements in the roads network are also likely to result in increased traffic.



Car Ownership

The study predicts that car ownership going to increase rapidly. In 2030, car ownership is projected to increase in such a way that the roads between Lusaka and Copperbelt will possibly be congested. The median estimate of car ownership growth by 2030 is 500%. This is represented in the figure on the right



Car Ownership Projection 2030

2030 Congestion Projections

The study observes that in 2030, highways between Lusaka and Copperbelt and between Lusaka and Kafue will be congested. However, a slowdown is likely along some highways such as the one between Lusaka - Chipata and the one between Lusaka – Livingstone. Congestions levels were graphically analysed using GIS maps. The green, yellow and red codes on the GIS map to the right signify slight, moderate and great congestion respectively.

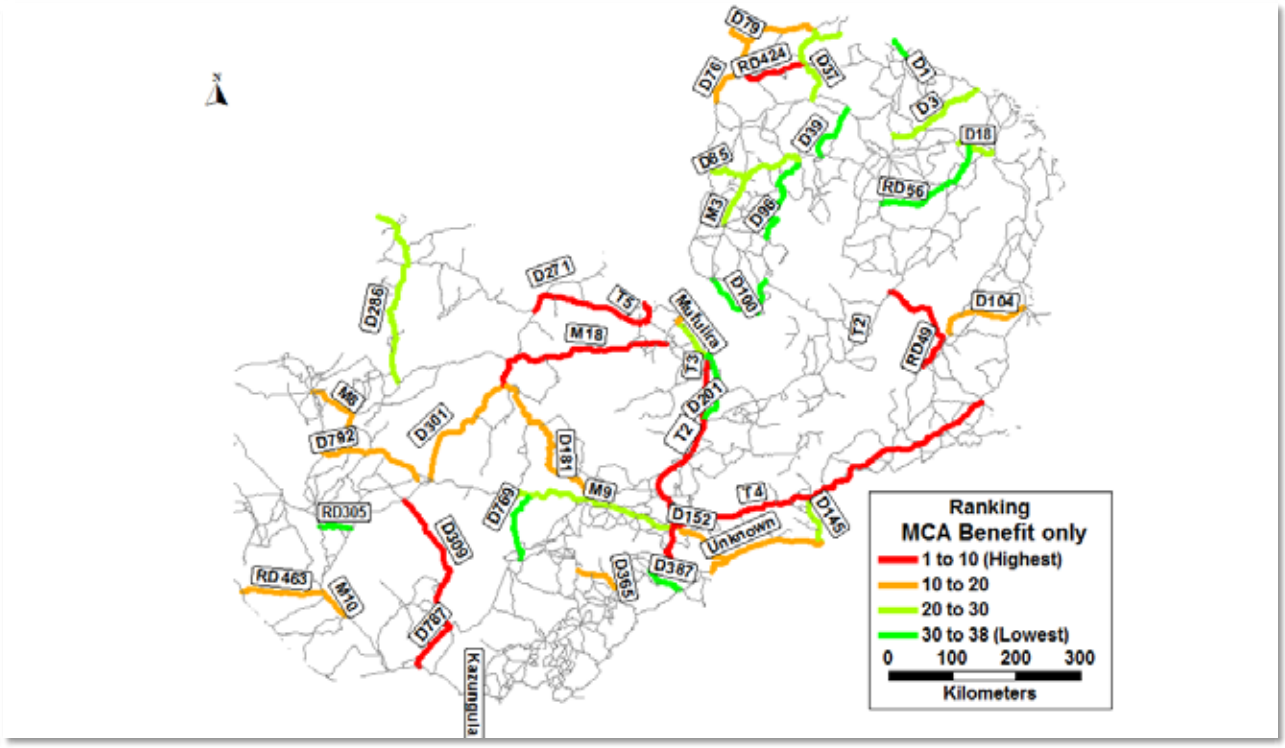
Project Evaluation

The evaluation considered 38 projects in total. Most of these projects are in the Zambia 8000 investment plan. Other projects include major trunk roads from Lusaka to major destinations. Projects were analyzed two ways; First, each project was analyzed using Multi-Criteria Analysis (MCA) and was ranked according its expected benefits. Next, each project was analysed using the cost-benefit ratio and ranked accordingly. The criteria used in this analysis are summarised below.

Criteria	Source	Year	Proposed Weight
Volume of Private Vehicles	Traffic Assignment in TDM (calibrated to traffic counts)	2013	20%
		2030	10%
Volume of Commercial Trucks	Truck Traffic Assignment (calibrated to traffic count)	2013	20%
Time Savings for Cars	Car Traffic Assignment	2013	5%
		2030	5%
Truck Time Savings	Truck Traffic Assignment	2013	20%
Current Road Standard	RDA Work Plan	2013	5%
Socio-Economic Index	User Passenger Average Socio-Economic Status	2013	10%
Border Impact	GIS Analysis	-	5%

Project Prioritization

While the MCA ranking makes no accounting for costs, the Cost-Benefit ranking assigns a high value to low cost projects, thereby causing low cost projects to be ranked highly despite the fact that the project may have little overall value to the economy. The question for policy-makers in choosing a method of prioritization is what policy they wish to pursue. If the benefit approach is chosen, this would lead to the development of the projects offering the highest benefit first. Corollary this would lead to increased benefit for the nation and a higher rate of public support for projects in the longer term. However, if a cost conscious method is chosen, more of small-scale projects may get done, but the benefit realized may be minimal.



To get around the above stated problem the study selected the top ten (10) projects from the benefit analysis as a starting point and then subjected them to benefit-cost analysis. The result is a new project priority list that selects the projects with greater benefits and is at the same time cost effective.

The new project priority list for the 38 projects therefore would start with the Lusaka to Kafue (T2) which involves upgrade to dual carriageway of a 57.4km road, Mununga to Mporokoso (D36 - RD424) requiring upgrading to bituminous of a 130km road, Kalulushi to Kasempa (M18 & D181) which involves upgrading to bituminous of a 185km road, Chingola to Chililabombwe/ Kasumbalesa (T3) which involves upgrading to dual carriageway of a 45km road, ….

Going forward, it is important that important investment decisions are cross checked on expected benefit and cost effectiveness using the various models available. This study provides one of the models that can consistently be used to prioritise infrastructure projects in the road sector. To further enhance the predictive value of the model used, it is recommended that the current national TDM is updated and preferably as part of the approaching national Transport Master Plan development activity.

Road ID	Road name	Length (km)	Status	Phase	Total points	Benefits Ranking	Cost-Benefit Ranking		
							Cost (USD, m)	CB ratio	Ranking (Best=1)
T2 & T3	Lusaka to Ndola	311.2	upgrade to dual carriageway	2	71.9	1	605.7	12%	33
T2	Lusaka to Kafue	57.4	upgrade to dual carriageway	-	66.2	2	100.5	66%	5
T5	Chingola to Solwezi/Mutanda	205.0	upgrade to dual carriageway	2	40.7	3	472.4	9%	36
D787 & D309	Sesheke (Simungoma)- Luampa	450.0	Upgrade to Bituminous	3	40.3	4	252.4	16%	28
M18 & D181	Kalulushi to Kasempa	185.0	Upgrade to Bituminous	2	38.6	5	101.2	38%	11
T4	Lusaka to Chipata	572.0	upgrade to dual carriageway	-	38.4	6	667.9	6%	38
RD49	Mpika - Nabwalya - Mfuwe	118.0	Upgrade to Bituminous Standard & Re-Align	1	38.0	7	183.2	21%	21
D36 - RD424	Mununga to Mporokoso	130.0	Upgrade to Bituminous	2	36.4	8	71.1	51%	7
T3	Chingola to Chililabombwe/ Kasumbalesa	45.0	upgrade to dual carriageway	2	35.1	9	103.7	34%	12
D76 - D77 - D79	Nchelenge -Chiengi-Luchinda -Kaputa	205.8	Upgrade to Bituminous Standard & Re-Align	-	34.7	10	139.2	25%	18
D152 & RD491	Katoba Basic School via Chiawa to Chirundu	120.0	Upgrade to Bituminous	1	32.5	11	124.5	26%	17
D301	Kasempa to Kaoma	215.0	Upgrade to Bituminous	2	31.2	12	117.6	27%	15
D792, D557, M8	Kaoma to Lukulu to Zambezi	275.3	Upgrade to Bituminous	2	30.7	13	150.6	20%	22
RD463, M10	Matebele - Shangombo	135.0	Upgrade to Bituminous	3	30.0	14	174.3	17%	26
Unknown	Chiawa - Feira Rd including Bridge across R. Chon	200.0	New road	1	28.6	15	321.7	9%	35
T3 Junction - M4	Sabina (T3 Junction) to Mufulira to Mukambo (M4	41.5	upgrade to dual carriageway	-	27.6	16	39.4	70%	4
D365	Monze to Niko	75.0	Upgrade and Re-Align	-	27.3	17	38.8	70%	3
D104	Mwase-Lundazi-Chitungulu & Mwanya Mfuwe	290.0	0	3	27.3	18	162.7	17%	27
D181	Mumbwa to Kasempa	284.0	Upgrade to Bituminous	2	26.8	19	145.5	18%	24
D3	Nseluka -Chitimukulu-Makasa up to D1	170.0	Upgrade to Bituminous	3	26.6	20	95.3	28%	13
D145	Luangwa to Feira including Bridge	80.9	Upgrade to Bituminous & Upgrade of bridge	-	26.5	21	59.4	45%	9
Mufulira rd.	Ndola to Mufulira	62.0	upgrade to dual carriageway	2	25.9	22	41.9	62%	6
Kazungula Bridge	Kazungula Bridge between Zambia & Botswana	0.8	Construction of bridge instead of ferry	-	25.0	23	18.0	139%	1
M9	Kafue hook bridge, Lusaka-Mongu Rd	270.0	Maintane and rehabilitate	-	24.1	24	50.0	48%	8
D286, M5	Kabompo to Mwinilunga to Jimbe	311.0	Upgrade to Bituminous	2	21.9	25	170.2	13%	32
T2 & D18	Isoka to Mbesuma	168.0	New road	1	21.4	26	77.1	28%	14
M3	Mansa to Chipili to Luwingu road	175.0	Upgrade to Bituminous	1	17.1	27	214.5	8%	37
D37	Mporokoso - Nsama - Kaputa	194.9	Upgrade to Bituminous	1	16.9	28	111.0	15%	29
M3 & D85	Munganga - Kawambwa & Mwenda to Kashiba	168.0	Upgrade to Bituminous	3	16.3	29	77.1	21%	20
D96	Samfya - Musaila - Lubwe - Kasaba - Ipukusilo - Luv	176.0	Construction of new bridges	1	16.3	30	111.9	15%	30
RD9	Mbala-Kaseshya Border - Kalambo	47.0	Upgrade to Bituminous	3	15.2	31	35.0	43%	10
D201	Old Congo Road Tug Argan to Kapiri	113.0	Upgrade to Bituminous	3	14.9	32	63.4	24%	19
D39	Luwingu to Kapatu Mission to Nondo	99.2	Upgrade to Bituminous	2	14.3	33	54.3	26%	16
RD305	Namushakende - Nalikwanda	60.0	Upgrade to Bituminous	3	13.1	34	67.9	19%	23
D387	Chikankata	30.0	Upgrade to Bituminous	3	12.9	35	16.3	79%	2
RD56 & D63	Safwa to Mulilansolo via Chinsali	185.0	Upgrade to Bituminous Standard & Re-Align	1	12.8	36	133.4	10%	34
D100	Chembe to Milenge to Kasanka	206.0	New road	-	11.2	37	81.6	14%	31
D769	Mumbwa - Itezhi Tezhi	110.0	Upgrade from gravel to bitoumen	3	10.9	38	61.1	18%	25

Acknowledgement

ZIPAR would like to acknowledge the invaluable support of the following Institutions to this study; Ministry of Finance (MoF), Ministry of Transport, Works, Supply and Communications (MTWSC), Ministry of Local Government and Housing (MLGH), Lusaka City Council (LCC), Road Development Agency, National Road Fund Agency (NRFA) and Road Traffic and Safety Agency (RTSA).

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1. Introduction

1.1 Background

Zambia's road network is undergoing significant improvements which will increase its total length and improve the condition of some of the existing roads and sections. Among the major projects going on are those encompassed by the Link Zambia 8000 Programme, the Lusaka-Copperbelt Corridor, and Pave Lusaka 400. In parallel, investments such as the rehabilitating the Lusaka-Chipata corridor and other important roads are also getting some consideration.

1.1.1 Link Zambia 8000

In an effort to meet the challenges of increasing population, increasing economic growth and to improve the economic viability of the country, Government initiated the Link Zambia 8000 Programme, also called the Accelerated National Roads Construction Programme. The goal of the project is to accelerate the road construction in the country. The Link Zambia 8000 Programme encompasses construction and rehabilitation of road infrastructure. It is expected to increase access to markets, enhance social inclusion and reduce travel time and cost to the benefit of the whole economy. The Programme will require an outlay of at least ZMW 28.2 billion over a five year period.

The link Zambia 8000 Programme has so many projects to be implemented in three phases. The first phase commenced in 2012 and focuses on the regions of Lusaka and Eastern Zambia. It has focuses on already been tendered and is already in progress with regard to construction. The second phase focuses on the Northwestern and Western regions of Zambia and is currently at the feasibility studies. The third phase focuses on specific major roads such as the Ndola-Chingola, and other scattered corridors. This phase is yet to reach the stages reached by the first two phases. Table 1 below shows a summary of the Link Zambia 8000 Programme phases and other road projects that intended to enhance mobility in Zambia.

Table 1: Link Zambia 8000 Programme Phases Summary

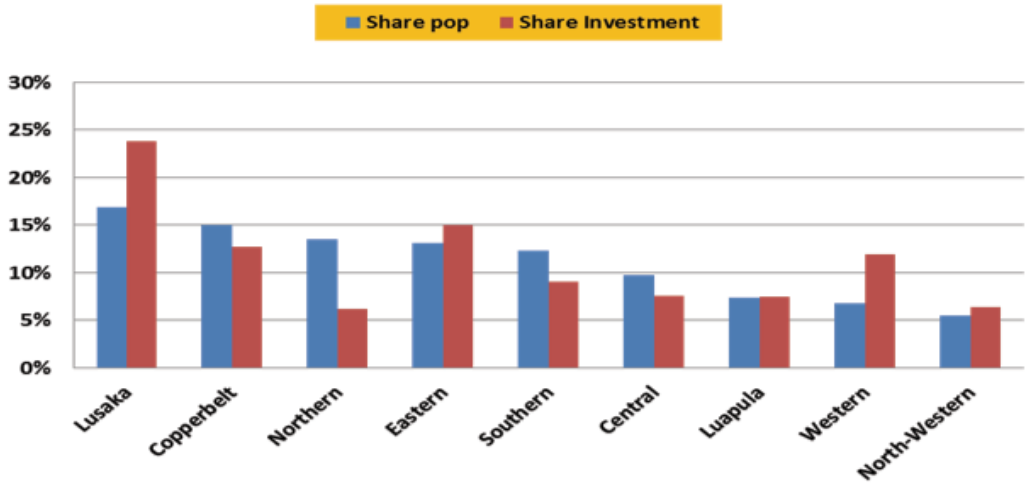
	Phase 1 2012-2014	Phase 2 2013-2015	Phase 3 2014-2016	Others 2012-2013	TOTAL (5 years)
Number of links	15	15	23	28	81
Length (km)	2,289.9	2,747.1	2,862	2,212	10,112
o/w under Construction (km)	730	91	-	1,481.5	2,302.5
Total estimated programme cost (ZMW, Billion)					28.2
Average annual cost (ZMW, Billion)					5.68

The scope of the Link Zambia is to upgrade a minimum of three roads in every province. A total of 37 roads are included as a part of the Link Zambia 8000 project over all 10 provinces. This will amount to the upgrading of 7,899.09 kilometres of roadway on 53 links over a five year period from 2012 to 2016. While 24 main roads will be constructed and rehabilitated under this Programme, the primary effect is to improve connectivity from rural areas to main roads. This is expected to enhance national economic growth and social development gains.

In addition to the Link Zambia 8000 projects, there are others that are scheduled to be launched, such as the rehabilitating of the Lusaka-Chipata corridor.

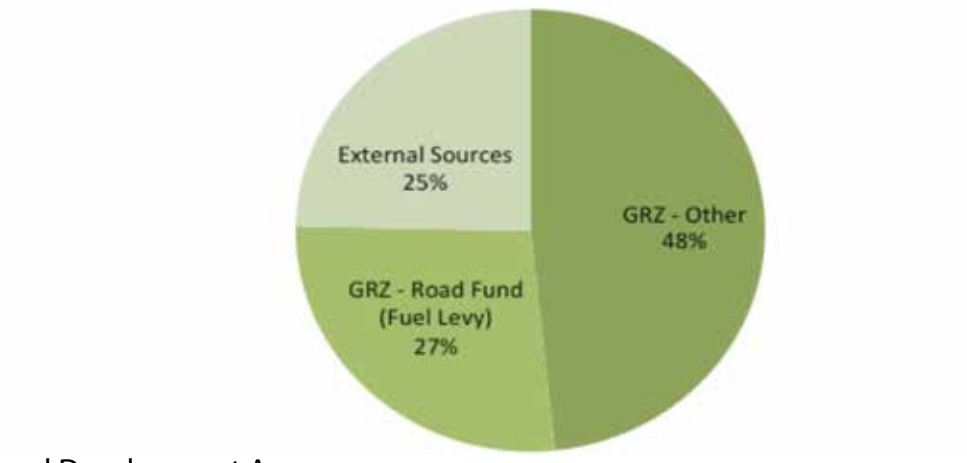
According to the RDA, ZMW3.3 billion was expected to be invested in road development throughout 2013. In order to complete the planned investments, budget for future years will need to be doubled up to roughly ZMW3.5-5.0 billion over the coming 5 years. Investments will not be distributed evenly between the provinces. Some provinces (Lusaka and Western) will enjoy a larger share than others (North-Western and Northern). This is reflected in Figure 1 below.

Figure 1: Population and Road Investment Share by Province



Road development is expected to be primarily internally financed. For instance the approved Road Sector Annual Work Plan (RSAWP) for 2013 shows over 75% percent of the funds were to be provided by Government. The financing profile for the 2013 RSAWP is shown in figure 2 below.

Figure 2: Road Sector Projects Profile for 2013



Source: Road Development Agency

1.1.2 The Importance of the Road Network in Zambia

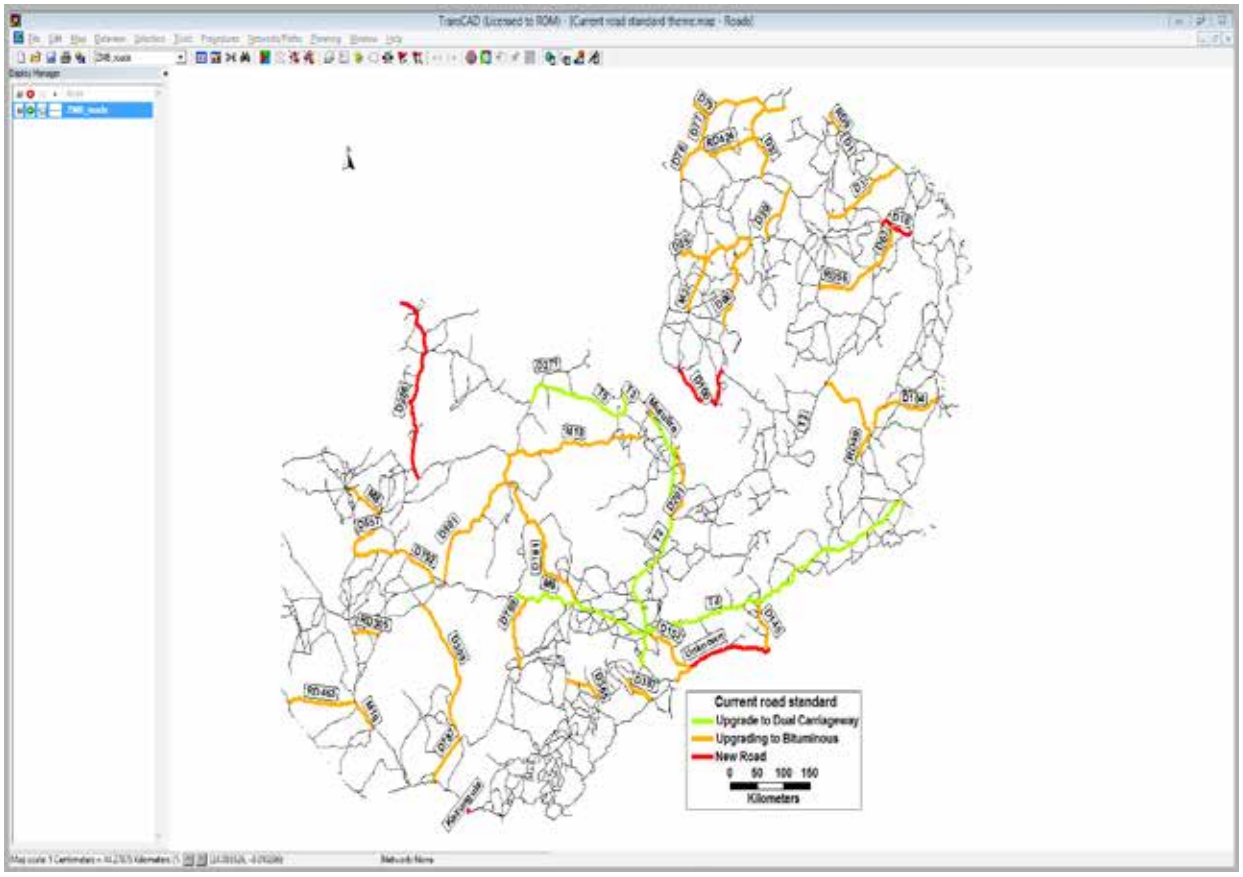
Zambia is a landlocked country with a population of over 13-million people spread over an area of 753,000 square kilometres. The development and population are predominantly concentrated along the line of rail. Over 40,445 kilometers of core road network link the population of Zambia. The total length of the country's roadways is over 91,000 kilometres of which approximately 20,000 kilometres are paved. The condition of the road network has been deteriorating over the years, and improving the infrastructure is considered a key step in the overall development of Zambia. Table 8 displays the condition of roadways in Zambia.

Table 2: Condition of Paved Road Network

Condition Score	Proportion of Road Network in each Condition Score				
	2006	2007	2008	2009*	2009**
Good	.29	.19	.33	.18	.75
Fair	.64	.71	.61	.76	.24
Poor	.07	.10	.06	.06	.01
* RoadSIP II					
** Proposed RoadSIP II					

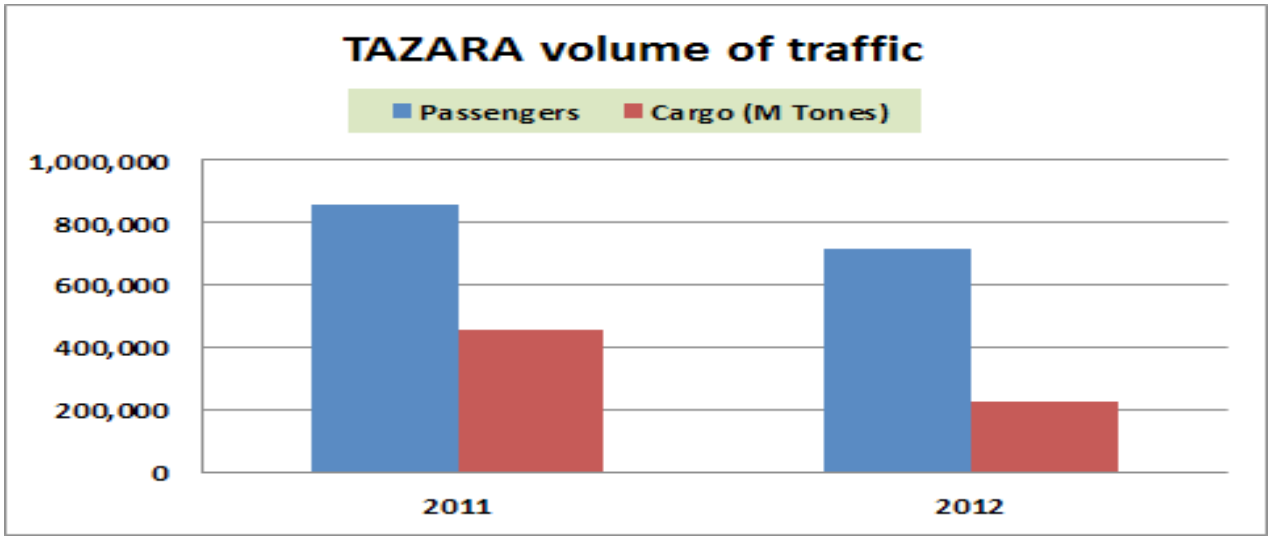
Source: Road Development Agency

Map 1: 2013 Zambia Roadway Conditions



Demand for rail service in Zambia has declined over the years due to slow and unpleasant service as well as increase in road transport service levels. Competitive pricing remains the only advantage of train over road transport. Freight trains still operates from the Copperbelt via Lusaka and Livingstone through Bulawayo to the port of Durban in South Africa. Another route, the TAZARA railway line, connects at Kapiri-Mposhi to the port of Dar-e-Salaam in Tanzania. However, the rail services are neither attractive nor financially sustainable. They fail to offer real competition to freight trucking on major routes. Data shows a significant decline of rail demand between 2011 and 2012 alone. Figure 5 shows the volume of traffic for the TAZARA rail line for both passengers and freight.

Figure 3: TAZARA Traffic Volumes



Zambia's social and economic development is highly dependent on transportation and more precisely, the road transportation, as other modes of transport (air, rail, marine) are very limited in service. The current road network needs significant improvement and maintenance to reach a satisfactory level. The vast size of the country, its dispersed population and land-locked status increases the importance of transportation optimized planning for Zambia's economic and social development.

In order to improve this situation, the Zambian government in recent years has allocated significant portions of its budgets towards road development, rehabilitation and maintenance. A good amount of resources is still expected to be injected into the improvement of the road network over the coming years. Table 1 below summarizes the importance of the road network for Zambia.

Table 3: Importance of the Road Network in Zambia

Purpose	Social	Economic	Poverty Reduction
Improve mobility and connectivity	+	+	+
Reduce travel time	+	+	+
Enhance social inclusion for residents in remote area	+		+
Reduce traveling operational cost	+	+	
Improve road safety condition	+	+	
Promote international investment in agriculture, industry & mining	+	+	+
Distribute the population beyond Lusaka and Copper belt areas	+		+

1.1.3 Study Objectives

The main objective of this study was to develop a consistent modeling tool for prioritizing road project.

The specific objectives were:

i. To assess the relative importance of the different road sections and corridors (projects) within the national road network and prioritize them based on transportation efficiency, accessibility and socio-economic factors

ii. To determine the most sustainable and beneficial road network possible.

1.1.4 Study Scope

The study assessed of the relative importance of the current road network and the planned improvements based on demographic, transportation efficiency, accessibility and socio-economic importance. Existing and projected traffic patterns were also used in the study. The assessment involved development of the first nation-wide travel demand model for Zambia coupled with a post-processor tool for project evaluation. The entire road network in Zambia was considered with special attention being given to major trunk roads that connect major urban centers and those that facilitate regional linkages.

The study incorporated base (2013) and horizon (2030) year transportation benefits appraisals for each of the considered projects. The estimated benefits were then evaluated against costs for the purposes of prioritization. A modeling framework of thirty eight (38) road sections (projects) from the Link Zambia 8000 Programme and other important road projects was.

The entire assessment process delivers a sufficient instrument for project prioritization. Our report therefore presents a coherent project evaluation tool for the prioritization of road transport infrastructure projects. The evaluation tool can be upgraded, updated and used on any set of road transport projects. The credence and limitations of the final project priority list and its attributes depend the credence and limitations of the data used.

While the list of projects may be amended, this study emphasizes a modeling and evaluation methodology to be adopted for the evaluation of future projects.

2. Methodology

2.1 Document Reviews

The study employed a combination of methodologies to arrive at its conclusions. The study mostly depended on qualitative and quantitative secondary. Therefore document reviews were a major undertaking in the execution of this study. Table 4 below gives a summary of the reviewed studies.

Table 4: Reviewed Studies

Document	Author	Published	Data
Sectorial Development Strategies- Transport sector	CUTS	2006	Zambia transportation status: PT, rail, roads, traffic congestion
Infrastructure- Sector Profile	ZDA	2013	Zambia transportation infrastructure status
Transport Prices and Costs in Africa: A review of the main international corridors	AICD	2008	Price of commercial goods transportation through main land corridors in Africa
Research on Cross-Border Transport Infrastructure	JICA)	2009	Study analysing the current situation and issues regarding CBTI in Sub-Saharan Africa. Proposal of a CBTI development strategy.
The Crisis in the Zambian Road Sector	ZIPAR	2013	Review of current national road status
Resource allocation model for the constituency development fund	ZIPAR	2013	Socio-Economic index by constituency
Country mining guide	KPMG	2013	Identify major location of Mining and volume of production
Transport Policy	MTC	2002	Zambia transportation policies to be implemented

2.2 Other Data

The secondary data used in the study included fiscal data for the road sector, traffic counts, and GPS surveys of major roads, maps, demographic data, household survey data and regional and international trade data. Project cost data and benefits data was also collected. Table 5 below summarizes the other secondary data used in the study.

Document	Author	Published	Data
Zambia Census of Population and Housing	CSO	2010	Demographic data- population and households for Zambia by ward
Living Conditions Monitoring Survey	CSO	2006 & 2010	Household social and economic welfare data
Zambia Census of population and housing	CSO	2000	Demographic data- population and households for Zambia by ward
Road Network Condition Survey in Zambia	RDA	2008	Traffic count data for inter- urban roads
Link Zambia 8000 Road Project	RDA	2013	Project timeline, road sections to be improved- current condition, project maps
GIS Inter-urban Road Network			GIS road layers

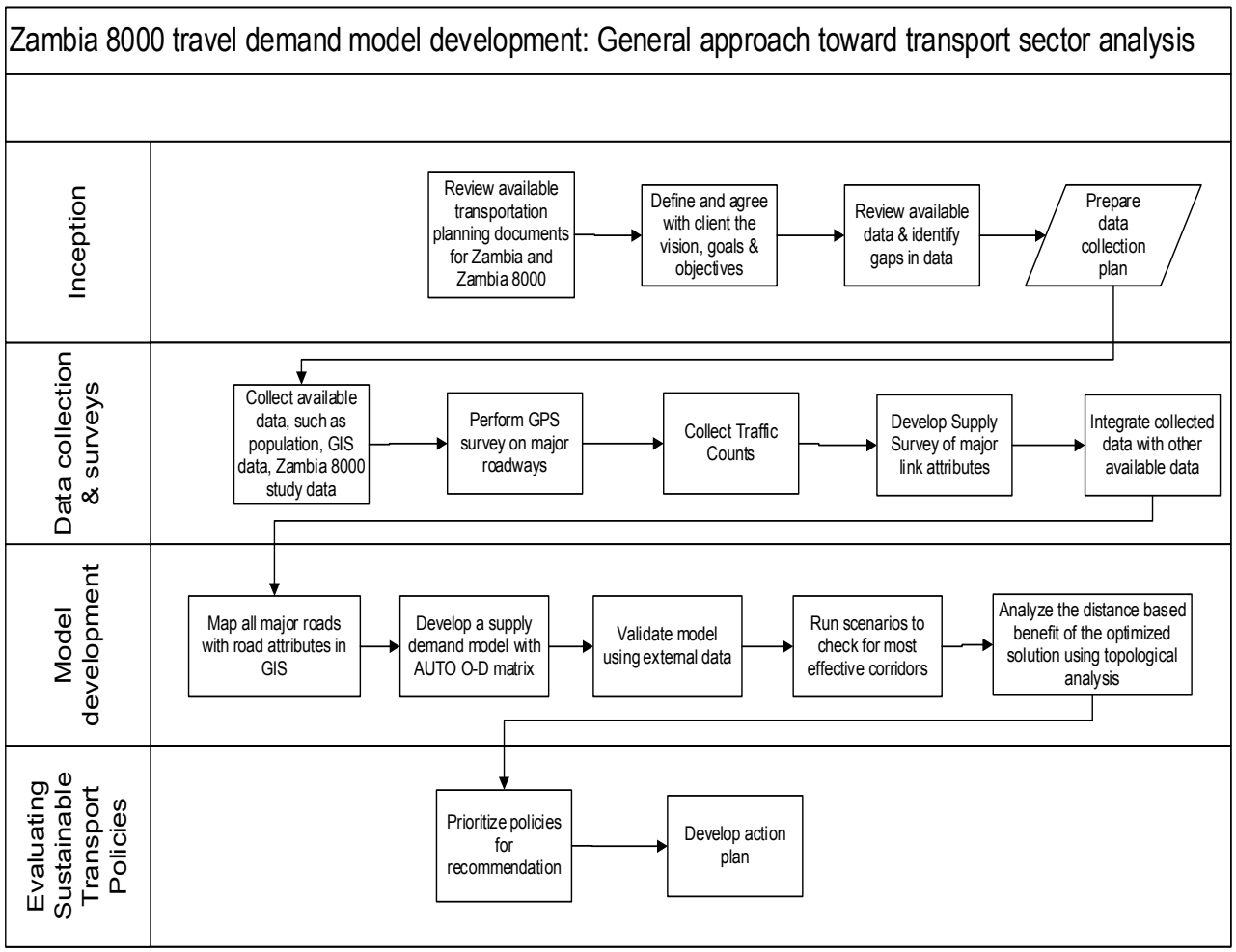
Further the study collected soft data in the form national and sectoral development goals and aspiration as well as social and economic development indicators. Key informant interviews were also used to collect and to validate documented soft data.

The GPS survey data was processed into road network maps using mapping software. The absence of a travel demand model for Zambia meant that one had to be created. Traffic count, demographic the other quantitative data were processed come up with the first Travel Demand Model for Zambia.

Data analysis was done at three levels. The first level was analysis of the travel demand for Zambia using the travel demand model. The second level was the multi-criteria analysis of benefits and then the cost – benefit analysis.

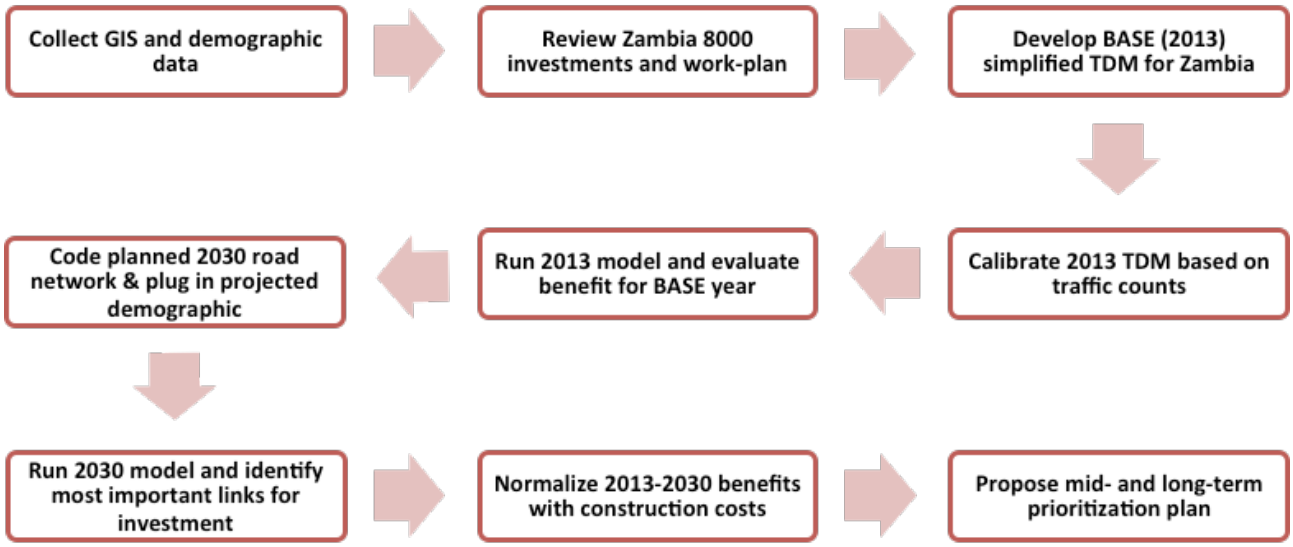
The summary of the methodology employed for this study is summarized in Figure 1 below.

Figure 4: Summary of Methodology



The work flow for the study is shown Figure 2 below.

Figure 5: Work Flow Chart



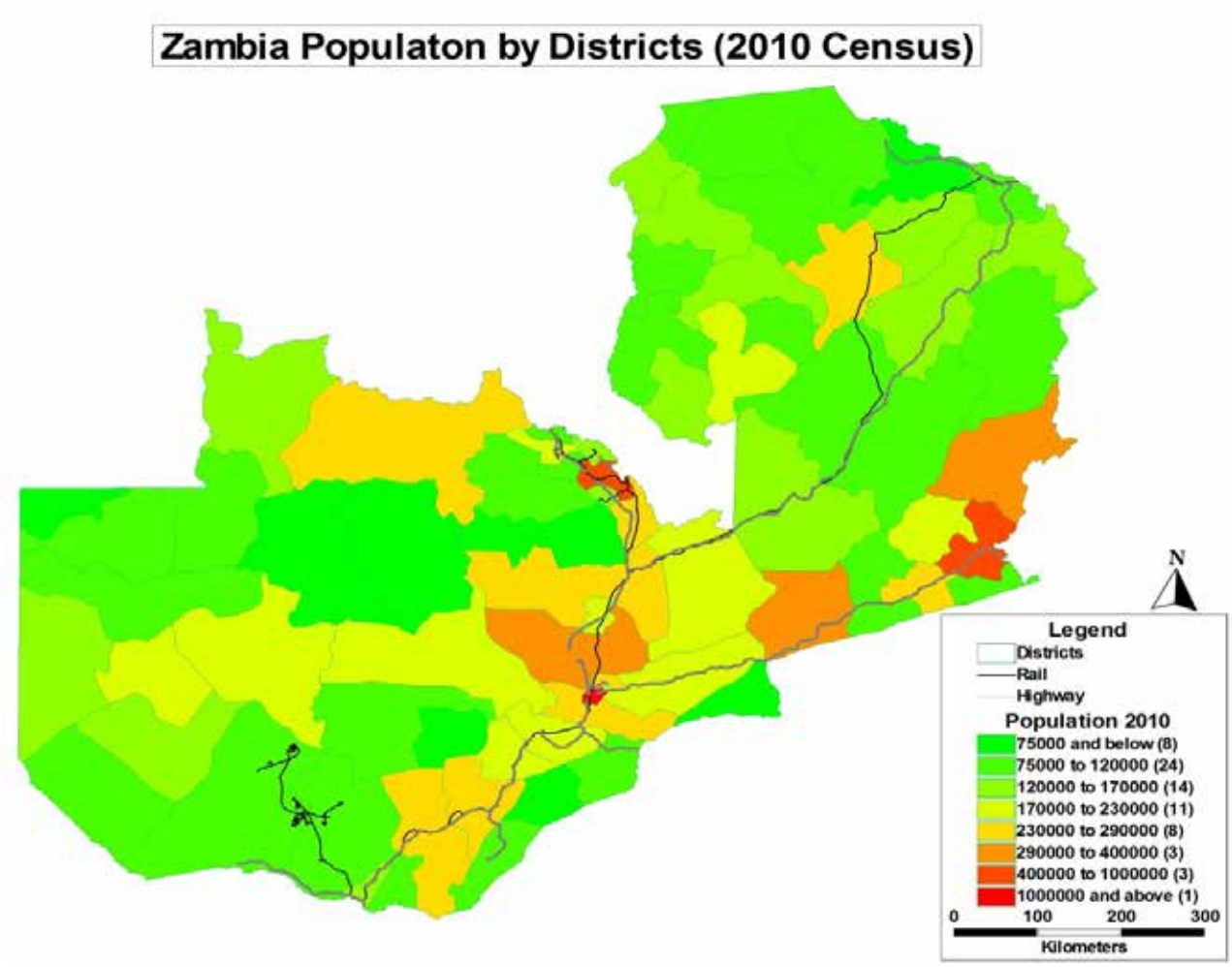
3. Data Analysis

3.1. Demographic Data Socio-Economic Data

The data was were mapped to give facilitate clear analysis of spatial concentrations. The data was used for the full analysis of the situation at the base yaer (2013) and the horizon year (2030).

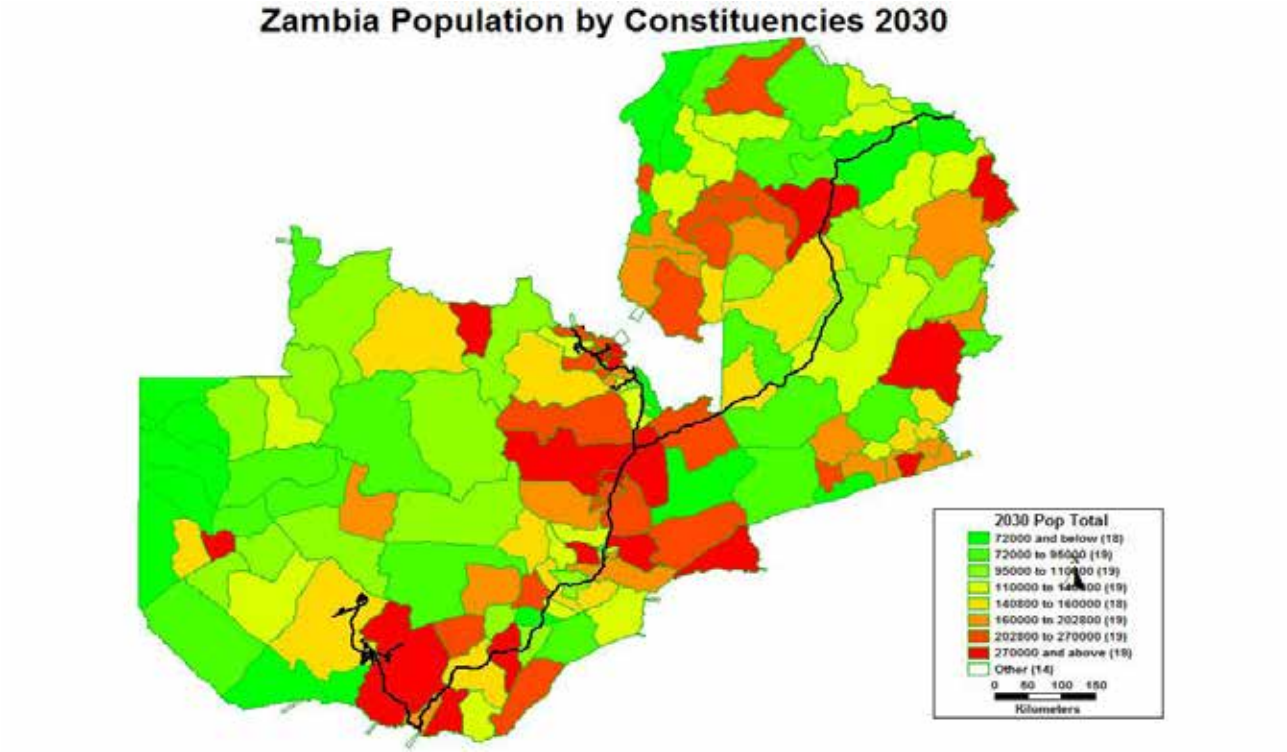
The demographic data revealed that Zambia's population is primarily concentrated along the Livingstone-Lusaka-Copperbelt corridors. Approximately 7 million people out of a total population of 13.05 million live along the stated corridors. Map 2 shows the 2010 population by district

Map 2: Zambia Population by District



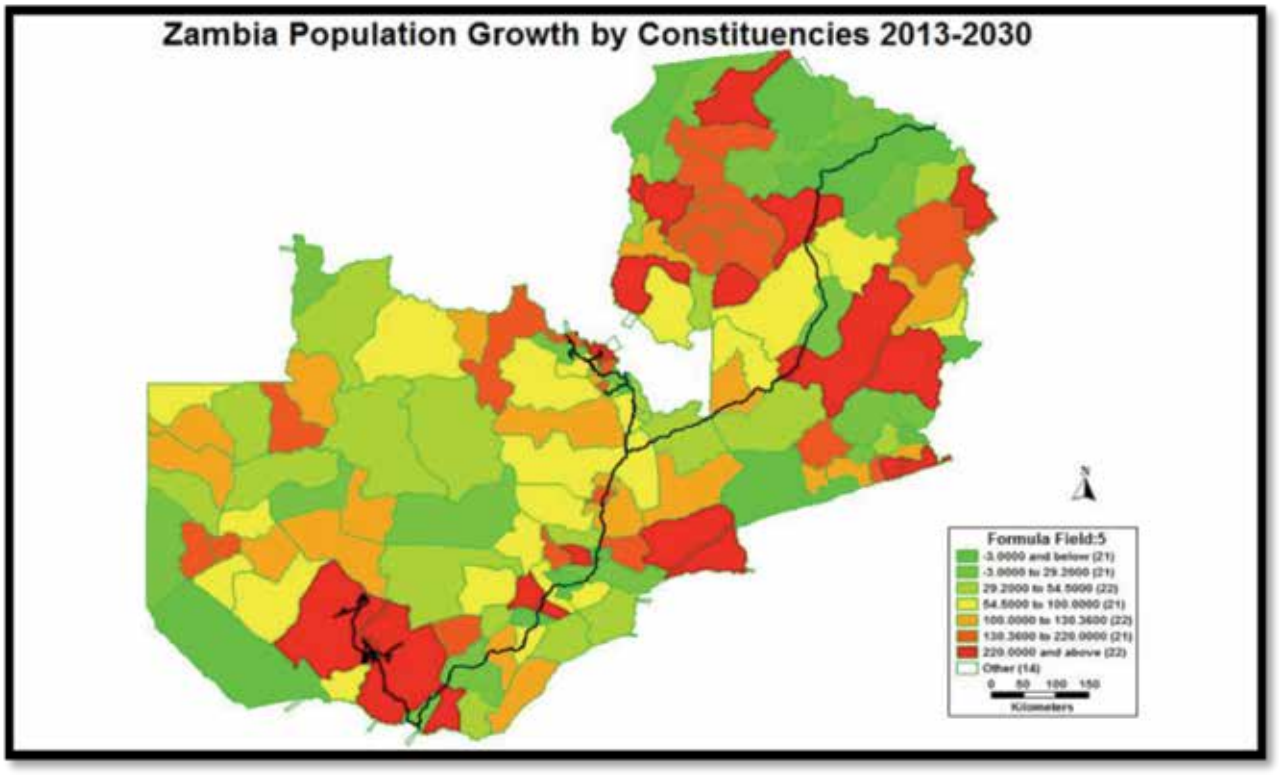
According to the population projection for the horizon year 2030, the total population in Zambia is to grow to 25.09M people which is slightly over 3% annual growth. Map 2 below shows the projected 2030 population of Zambia by constituency.

Map 3: Zambia population by Constituency (2030)



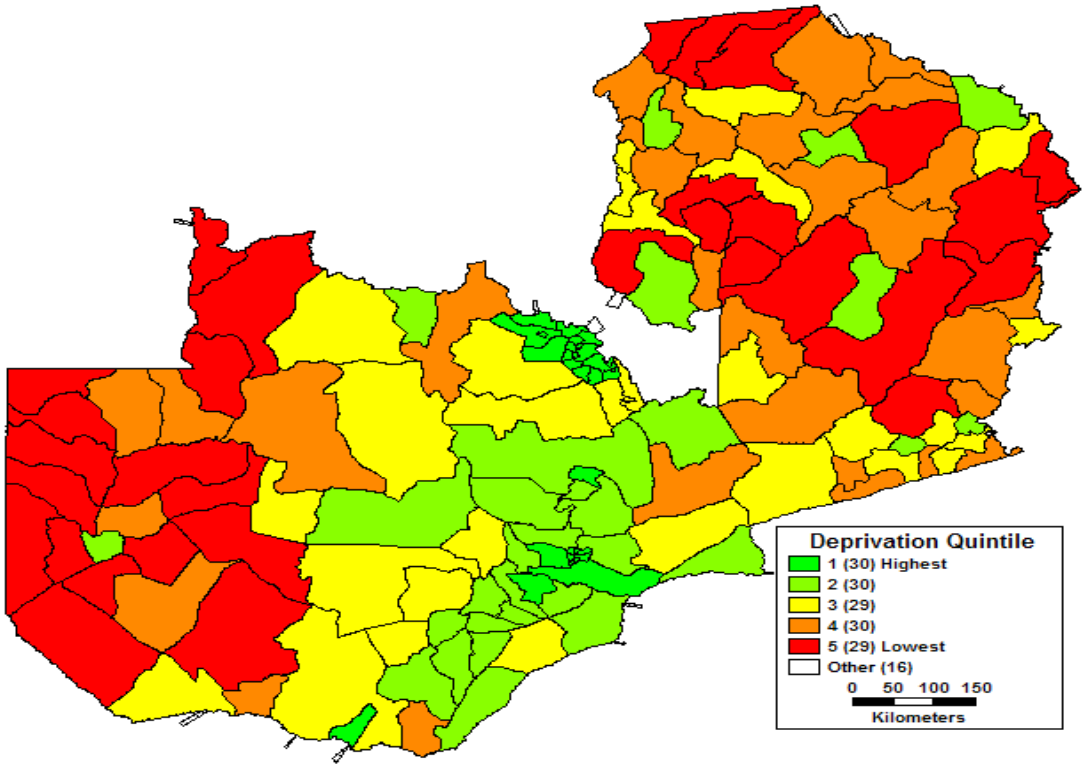
Over the 2013-2030 time horizon, Zambia's population is expected to increase by 78%. However, some areas, such as those in green in Map 4, will grow less while others, such as those in red, are expected to more than double their population.

Map 4: Zambia Population Growth by Constituency (2013 - 2030)



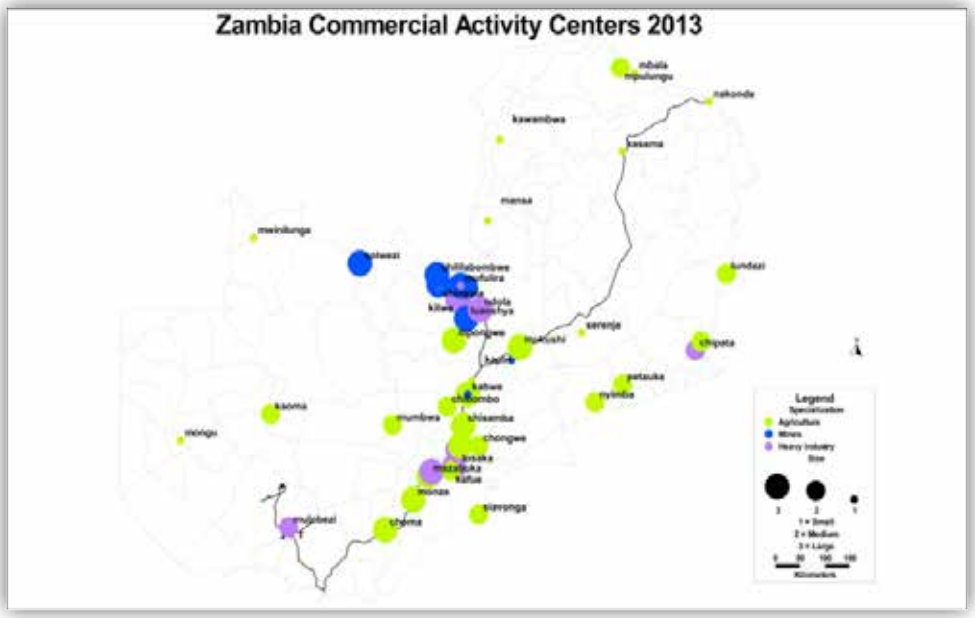
In order to develop a socio-economic factor for the prioritization of roadways in Zambia, different data sets were considered. The study used the 2010 census of population and housing based socio-economic deprivation index developed by ZIPAR, as shown in Map 5.

Map 5: Economic Index by Constituency



In order to construct a freight (trucking) model of the travel demand moodel, 50 major commercial and industrial activities around the country were also mapped. This assists to develop an understanding of primary origin and destination points in the country, such as extraction centres, manufacturing centres, employment centers, shopping centers and recreation centers. Map 7 below summarises the mapping of major commercial and inductsrial activities.

Map 6: Zambia Commercial Activity Centres (2013)



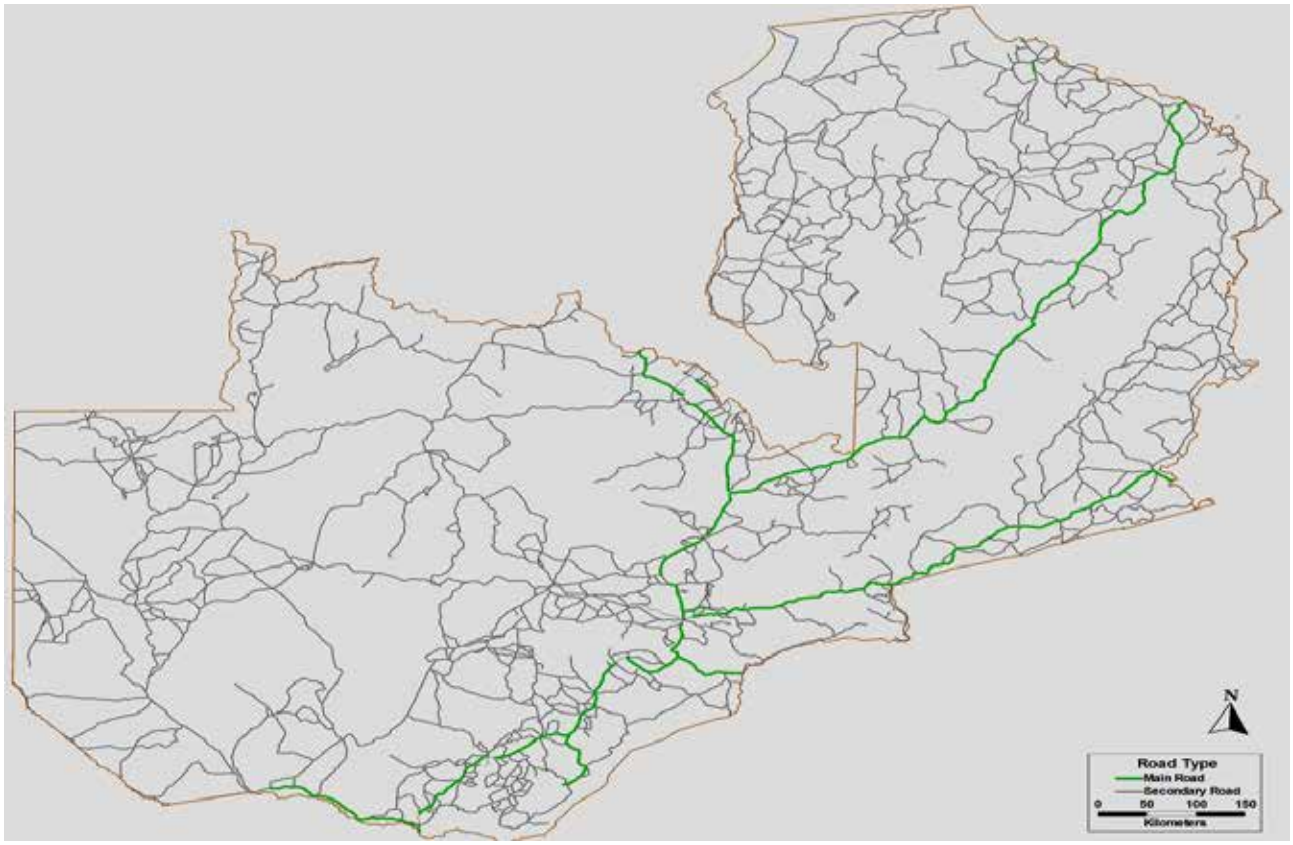
3.2. Road Network Data

Interurban roads in Zambia are classified into 4 categories, according to their purpose. Trunk roads function as international highways, with roads connecting them to district roads being called main roads. District roads connect districts within Zambia, while access roads are roads for those traveling within the district.

The GIS data that was collected to develop the road network consists of interurban roads classified in 2 different ways. The first classification was by their position within the roadway hierarchy and are split between main roads and secondary roads. Main roads pass through only 5 of the country's 9 provinces (there are 10 provinces now) and 31 of the 72 districts (there are now over 100 districts). These roads constitute Zambia's main transportation corridors. The second division is based on the roadway material; paved or gravel.

Map 7 below shows the resulting main and secondary road network in Zambia. Nearly half of the country suffers from low connectivity and accessibility to the the road network. In addition, inter-city public transport service is very limited, further contributing to accessibility issues.

Map 7: Zambia Main and Secondary Road System



3.3. Traffic count

The RDA traffic count data for 2008, 2011 and 2013 containing over 60 points each were analysed. The analysis revealed that traffic counts are very low, representing low traffic volume on interurban roads overall. For instance, the average daily traffic count for all points surveyed in 2011 is 1,336, representing a relatively low volume of traffic. Even on the international highways, defined as roads T1 through T5, the average traffic count is only 2,260, reflecting low traffic volume for such high level roads. This is partially a result of poor road infrastructure causing extended travel times, relatively high overall transport costs and reduced incentive for traveling and shipping.

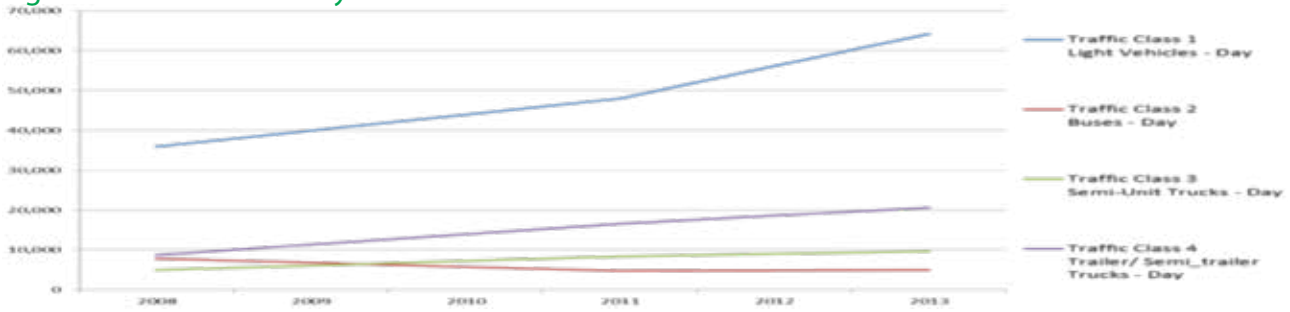
Traffic counts show an overall increase in traffic of 73% between 2008 and 2013, indicating an average annual growth of 15%, which is well beyond population growth. However, traffic levels remain relatively low nationwide. Table 6 below shows the changes in traffic demand between 2008 and 2013 on district, main and trunk roads. Appendix B and C show full tables of traffic counts for 2011 and 2013, respectively.

Table 5: Average Daily Traffic (2008-2013)

Road Type	Average Daily Traffic Count			Traffic Growth Rate	
	2008	2011	2013	2008 - 2011	2011 - 2013
District Roads	117	222	347	30%	28%
Main Roads	523	774	946	16%	11%
Trunk Roads	1,784	1,918	2,951	3%	27%

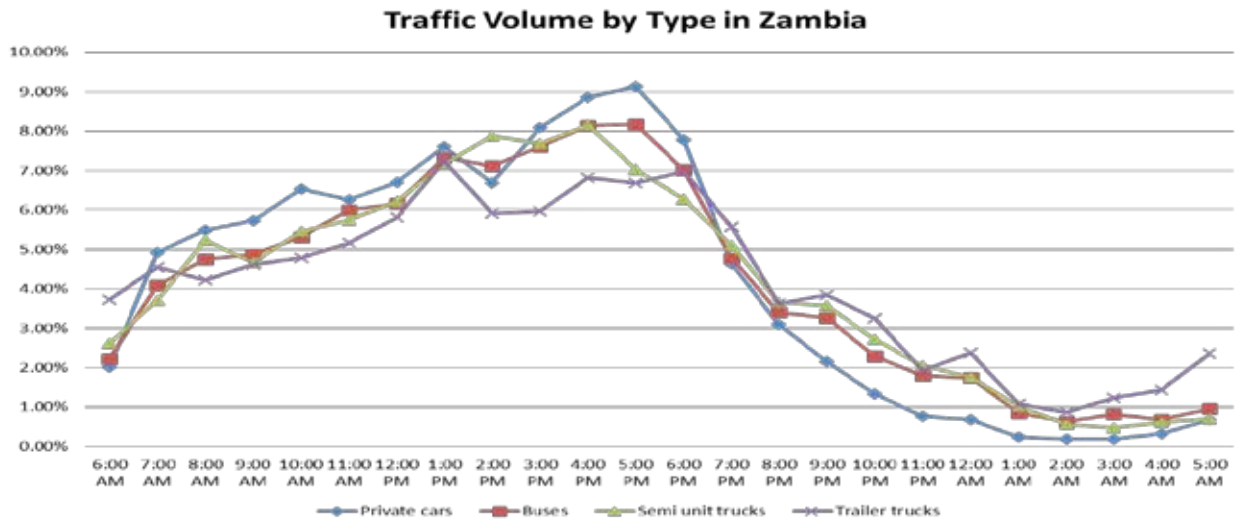
Futher analysis shows that while the number of private vehicles (light vehicles) on intercity roads increased rapidly between 2008 and 2013 and particularly between 2011 and 2013, the number of public transport vehicles (buses) decreased. This is demonstrates in Figure 6 below.

Figure 6: Traffic Growth by Class



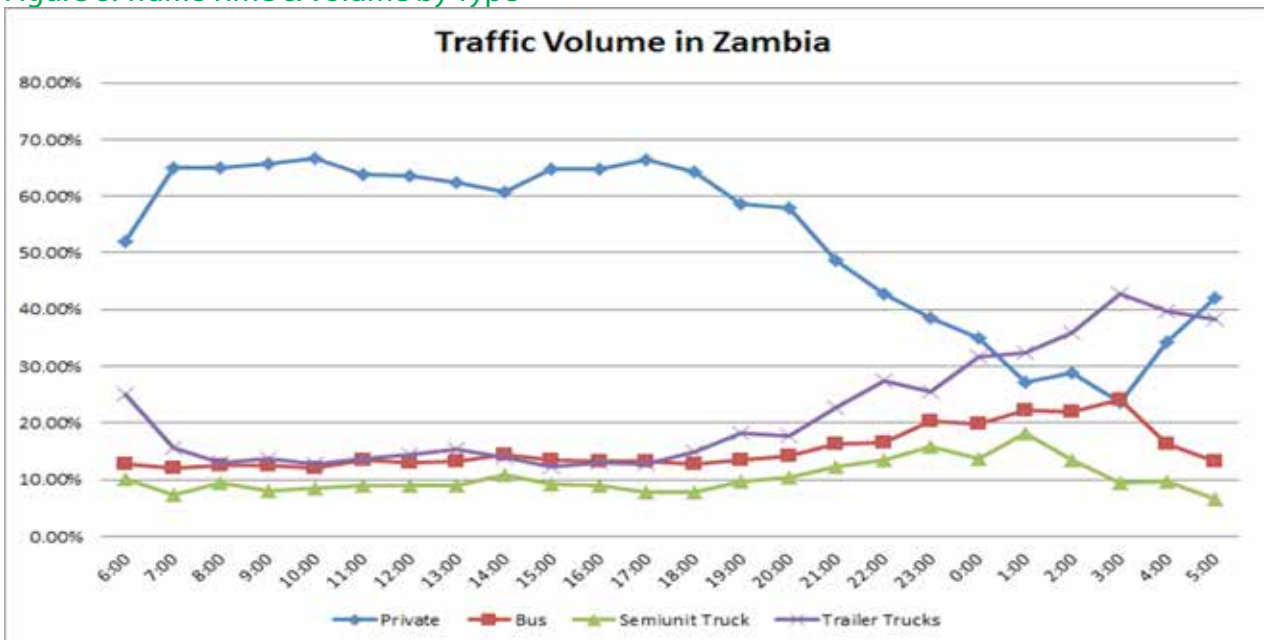
Traffic count analysis also show that half of the traffic (50%) moves between 12:00 and 19:00, although, as shown in Figure 7 below, a significant proportion (22%) moves after 19:00. This means that Zambia requires additional safety/precaution infrastructure for night travel.

Figure 7: Traffic Time Structure by Class



Private cars represent 61% of all vehicles on the road, but only 44% of traffic volume when adjusting for vehicle size in terms of passenger car unit equivalents (PCU). After 20:00 the volume of large trucks increases in proportion of traffic when compared to private cars.

Figure 8: Traffic Time & Volume by Type



4. National Travel-Demand-Model for Zambia

This study uses a Travel Demand Model (TDM) to understand the roadway requirements and to prioritize road development in Zambia.

4.1. Model Description

A travel demand model (TDM) is a econometric tool that replicates travel behavior and predicts traffic movement for different modes under multiple scenarios. In other words, a TDM is a tool that is used to forecast where traffic congestion will be and where demand for road space or transportation services will be, given a set of conditions. It used to support decision-making in the development of different transport facilities and can answer questions such as:

- How many vehicles will travel on a specific road in different horizon years?
- What will be the traffic and socio-economic impact if we open or expand a new or existing road from A to B?
- Which road will be the busiest given different population and economic growth projections?
- How many passengers/commodities will use a specific rail route/bus route given specified attributes (speed, fare cost, comfort, location of stops)?
- What will be the impact of tolls on overall traffic volume and potential revenue?

The TDM is used to analyze future transportation patterns and compare outcomes given different sets of scenarios. Scenarios that can be analyzed include:

Business as Usual: A scenario in which development and conditions continue in the same tradjectory as the current situation. Roads are developed at the same pace and development takes place using the same patterns as exist today.

Network Development: In this scenario, transportation services and infrastructure networks are improved. These networks may include road, public transport or rail networks.

Behavioral Changes: Including changes in attitudes toward automobile travel or changes in travel patterns due to employment changes or other external changes.

Policy Analysis: This includes changes in travel patterns due to a government policy change, such as implementation of roadway tolls, changes in public transport fare structures or improvements in capacity.

Land Use Development: These scenarios are based on different land uses, such as changes in the population in an area or the development of an employment center in an area.

NMT Development: implementation of infrustucture that encourages the use of non-motorized transportation modes, such as walking and bicycling, which reduces demand for automobile transportation.

4.2. Why Zambia needs a Travel-Demand-Model

There are several purposes to developing a national TDM. The TDM can help identify relationships between areas, so that we can understand where people are coming from (origin) and where they are going to (destination). In that way, we can understand where people go as well as where

they come from. Based on that understanding, we can make the appropriate connections and transportation computations between those places.

By understanding the connections and the demand for transportation services and infrastructure, we are able to prioritize infrastructure investments and assess the benefits of each proposed investment, such as roadways and transportation services. The TDM allows us to consider the benefits of new roads in terms of travel time savings, traffic volume and cost effectiveness.

It is anticipated that TDM based project prioritisation will increase the interest of international investors and donors in the Zambian road sector. A complete national TDM would elicit analysis of the impacts of specific pricing scenarios, such as road tolling for purposes of private sector project financing in the form of public-private partnerships (PPP). The other type of impacts that may be analyzed with the TDM are land use development changes associated with future road network needs as well as public transport ridership of intercity rail or bus service and future traffic volumes. The TDM therefore elicits analysis of fuel consumption, traffic emissions and the desired service and infrastructure expansions.

4.3. Challenges in Development of Travel-Demand-Model for Zambia

The found encountered data several data challenges in the attempt to develop the TDM. The geographical size of the country itself presented serious cost implications with regard to primary data collection. To circumvent this challenge, the study depended more on secondary data. The quality and amount of the secondary data available were not sufficient for the development of a complete national TDM. In this respect a simplified TDM was developed and the following assumptions had to be made;

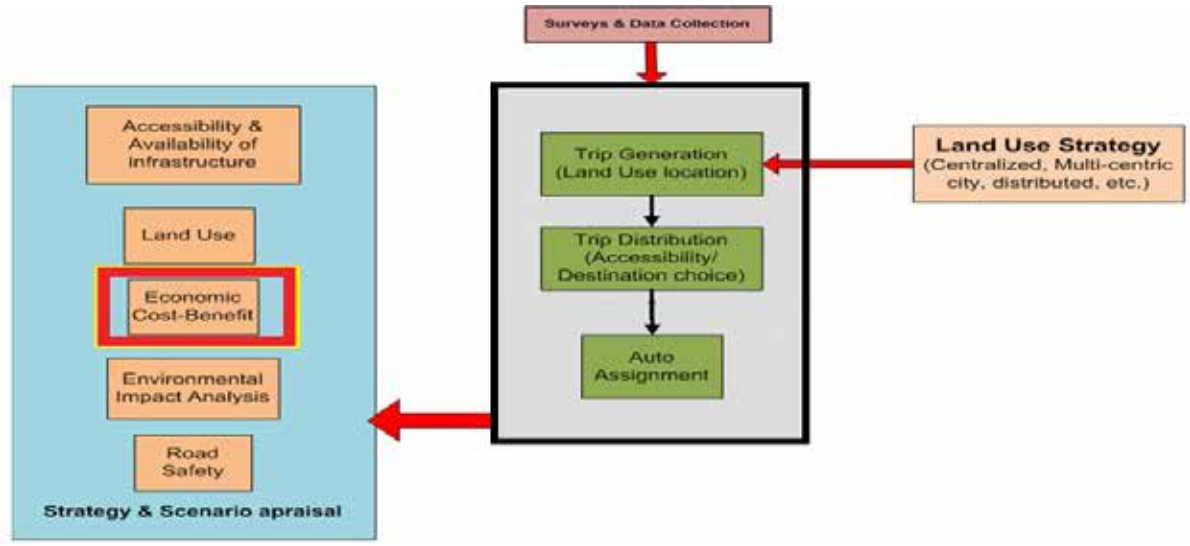
- Model developed for full day demand
- Production and attraction are equal at all points
- Traffic was only estimated for inter-constituency traffic
- Modes included private cars and trucks

Further, the model exluded intermadal transportion aspects and the intra-city public transport.

4.4. Model Development

A three step model was developed for the estimation of travel demand for both private cars and freight. As shown in Graph 9, the three steps include trip generation, trip distribution and auto assignment. Trip generation defines the origin of the trip, trip distribution defines the destination of the trip

Figure 9: Three Step Travel Demand Model Scheme



The GIS road network was received from the client and had to be adjusted to the TDM needs. Connectivity between links was checked and fixed, missing roads were coded, and attributes such as road type, road capacity, and driving speed were added to the layer info table. Free flow time and capacity are the foundations on which the TDM is based on. Capacity and free flow time on the road links were estimated. Free flow time is calculated by dividing a link length by the estimated driving speed on the link. The calculation for capacity is based on the type of road and number of lanes. The TDM displays roadway characteristics that depend on the data used.

A trip generation formula was developed to estimate the initial (before calibration) production and attraction of each constituency. The following variables were used:

i. The 2013 population of constituencies based on the 2010 national census inflated by population growth;
ii. Socio-economic quintile division from the resource allocation model;
iii. Estimated total number of car trips in Zambia from the 2008 and 2012 traffic counts;

An estimated inflation factor was applied for Lusaka and Copperbelt regions in an iterative process that was modified until receiving the best match at the initial assignment (before calibration). In addition to the 150 constituencies, 14 border cross point traffic zones were created to analyze traffic entering the country. The model specification is as follows:

*Total daily production = A*pop20XX* [1+(isLus*0.1)+(isCB*0.5)]* socioFac*
Where: A = generation coefficient (car trip per person), pop20XX = population for the given year, socioFac = socio-demographic factor, isLus = if constituency is in Lusaka, and isCB = if constituency is in Copperbelt.

The trip distribution model is a gravity model estimating the number of trips generated in zone i and attracted to zone j based on the following equation:

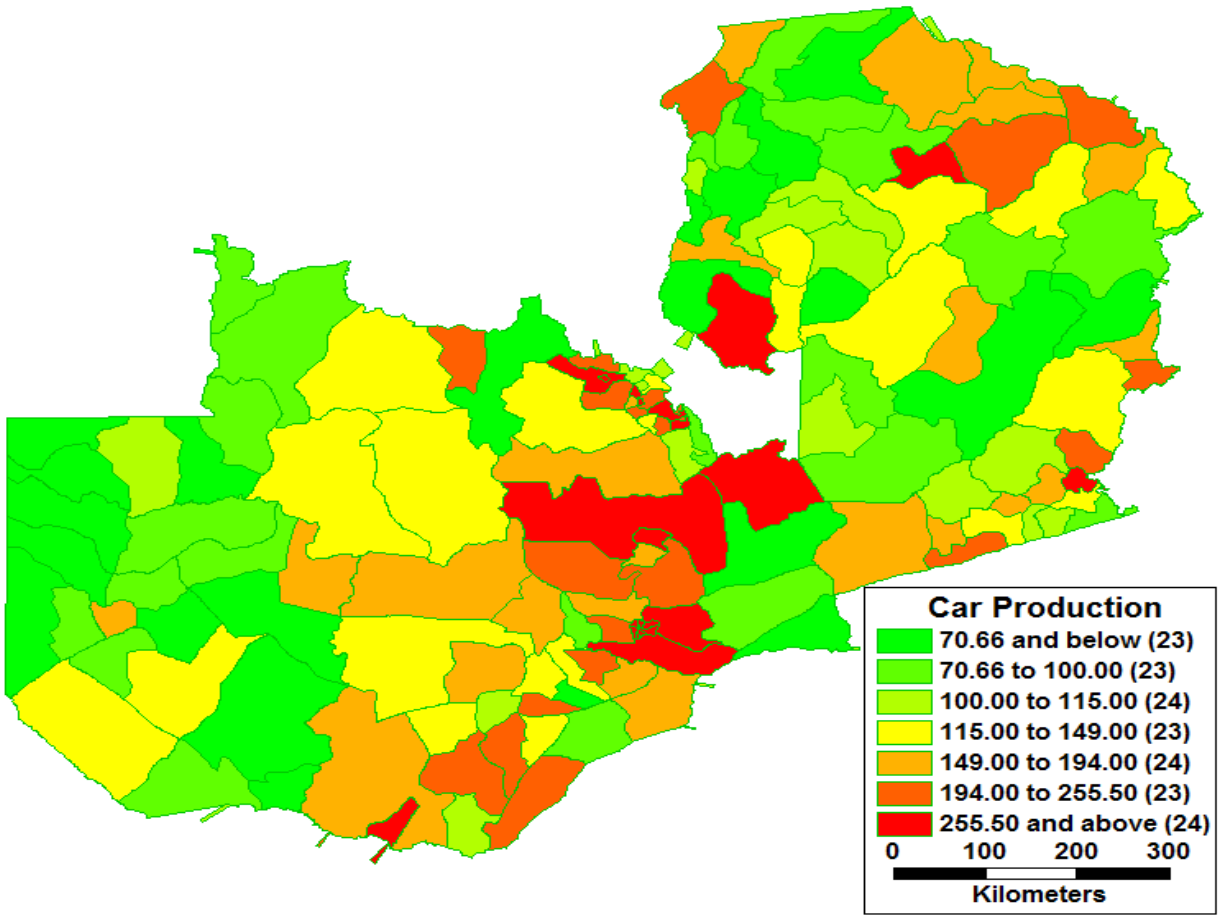
$$T_{ij} = a \, P \, d_i^{b_1} Att_j^{b_2} dis \tan e^{g}$$

With these data combinations, the model estimated the number of vehicle trip generation by traffic zone (constituency). The results was were consistent with expectation. Table 8 below shows an exerpt of the trip generation data while Map 8 shows the number of cars produced by zone.

Table 6: Trip Generation Model

Constituency	2013 Pop Total	2013 Trip Gen.		2030 Trip Gen.	Annual Growth	Socio-Economic Factor
		Private Car	Freight	Private Car	2013/2013	
Bahati	95,009	160	95	898	11%	1
Bangweulu	96,814	147	88	704	10%	0.9
Bwacha	92,585	172	102	612	8%	1.1
Bwana Mkubwa	131,265	266	791	842	7%	1.2
Bweengwa	62,648	116	69	522	9%	1.1
Chadiza	64,919	109	65	904	13%	1
Chama North	56,606	76	46	666	14%	0.8
Chama South	52,352	71	42	681	14%	0.8
Chasefu	103,173	157	93	2,463	18%	0.9
Chavuma	43,012	58	35	620	15%	0.8
Chawama	205,945	458	1,242	1,302	6%	1.2

Map 8: Number of Cars Produced by Zone



The model estimated an average trip length of 220 KM (only for trips across constituencies). Only 10% of trips are longer than 450 km.

1.4.1. Private Vehicle Assignment

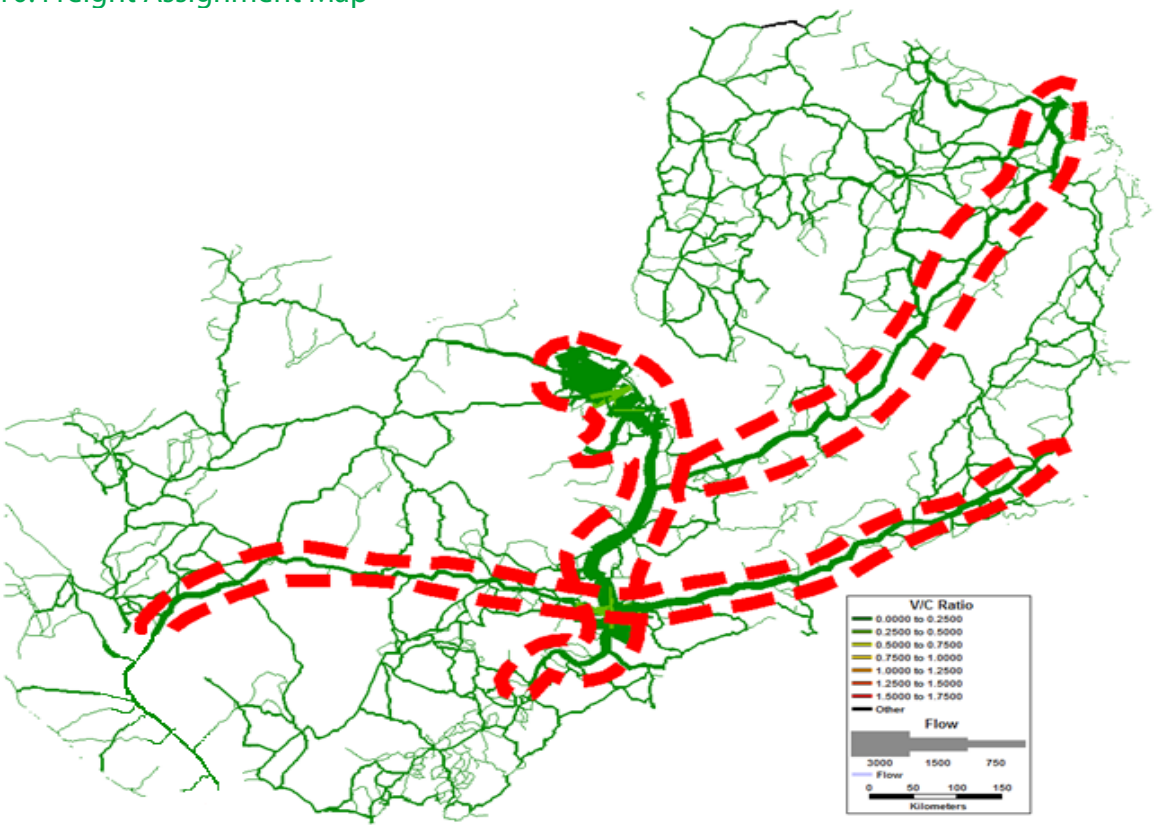
The resulting private vehicle assignment map (Map 8) shows green color for almost all the roads. This implies that there is no congestion on inter-city roads on a daily basis and there is very limited congestion during peak morning hours. Roads T2 and T3 are clearly the busiest in Zambia, as the main traffic flow moves between Lusaka and the Copperbelt.

Map 9: Private Vehicle Assignment Map

1.4.2. Freight Assignment

The model showed that truck traffic flow stays primarily on the main roads. This is because most of freight moves predominantly from one main commercail and industrial centre to another and main roads largely connect to these centres. Most of the country's trucks use roads in the Copperbelt region. Map 11 below shows the freight assignment and this is emphasised by the broken red lines.

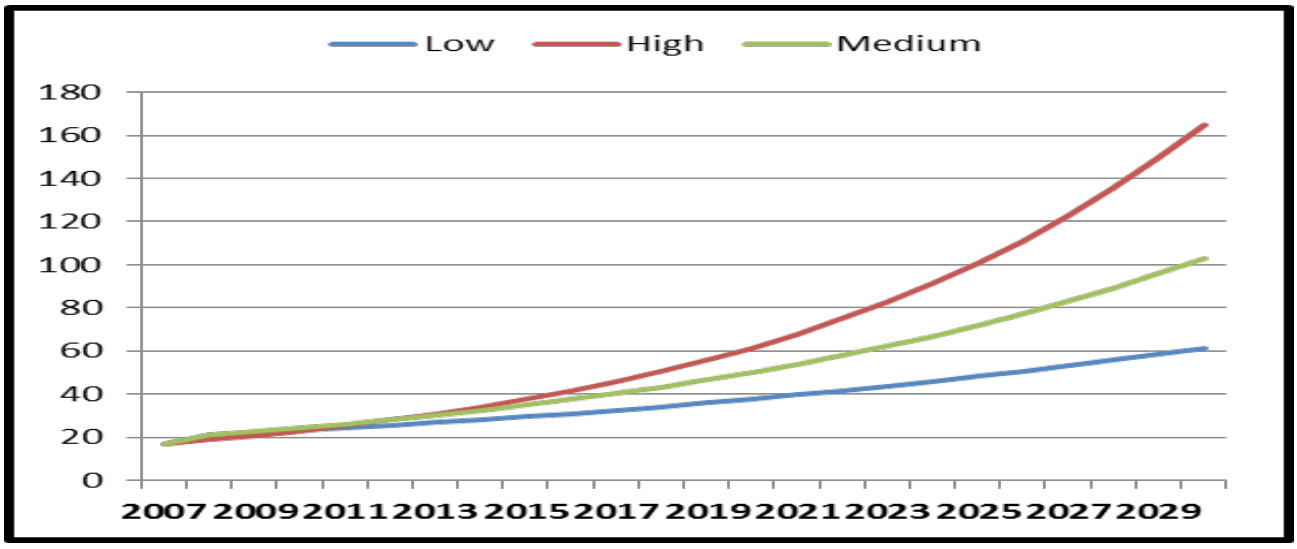
Map 10: Freight Assignment Map



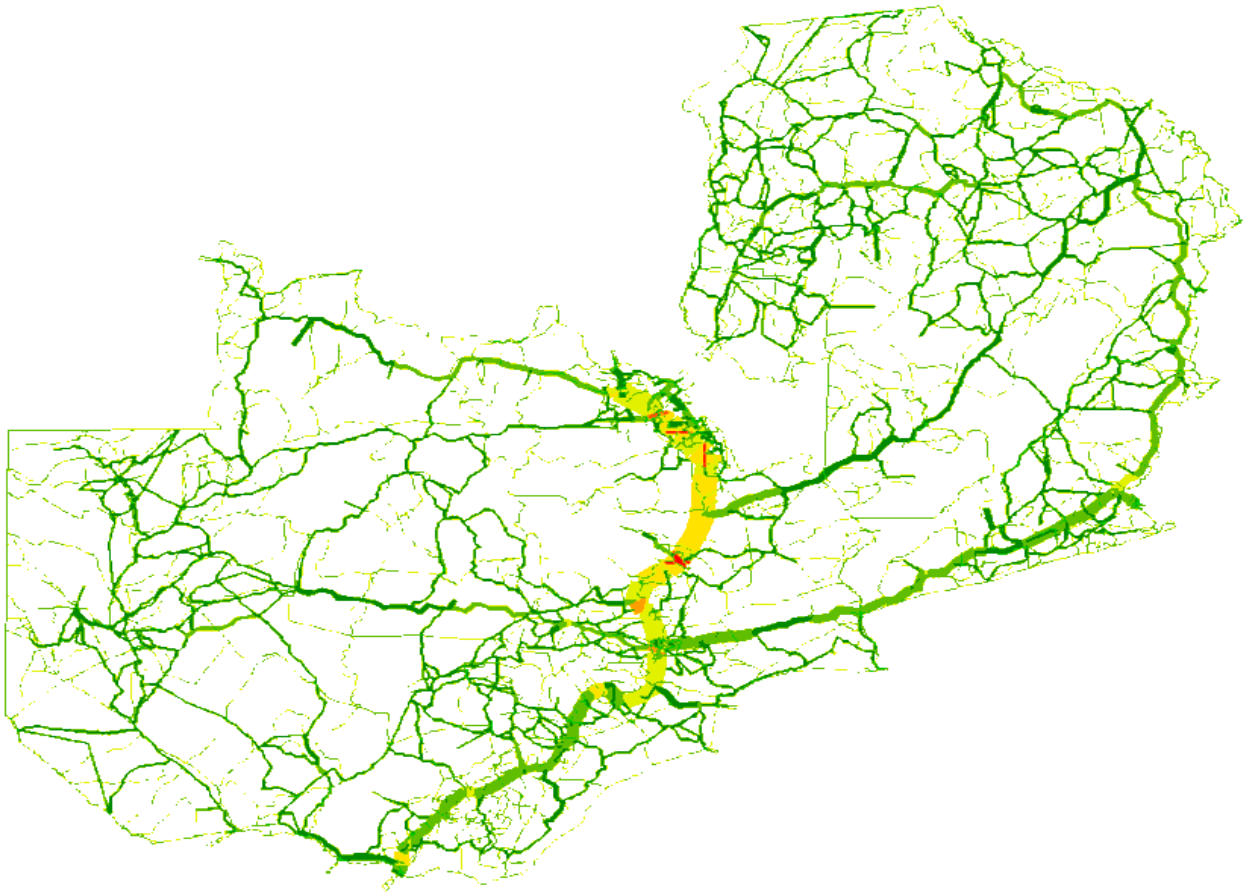
1.4.3. Motorisation

The motorization growth through 2030 was calculated and a growth factor was extracted for the year 2030. This factor was applied over each constituency's population in 2030 to estimate production and attraction. In the 2030 assignment, the roads between Lusaka and Copperbelt are congested. A slow down is expected along the Lusaka-Livingstone and Lusaka -Chipata highways. Car ownership growth projections through 2030 are shown in Figure 10, while the 2030 traffic assignment is shown in Map 12.

Figure 10: Private Vehicle Post-Calibration Scatter Plot



Map 11: 2030 Traffic Assignment



4.5. Model calibration

Each of the car and freight models were calibrated to match the latest traffic counts (2012). The model must be calibrated well to replicate actual and projected traffic volume and time savings accurately. The correlation between model assignments and traffic counts was found to be significantly high. The initial assignment showed significant correlation to traffic counts with a 0.55 R-square for private vehicles and 0.53 for trucks. Post calibration, the assignment showed significant correlation to traffic counts with an R-square of 0.97. These are shown in Figures 12 and 11 respectively.

Figure 11: Private Vehicle Post-Calibration Scatter Plot

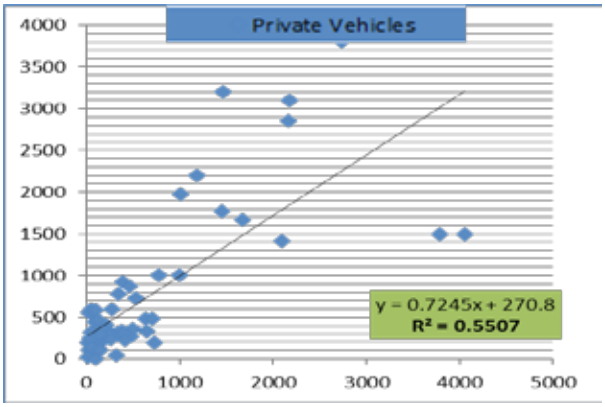
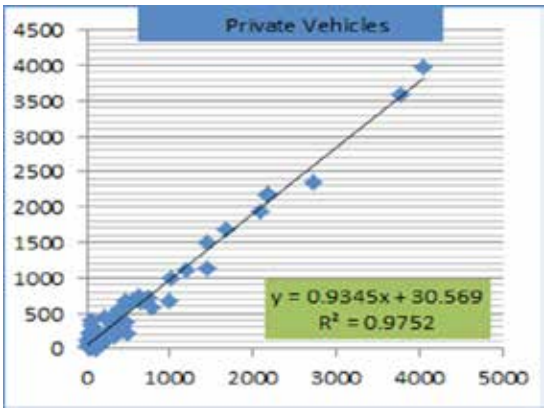


Figure 12: Private Vehicle Pre-Calibration Scatter Plot



5. Project Definition

5.1. How we define the project

In this study, we defined a list of 38 projects to be appraised using our cost-benefit model. Most of these projects are under the Link Zambia 8000 investment plan. Other projects include major trunk roads from Lusaka to four major destinations: Livingstone, Kafue, Chipata, Copperbelt and Kaoma. The selection did not include projects that are undergoing construction or are already contracted.

There are three types of projects listed:

- Road section rehabilitation and construction projects as part of the Zambia 8000 plan that were not yet initiated,
- Additional strategic road planning that fits within the national transportation plan, and
- Specific bridges that connect Zambia to bordering countries.

In some cases, project definition discrepancy were encountered. For instance, two projects would be defined under the same road section. In these cases, the study redefined the alignment of the particular project.

6. Project appraisal

6.1. Appraisal Tools

A Multi-Criteria Analysis (MCA) is a common comparison tool for project prioritization given, a set of criteria that do not share the same attributes. For the purposes of this study, a MCA is the chosen methodology because of its effectiveness in comparing projects to find the set of projects that yield the optimal benefit for the country on the whole. One benefit of a MCA is that it can include effects that are not easily monetized, such as poverty reduction, border impacts, and health benefits, among others.

The common practice in transport project benefit evaluation is to complete a full cost-benefit analysis to analyze the costs of developing and managing the project compared to the benefits for the economy. The benefits are considered against a do-nothing scenario (for both the base and horizon years) and this normally consist of:

- Time savings (for passengers) and vehicle km savings (fuel) for different modes (car, PT, etc.)
- Operational savings for the economy (mainly for PT projects)
- Environmental benefits (pollution reduction)
- Car accident monitary value savings.

The expected cost of the project will be weighed against the benefit and provide a consistent benefit/cost ratio per project.

4.1.1. Criteria definition summary

The criteria used in MCA are selected to suit a particular environment and situation. Criteria are weighted in such a manner that those representing issues that are more important are assigned relatively more weights than less important criteria. Table 7 summerizes the set of criteria selected for use in this project MCA provided for each project.

Table 7: MCA Criteria and Attributes

Indicator	Source	Year	Proposed Weight
Volume of Private Vehicles	Traffic Assignment in TDM (calibrated to traffic counts)	2013	20%
		2030	10%
Volume of Commercial Trucks	Truck Traffic Assignment (calibrated to traffic count)	2013	20%
Time Savings for Cars	Car Traffic Assignment	2013	5%
		2030	5%
Truck Time Savings	Truck Traffic Assignment	2013	20%
Current Road Standard	RDA Work Plan	2013	5%
Socio-Economic Index	User Passenger Average Socio-Economic Status	2013	10%
Border Impact	GIS Analysis	-	5%

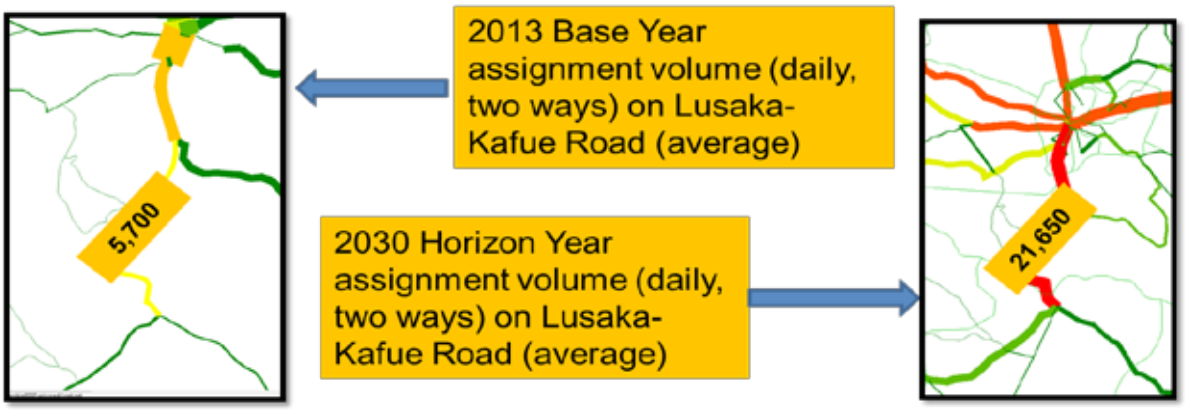
A TDM can support both short-term and long-term road network prioritization, based on topological benefits, as well as potential demand and time or VKMT savings. This can then be fed into an MCA analysis.

Criterion 1: Volume of Private Vehicles (2013 & 2030) – 30%

The first criterion is the volume of private vehicles crossing the specific link being considered in both the base year and the horizon year. This criterion considers the actual volume for each project. Traffic counts were used , where they were available. However, in most cases traffic counts were

not available, and in those cases the traffic volume from the TDM assignment was used instead. The volume for 2030 is based on the 2030 TDM and assumes different land use distribution and higher motorization levels. In order to eliminate cross-effects from different criteria, the traffic volume appraisal for each project is based on the existing networks. As shown in Figure 13, the calibrated TDM enables us to analyze different projects for base volume without having real-traffic counts. Horizon projected volume is also provided.

Figure 13: Sample Traffic Volume Analysis from TDM



Criterion 2: Commercial Vehicle Volume (2013) – 20%

The second criterion considers actual commercial truck volume on the specific link on 2013. Commercial truck traffic counts were used , where they were available. However, in most cases truck traffic counts were not available, and in those cases the volume from the TDM assignment was used instead. Due to the unavailablility of projected economic growth data by constituency for 2030, freight impacts were calculated only for the 2013 Base Year. Most commercial vehicles identified were on the Lusaka-Chingola corridor, around Lusaka, and in Copperbelt, which is shown in Map 13.

Criterion 3: Car Time Savings (2013) – 10%

The third criterion considers the cumulative time savings that travelers experience due to the improvement. This is measured by subtracting the total driving time for all cars with the improvement from the total driving time for all cars without the improvement. This calculation represents the overall benefit to the economy of the improvement, including passenger time, vehicle time and O&M savings. The utillity is a product of volume, length and type of improvement. The time savings calculation is achieved as described in Table 9.

Table 8: Time Saving Calculation

Project Type	Model Change	Traffic Impact
Upgrading to Bituminous	Upgrade speed to 80 KpH	Decreased travel time for existing traffic
		Divert additional traffic
Upgrade Bridge	Reducing travel time by 15 minutes	Decreased travel time for existing traffic
		Divert additional traffic
Upgrading to Dual Carriageway	Upgrade speed to 100 KpH, double capacity	Decreased travel time for existing traffic
		Divert additional traffic, reduce congestion
Construction of New Roadway/Bridge	Include new roadway in network	Decreased travel time by allowing short cut via new roadway

Overall, inter-constituency travel time is estimated at 151,000 daily hours. Time savings from all projects is estimated at 41,000 hours. In other words, the national long distance speed will increase by 27% if all projects are developed.

Criterion 4: Current Road Standards (2013) – 20%

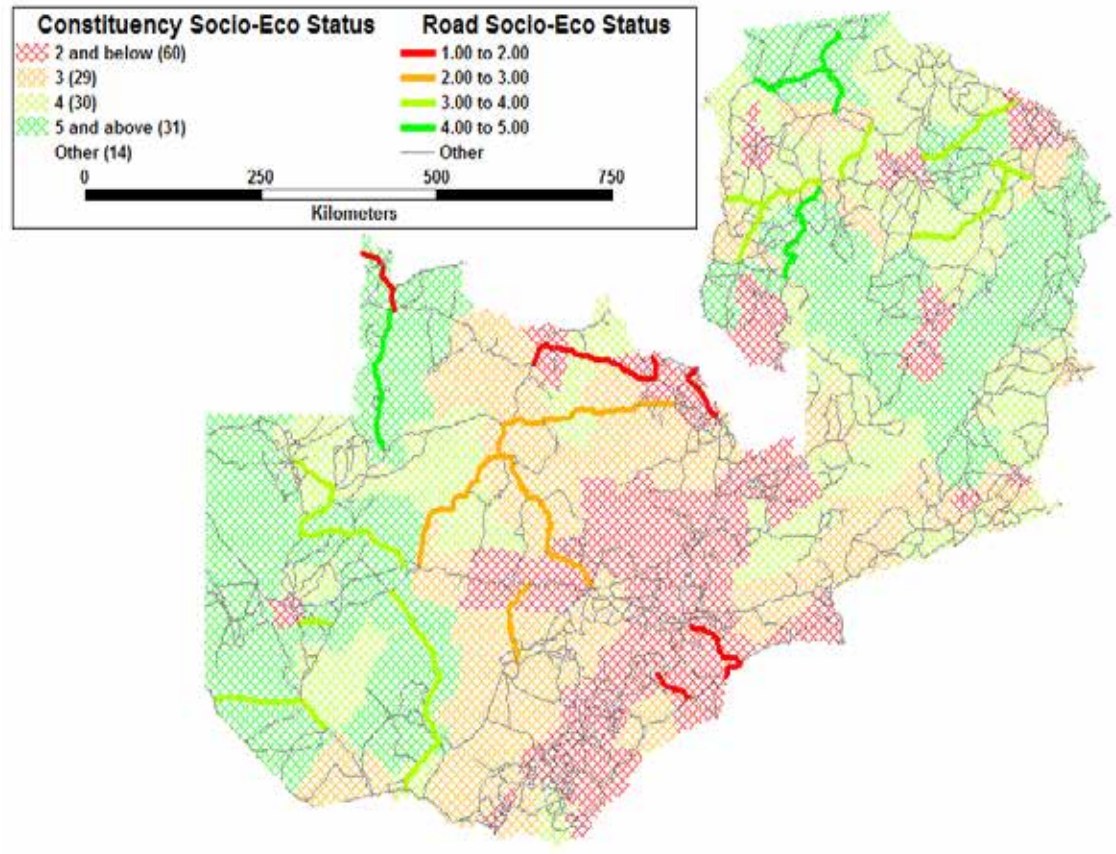
The MCA gives an advantage to roads in poor condition, because improvement of these roads provides additional benefits, such as increased accessibility and reduction in car accidents. The assessment of such roads is based on the RDA Work Plan. For the current condition of the roadways in Zambia, refer to Map 1.

Criterion 5: Socio-Economic Index (2013) – 10%

A constituency level socio-economic development index developed by ZIPAR was used as one of the criterion in the MCA. It is useful in the determination of the extent to road improvements would help to improve the quality of life of those who need accessibility the most.

The index is defined by the weighted average of the socio-economic index of the origin and destination constituencies travelled through in the examined project. This criterion gives more weight and priority to raod serving communities with low socio-economic conditions. This criteria is used as a proxy for public transport use that doesn't exist in the MCA. For instance, Lusaka-Chirundu Road, shown in Map 15, primarily serves vehicles from nearby areas that have a socio-economic rating above the national average. Therefore, the road receives a low index of 1.3, and a ranking of 35th out of 38. Projects with high socio-economic value typically exist in low socio-economic regions such as Western and Northern provinces. The socio-economic values of each province is shown in Map 12.

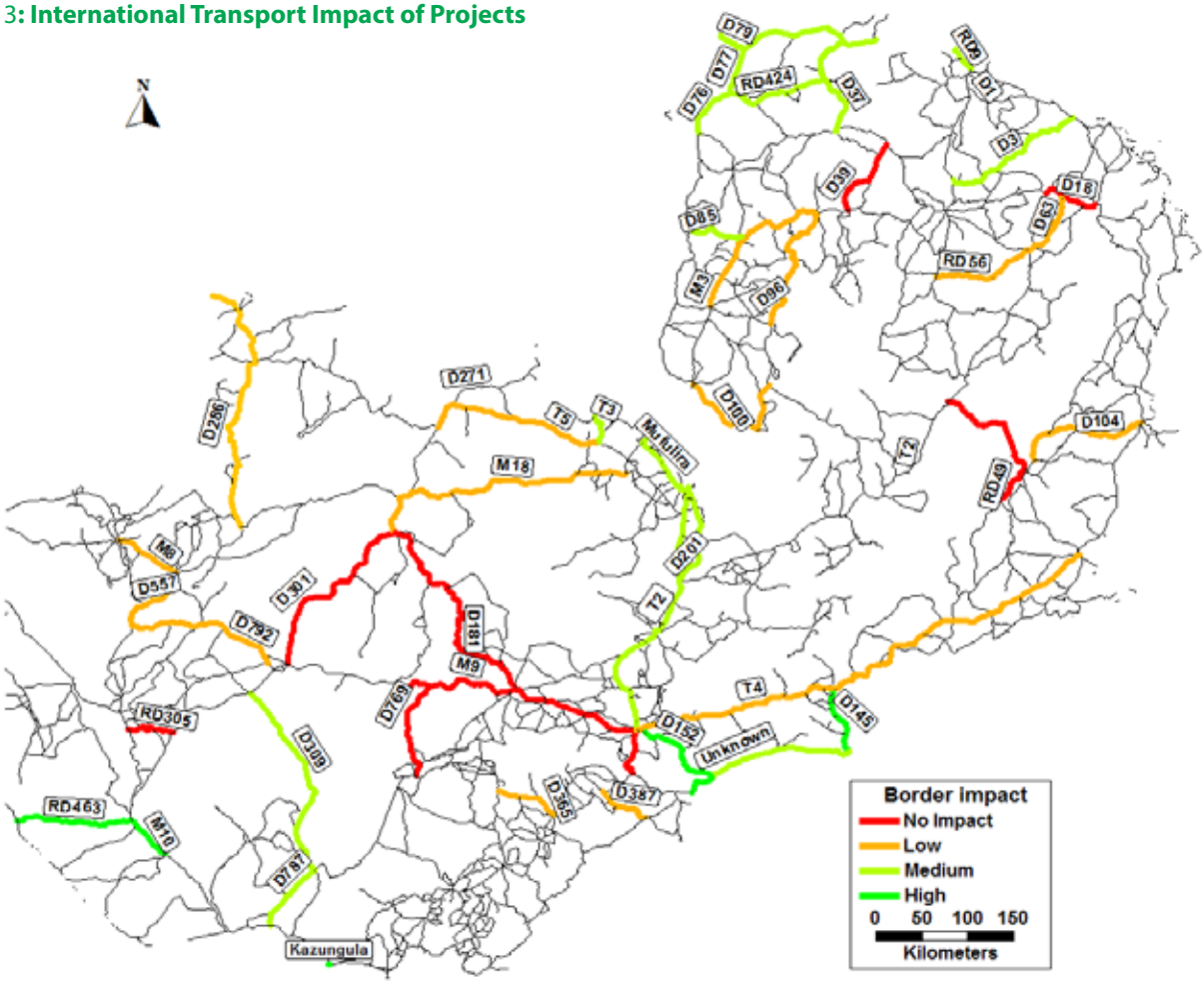
Map 12: Constituency Socio-Economic Status



Criterion 6: International Transport Impact – 5%

The MCA gave an advantage to projects with proximity to international borders as they have added commercial value, something not always reflected in the TDM due to the lack of a border-crossing traffic count. Criterion 6 is the impact that the improvement has on border crossings. The determination was made based on analysis of GIS data, gauging the proximity of the project to international border crossings. Five points were given based on border impact, with 5 points for high impact, 3.5 points for medium impact, 2.5 points for low impact and no points given where there was no impact. Map 13 below shows the impact that each project has on border crossing.

Map 13: International Transport Impact of Projects



7. Project Appraisal Results

6.2. Benefits Analysis Results

The results of the benefits analysis for each selected criteria are tabulated below. Table 9 shows the traffic volume criteria outcomes, Table 10 shows the outcomes for the time saving criteria while Table 18 shows the results for all the other criteria. The combined results of the benefits analysis are shown in Table 19.

Table 9: Traffic Volume Criteria Outcomes

Road ID	Road name	Length	Status	Phase	2013 Car Volume (20%)			2030 Car Volume (10%)			2013 Comercial (20%)		
					Value	Point	Rank	Value	Point	Rank	Value	Point	Rank
M3	Mansa to Chipili to Luwingu road	175.0	Upgrading to Bituminous	1	207.0	0.6	28	1,121.0	0.5	30	50.3	0.1	37
D96	Samfya to Musaila to Lubwe to Kasaba to Ipukusilo t	176.0	Construction of new bridges	1	194.3	0.6	31	1,343.9	0.6	27	65.0	0.2	35
D152 & RD491	Katoba Basic School via Chiawa to Chirundu	120.0	Upgrading to Bituminous	1	626.0	2.1	8	3,686.0	1.6	12	603.6	5.2	7
T4	Lusaka to Chipata	572.0	upgrade to dual carriageway	-	1,318.0	4.5	3	10,555.0	4.8	3	565.0	4.8	10
T2	Lusaka to Kafue	57.4	upgrade to dual carriageway	-	5,700.0	20.0	1	21,650.0	10.0	1	1,232.0	11.0	2
T2 & T3	Lusaka to Ndola	311.2	upgrade to dual carriageway	2	3,323.7	11.6	2	11,818.3	5.4	2	2,210.0	20.0	1
D37	Mporokoso - Nsama - Kaputa	194.9	Upgrading to Bituminous	1	151.8	0.4	34	951.6	0.4	34	283.2	2.2	24
RD 56 & D63	Safwa to Mulilansolo via Chinsali	185.0	Upgrading to Bituminous Standar	1	202.6	0.6	30	990.3	0.4	33	63.0	0.2	36
T2 & D18	Isoka to Mbesuma	168.0	New road	1	433.0	1.4	12	1,932.0	0.8	23	322.0	2.6	21
M18 & D181	Kalulushi to Kasempa	185.0	Upgrading to Bituminous	2	499.5	1.6	11	5,782.2	2.6	6	343.0	2.8	20
D181	Mumbwa to Kasempa	284.0	Upgrading to Bituminous	2	385.1	1.2	17	2,379.1	1.0	17	144.0	1.0	29
D301	Kasempa to Kaoma	215.0	Upgrading to Bituminous	2	332.0	1.0	19	1,963.8	0.8	22	433.0	3.6	13
D792, D557, M8	Kaoma to Lukulu to Zambezi	275.3	Upgrading to Bituminous	2	321.0	1.0	21	2,432.0	1.1	15	426.6	3.6	18
D286, M5	Kabompo to Mwinilunga to Jimbe	311.0	Upgrading to Bituminous	2	36.3	-	38	1,314.5	0.5	28	154.0	1.0	27
D39	Luwingu to Kapatu Mission to Nondo	99.2	Upgrading to Bituminous	2	101.1	0.2	36	1,051.0	0.4	32	40.9	-	38
D36 - RD424	Mununga to Mporokoso	130.0	Upgrading to Bituminous	2	216.8	0.6	26	1,761.0	0.7	25	432.0	3.6	16
T3	Chingola to Chililabombwe/Kasumbalesa	45.0	upgrade to dual carriageway	2	972.7	3.3	5	5,854.6	2.7	5	1,098.0	9.7	3
T5	Chingola to Solwezi/Mutanda	205.0	upgrade to dual carriageway	2	989.0	3.4	4	6,654.2	3.0	4	644.7	5.6	6
Mufulira rd.	Ndola to Mufulira	62.0	upgrade to dual carriageway	2	564.0	1.9	9	3,987.0	1.8	11	732.0	6.4	5
D3	Nseluka -Chitimukulu-Makasa up to D1	170.0	Upgrading to Bituminous	3	302.0	0.9	22	1,823.0	0.8	24	232.0	1.8	25
M3 & D85	Munganga - Kawambwa & Mwenda to Kashiba	168.0	Upgrading to Bituminous	3	203.5	0.6	29	1,538.3	0.6	26	128.3	0.8	30
D769	Mumbwa - Itezhi Tezhi	110.0	Upgrading from gravel to bitoume	3	334.1	1.1	18	2,024.1	0.9	21	71.5	0.3	33
D787 & D309	Sesheke (Simungoma)- Luampa	450.0	Upgrading to Bituminous	3	421.6	1.4	14	2,421.0	1.1	16	366.8	3.0	19
RD 463, M10	Matebele - Shangombo	135.0	Upgrading to Bituminous	3	183.0	0.5	32	1,082.0	0.4	31	431.0	3.6	17
RD305	Namushakende - Nalikwanda	60.0	Upgrading to Bituminous	3	252.0	0.8	24	2,080.0	0.9	20	109.0	0.6	32
D387	Chikankata	30.0	Upgrading to Bituminous	3	257.0	0.8	23	1,253.0	0.5	29	311.0	2.5	22
D104	Mwase-Lundazi-Chitungulu & Mwanya Mfuwe	290.0	-	3	165.0	0.5	33	678.0	0.2	36	169.0	1.2	26
RD9	Mbala-Kaseshya Border - Kalambo	47.0	Upgrading to Bituminous	3	125.5	0.3	35	631.0	0.2	37	111.1	0.6	31
D201	Old Congo Road Tug Argan to Kapiri	113.0	Upgrading to Bituminous	3	209.7	0.6	27	2,358.9	1.0	18	433.0	3.6	13
M9	Kafue hook bridge, Lusaka-Mongu Rd	270.0	Maintane and rehabilitate	-	879.0	3.0	6	5,021.0	2.3	7	537.0	4.6	12
Unknown	Chiawa to Feira Road including Bridge across Chon	200.0	New road	1	322.3	1.0	20	3,200.0	1.4	13	544.0	4.6	11
RD 49	Mpika - Nabwalya - Mfuwe	118.0	Upgrading to Bituminous Standar	1	538.0	1.8	10	3,128.4	1.4	14	302.7	2.4	23
D76 - D77 - D79	Nchelenge -Chiengi-Luchinda -Kaputa	205.8	Upgrading to Bituminous Standar	-	247.9	0.7	25	794.2	0.3	35	433.0	3.6	13
D145	Luangwa to Feira including Bridge	80.9	Upgrading to Bituminous and Upg	-	425.2	1.4	13	4,491.9	2.0	10	154.0	1.0	27
D365	Monze to Niko	75.0	Upgrading and Re-Alignment	-	655.0	2.2	7	4,949.2	2.2	8	597.1	5.1	9
T3 Junction to M4	Sabina (T3 Junction) to Mufulira to Mukambo (M4)	415	upgrade to dual carriageway	-	416.8	1.3	15	4,532.4	2.0	9	755.5	6.6	4
D100	Chembe to Milenge to Kasanka	206.0	New road	-	56.1	0.1	37	148.6	-	38	68.7	0.3	34
Kazungula Bridge	Kazungula Bridge Project between Zambia and zimba	0.8	Construction of new bridge instea	-	401.7	1.3	16	2,286.0	1.0	19	601.0	5.2	8

Table 10: Time Saving Criteria Scoring

Road ID	Road name	Length (km)	Status	Phase	Time Saving								
					2013 - Car (5%)			2030 - Car (5%)			2013 - Truck (20%)		
					Value	Point	Rank	Value	Point	Rank	Value	Point	Rank
M3	Mansa to Chipili to Luwingu road	175.0	Upgrade to Bituminous	1	232.0	0.2	29	1,921.0	0.6	28	178.0	1.7	27
D96	Samfya - Musaila - Lubwe - Kasaba - Ipukusilo - Luwingu vi	176.0	Construction of new bridges	1	298.2	0.2	28	3,494.5	1.0	20	172.0	1.6	28
D152 & RD491	Katoba Basic School via Chiawa to Chirundu	120.0	Upgrade to Bituminous	1	975.0	0.9	14	4,089.0	1.2	17	1,325.0	13.1	5
T4	Lusaka to Chipata	572.0	upgrade to dual carriageway	-	3,092.0	2.9	4	7,654.0	2.3	7	1,099.0	10.8	11
T2	Lusaka to Kafue	57.4	upgrade to dual carriageway	-	3,240.6	3.0	3	10,460.0	3.2	4	1,543.0	15.2	4
T2 & T3	Lusaka to Ndola	311.2	upgrade to dual carriageway	2	5,321.6	5.0	1	16,323.0	5.0	1	2,021.8	20.0	1
D37	Mporokoso - Nsama - Kaputa	194.9	Upgrade to Bituminous	1	543.0	0.5	20	2,345.0	0.7	27	68.4	0.6	34
RD 56 & D63	Safwa to Mulilansolo via Chinsali	185.0	Upgrade to Bituminous Standard & Re-Alig	1	134.0	0.1	32	844.0	0.2	32	84.0	0.7	33
T2 & D18	Isoka to Mbesuma	168.0	New road	1	204.0	0.1	30	756.2	0.2	35	143.0	1.3	29
M18 & D181	Kalulushi to Kasempa	185.0	Upgrade to Bituminous	2	2,756.0	2.6	6	10,948.9	3.3	3	1,255.7	12.4	6
D181	Mumbwa to Kasempa	284.0	Upgrade to Bituminous	2	1,027.8	0.9	13	7,245.1	2.2	9	988.0	9.7	19
D301	Kasempa to Kaoma	215.0	Upgrade to Bituminous	2	777.0	0.7	15	5,656.0	1.7	11	990.0	9.7	17
D792, D557, M8	Kaoma to Lukulu to Zambezi	275.3	Upgrade to Bituminous	2	677.0	0.6	17	5,433.0	1.6	12	878.0	8.6	22
D286, M5	Kabompo to Mwinilunga to Jimbe	311.0	Upgrade to Bituminous	2	323.0	0.3	27	3,272.6	1.0	21	131.3	1.2	30
D39	Luwingu to Kapatu Mission to Nondo	99.2	Upgrade to Bituminous	2	69.7	0.0	36	4,343.0	1.3	15	87.0	0.7	32
D36 - RD424	Mununga to Mporokoso	130.0	Upgrade to Bituminous	2	2,740.5	2.6	7	7,540.4	2.3	8	1,021.0	10.0	16
T3	Chingola to Chililabombwe/ Kasumbalesa	45.0	upgrade to dual carriageway	2	1,506.0	1.4	9	6,069.0	1.8	10	1,132.0	11.1	9
T5	Chingola to Solwezi/Mutanda	205.0	upgrade to dual carriageway	2	3,092.0	2.9	4	13,212.0	4.0	2	1,793.5	17.7	2
Mufulira rd.	Ndola to Mufulira	62.0	upgrade to dual carriageway	2	623.0	0.5	18	3,825.9	1.1	19	1,064.0	10.5	13
D3	Nseluka -Chitimukulu-Makasa up to D1	170.0	Upgrade to Bituminous	3	761.1	0.7	16	3,211.0	1.0	22	745.0	7.3	23
M3 & D85	Munganga - Kawambwa & Mwenda to Kashiba	168.0	Upgrade to Bituminous	3	88.8	0.0	35	817.8	0.2	33	12.0	-	38
D769	Mumbwa - Itezhi Tezhi	110.0	Upgrade from gravel to bitoumen	3	451.8	0.4	24	2,897.6	0.9	23	33.9	0.2	35
D787 & D309	Sesheke (Simungoma)- Luampa	450.0	Upgrade to Bituminous	3	1,250.7	1.1	11	8,731.0	2.7	6	1,673.0	16.5	3
RD 463, M10	Matebele - Shangombo	135.0	Upgrade to Bituminous	3	531.8	0.5	22	1,012.0	0.3	31	961.8	9.5	21
RD305	Namushakende - Nalikwanda	60.0	Upgrade to Bituminous	3	89.0	0.0	34	721.0	0.2	36	109.0	1.0	31
D387	Chikankata	30.0	Upgrade to Bituminous	3	1,092.0	1.0	12	2,453.0	0.7	26	231.0	2.2	25
D104	Mwase-Lundazi-Chitungulu & Mwanya Mfuwe	290.0	-	3	539.8	0.5	21	2,678.0	0.8	24	978.0	9.6	20
RD9	Mbala-Kaseshya Border - Kalambo	47.0	Upgrade to Bituminous	3	48.2	-	38	242.5	0.0	37	20.0	0.1	36
D201	Old Congo Road Tug Argan to Kapiri	113.0	Upgrade to Bituminous	3	168.5	0.1	31	767.0	0.2	34	180.5	1.7	26
M9	Kafue hook bridge, Lusaka-Mongu Rd	270.0	Maintane and rehabilitate	-	1,278.0	1.2	10	4,276.0	1.3	16	1,134.0	11.2	8
Unknown	Chiawa - Feira Road including Bridge across R. Chongwe	200.0	New road	1	564.0	0.5	19	4,596.0	1.4	13	989.0	9.7	18
RD 49	Mpika - Nabwalya - Mfuwe	118.0	Upgrade to Bituminous Standard & Re-Alig	1	3,432.0	3.2	2	9,343.0	2.8	5	1,166.0	11.5	7
D76 - D77 - D79	Nchelenge -Chiengi-Luchinda -Kaputa	205.8	Upgrade to Bituminous Standard & Re-Alig	-	2,112.4	2.0	8	3,946.0	1.2	18	1,066.0	10.5	12
D145	Luangwa to Feira including Bridge	80.9	Upgrade to Bituminous & Upgrade of bridg	-	432.9	0.4	25	2,492.4	0.7	25	1,099.5	10.8	10
D365	Monze to Niko	75.0	Upgrade and Re-Align	-	346.8	0.3	26	4,400.5	1.3	14	1,045.1	10.3	14
T3 Junction to M4	Sabina (T3 Junction) to Mufulira to Mukambo (M4)	41.5	upgrade to dual carriageway	-	453.0	0.4	23	1,323.0	0.4	30	1,032.0	10.2	15
D100	Chembe to Milenge to Kasanka	206.0	New road	-	50.5	0.0	37	121.8	-	38	17.4	0.1	37
Kazungula Bridge	Kazungula Bridge Project between Zambia & Zimbabwe	0.8	Construction of bridge instead of ferry	-	100.4	0.0	33	1,571.5	0.4	29	254.0	2.4	24

Table 11: Other Criteria Scoring

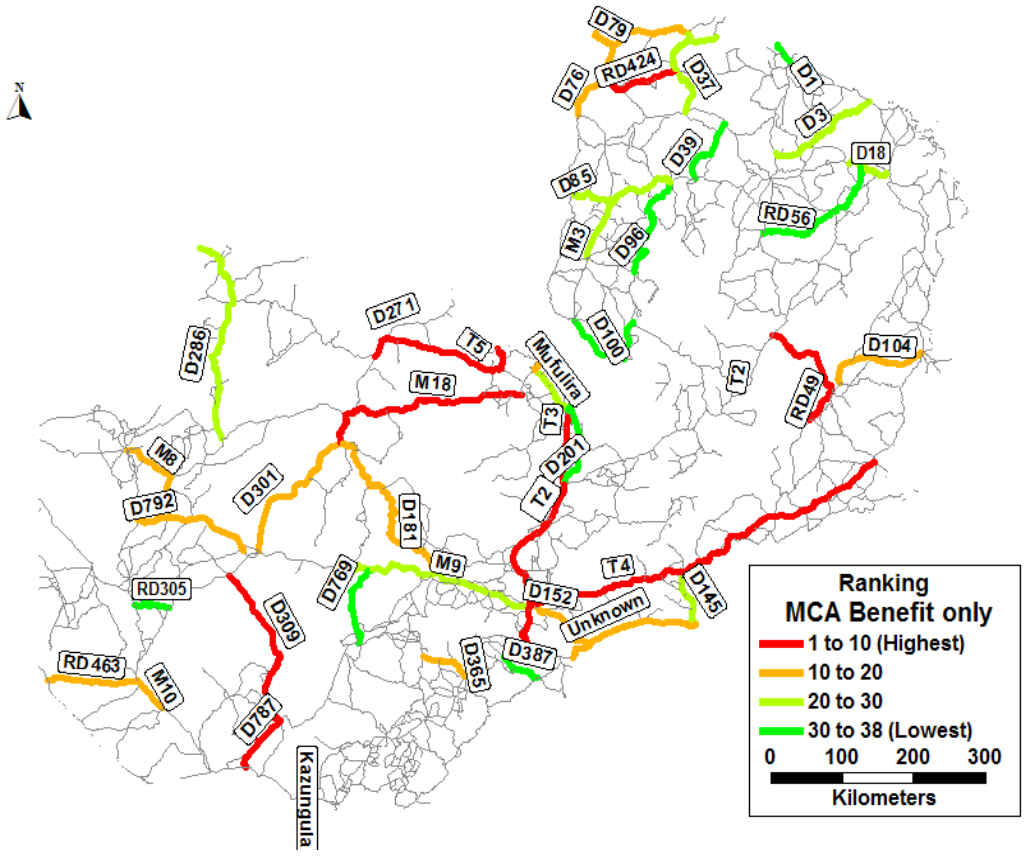
Road ID	Road name	Length (km)	Status	Phas	Road Standard (5%)			Socio-Economic Benefit (10%)			Border impact (5%)		
					Value	Point	Rank	Value	Point	Rank	Value	Point	Rank
M3	Mansa to Chipili to Luwingu road	175.0	Upgrade to Bituminous	1	8.0	3.0	6	3.7	8.0	10	5.0	2.5	12
D96	Samfya - Musaila - Lubwe - Kasaba - Ipukusilo - Luwingu	176.0	Construction of new bridges	1	8.0	3.0	6	4.0	9.1	5	-	-	20
D152 & RD491	Katoba Basic School via Chiawa to Chirundu	120.0	Upgrade to Bituminous	1	8.0	3.0	6	1.3	0.4	35	10.0	5.0	1
T4	Lusaka to Chipata	572.0	upgrade to dual carriageway	-	5.0	-	32	2.6	4.7	23	7.0	3.5	3
T2	Lusaka to Kafue	57.4	upgrade to dual carriageway	-	5.0	-	32	1.6	1.3	32	5.0	2.5	12
T2 & T3	Lusaka to Ndola	311.2	upgrade to dual carriageway	2	5.0	-	32	1.9	2.4	27	5.0	2.5	12
D37	Mporokoso - Nsama - Kaputa	194.9	Upgrade to Bituminous	1	8.0	3.0	6	4.1	9.2	4	-	-	20
RD 56 & D63	Safwa to Mulilansolo via Chinsali	185.0	Upgrade to Bituminous Standard & Re-Align	1	8.0	3.0	6	3.5	7.5	17	-	-	20
T2 & D18	Isoka to Mbesuma	168.0	New road	1	10.0	5.0	1	3.5	7.4	19	5.0	2.5	12
M18 & D181	Kalulushi to Kasempa	185.0	Upgrade to Bituminous	2	8.0	3.0	6	3.6	7.7	14	5.0	2.5	12
D181	Mumbwa to Kasempa	284.0	Upgrade to Bituminous	2	8.0	3.0	6	3.6	7.7	14	-	-	20
D301	Kasempa to Kaoma	215.0	Upgrade to Bituminous	2	8.0	3.0	6	3.7	8.0	10	5.0	2.5	12
D792, D557, M8	Kaoma to Lukulu to Zambezi	275.3	Upgrade to Bituminous	2	8.0	3.0	6	3.9	8.7	7	5.0	2.5	12
D286, M5	Kabompo to Mwinilunga to Jimbe	311.0	Upgrade to Bituminous	2	10.0	5.0	1	4.1	9.4	3	7.0	3.5	3
D39	Luwingu to Kapatu Mission to Nondo	99.2	Upgrade to Bituminous	2	8.0	3.0	6	3.9	8.6	8	-	-	20
D36 - RD424	Mununga to Mporokoso	130.0	Upgrade to Bituminous	2	8.0	3.0	6	4.3	10.0	1	7.0	3.5	3
T3	Chingola to Chililabombwe/ Kasumbalesa	45.0	upgrade to dual carriageway	2	5.0	-	32	1.2	-	38	10.0	5.0	1
T5	Chingola to Solwezi/Mutanda	205.0	upgrade to dual carriageway	2	5.0	-	32	1.7	1.6	30	5.0	2.5	12
Mufulira rd.	Ndola to Mufulira	62.0	upgrade to dual carriageway	2	5.0	-	32	1.3	0.2	37	7.0	3.5	3
D3	Nseluka -Chitimukulu-Makasa up to D1	170.0	Upgrade to Bituminous	3	8.0	3.0	6	3.6	7.7	16	7.0	3.5	3
M3 & D85	Munganga - Kawambwa & Mwenda to Kashiba	168.0	Upgrade to Bituminous	3	8.0	3.0	6	3.5	7.5	18	7.0	3.5	3
D769	Mumbwa - Itezhi Tezhi	110.0	Upgrade from gravel to bitoumen	3	8.0	3.0	6	2.5	4.3	25	-	-	20
D787 & D309	Sesheke (Simungoma)- Luampa	450.0	Upgrade to Bituminous	3	8.0	3.0	6	3.7	8.0	10	7.0	3.5	3
RD 463, M10	Matebele - Shangombo	135.0	Upgrade to Bituminous	3	8.0	3.0	6	3.9	8.7	6	7.0	3.5	3
RD305	Namushakende - Nalikwanda	60.0	Upgrade to Bituminous	3	8.0	3.0	6	3.3	6.6	21	-	-	20
D387	Chikankata	30.0	Upgrade to Bituminous	3	8.0	3.0	6	1.9	2.2	28	-	-	20
D104	Mwase-Lundazi-Chitungulu & Mwanya Mfuwe	290.0	-	3	8.0	3.0	6	3.7	8.0	13	7.0	3.5	3
RD9	Mbala-Kaseshya Border - Kalambo	47.0	Upgrade to Bituminous	3	8.0	3.0	6	3.5	7.4	20	7.0	3.5	3
D201	Old Congo Road Tug Argan to Kapiri	113.0	Upgrade to Bituminous	3	8.0	3.0	6	1.6	1.2	33	7.0	3.5	3
M9	Kafue hook bridge, Lusaka-Mongu Rd	270.0	Maintane and rehabilitate	-	5.0	-	32	1.4	0.6	34	-	-	20
Not idenfified	Chiawa - Feira Road including Bridge across R. Chongw	200.0	New road	1	10.0	5.0	1	1.6	1.4	31	7.0	3.5	3
RD 49	Mpika - Nabwalya - Mfuwe	118.0	Upgrade to Bituminous Standard & Re-Align	1	8.0	3.0	6	3.8	8.4	9	7.0	3.5	3
D76 - D77 - D79	Nchelenge -Chiengi-Luchinda -Kaputa	205.8	Upgrade to Bituminous Standard & Re-Align	-	8.0	3.0	6	4.3	10.0	2	7.0	3.5	3
D145	Luangwa to Feira including Bridge	80.9	Upgrade to Bituminous & Upgrade of bridge	-	8.0	3.0	6	1.9	2.2	29	10.0	5.0	1
D365	Monze to Niko	75.0	Upgrade and Re-Align	-	8.0	3.0	6	2.1	2.8	26	-	-	20
T3 Junction - M4	Sabina (T3 Junction) to Mufulira to Mukambo (M4)	41.5	upgrade to dual carriageway	-	8.0	3.0	6	1.3	0.3	36	7.0	3.5	3
D100	Chembe to Milenge to Kasanka	206.0	New road	-	10.0	5.0	1	3.0	5.8	22	-	-	20
Kazungula Bridge	Kazungula Bridge Project between Zambia & Zimbabwe	0.8	Construction of bridge instead of ferry	-	10.0	5.0	1	2.6	4.6	24	10.0	5.0	1

Table 12: Combined Benefits Analysis Results

Road ID	Road Name	Length (km)	Status	Phase	Total Points	Benefits Ranking (Best=1)
T2 & T3	Lusaka to Ndola	311.2	upgrade to dual carriageway	2	71.9	1
T2	Lusaka to Kafue	57.4	upgrade to dual carriageway	-	66.2	2
T5	Chingola to Solwezi/Mutanda	205.0	upgrade to dual carriageway	2	40.7	3
D787 & D309	Sesheke (Simungoma)- Luampa	450.0	Upgrade to Bituminous	3	40.3	4
M 18 & D181	Kalulushi to Kasempa	185.0	Upgrade to Bituminous	2	38.6	5
T4	Lusaka to Chipata	572.0	upgrade to dual carriageway	-	38.4	6
RD 49	Mpika - Nabwalya - Mfuwe	118.0	Upgrade to Bituminous Standard & Re-Align	1	38.0	7
D36 - RD424	Mununga to Mporokoso	130.0	Upgrade to Bituminous	2	36.4	8
T3	Chingola to Chililabombwe/ Kasumbalesa	45.0	upgrade to dual carriageway	2	35.1	9
D76 - D77 - D79	Nchelenge -Chiengi-Luchinda -Kaputa	205.8	Upgrade to Bituminous Standard & Re-Align	-	34.7	10
D152 & RD491	Katoba Basic School via Chiawa to Chirundu	120.0	Upgrade to Bituminous	1	32.5	11
D301	Kasempa to Kaoma	215.0	Upgrade to Bituminous	2	31.2	12
D792, D557, M8	Kaoma to Lukulu to Zambezi	275.3	Upgrade to Bituminous	2	30.7	13
RD 463, M 10	Matebele - Shangombo	135.0	Upgrade to Bituminous	3	30.0	14
Not idenfified	Chiawa - Feira Road including Bridge across R. Chongwe	200.0	New road	1	28.6	15
T3 Junction to M4	Sabina (T3 Junction) to Mufulira to Mukambo (M4)	41.5	upgrade to dual carriageway	-	27.6	16
D365	Monze to Niko	75.0	Upgrade and Re-Align	-	27.3	17
D104	Mwase-Lundazi-Chitungulu & Mwanya Mfuwe	290.0	-	3	27.3	18
D181	Mumbwa to Kasempa	284.0	Upgrade to Bituminous	2	26.8	19
D3	Nseluka -Chitimukulu-Makasa up to D1	170.0	Upgrade to Bituminous	3	26.6	20
D145	Luangwa to Feira including Bridge	80.9	Upgrade to Bituminous & Upgrade of bridge	-	26.5	21
Mufulira rd.	Ndola to Mufulira	62.0	upgrade to dual carriageway	2	25.9	22
Kazungula Bridge	Kazungula Bridge Project between Zambia & Zimbabwe	0.8	Construction of bridge instead of ferry	-	25.0	23
M9	Kafue hook bridge, Lusaka-Mongu Rd	270.0	Maintane and rehabilitate	-	24.1	24
D286, M5	Kabompo to Mwinilunga to Jimbe	311.0	Upgrade to Bituminous	2	21.9	25
T2 & D18	Isoka to Mbesuma	168.0	New road	1	21.4	26
M3	Mansa to Chipili to Luwingu road	175.0	Upgrade to Bituminous	1	17.1	27
D37	Mporokoso - Nsama - Kaputa	194.9	Upgrade to Bituminous	1	16.9	28
M3 & D85	Munganga - Kawambwa & Mwenda to Kashiba	168.0	Upgrade to Bituminous	3	16.3	29
D96	Samfya - Musaila - Lubwe - Kasaba - Ipukusilo - Luwingu via	176.0	Construction of new bridges	1	16.3	30
RD9	Mbala-Kaseshya Border - Kalambo	47.0	Upgrade to Bituminous	3	15.2	31
D201	Old Congo Road Tug Argan to Kapiri	113.0	Upgrade to Bituminous	3	14.9	32
D39	Luwingu to Kapatu Mission to Nondo	99.2	Upgrade to Bituminous	2	14.3	33
RD305	Namushakende - Nalikwanda	60.0	Upgrade to Bituminous	3	13.1	34
D387	Chikankata	30.0	Upgrade to Bituminous	3	12.9	35
RD 56 & D63	Safwa to Mulilansolo via Chinsali	185.0	Upgrade to Bituminous Standard & Re-Align	1	12.8	36
D100	Chembe to Milenge to Kasanka	206.0	New road	-	11.2	37
D769	Mumbwa - Itezhi Tezhi	110.0	Upgrade from gravel to bitoumen	3	10.9	38

The road projects that were subjected to the multi-criteria analysis as shown in Table 12 above are also graphically characterized in Map 14 below. The ten highest ranked projects with regard to expected benefit are coded in the red color while those that are indicatively least beneficial are coded in green in the projects benefit Map below. When only benefits are considered, the upgrading of the roadways to a dual carriageways such as the T2 and T3 from Lusaka to Ndola, which is over 311 km long appear to be the better options. Generally, the projects that are most beneficial are the ones on major roads with high car and truck traffic.

Map 14: Road Projects Coded according to Benefits Ranking of the MCA



6.3. Cost Benefit Analysis

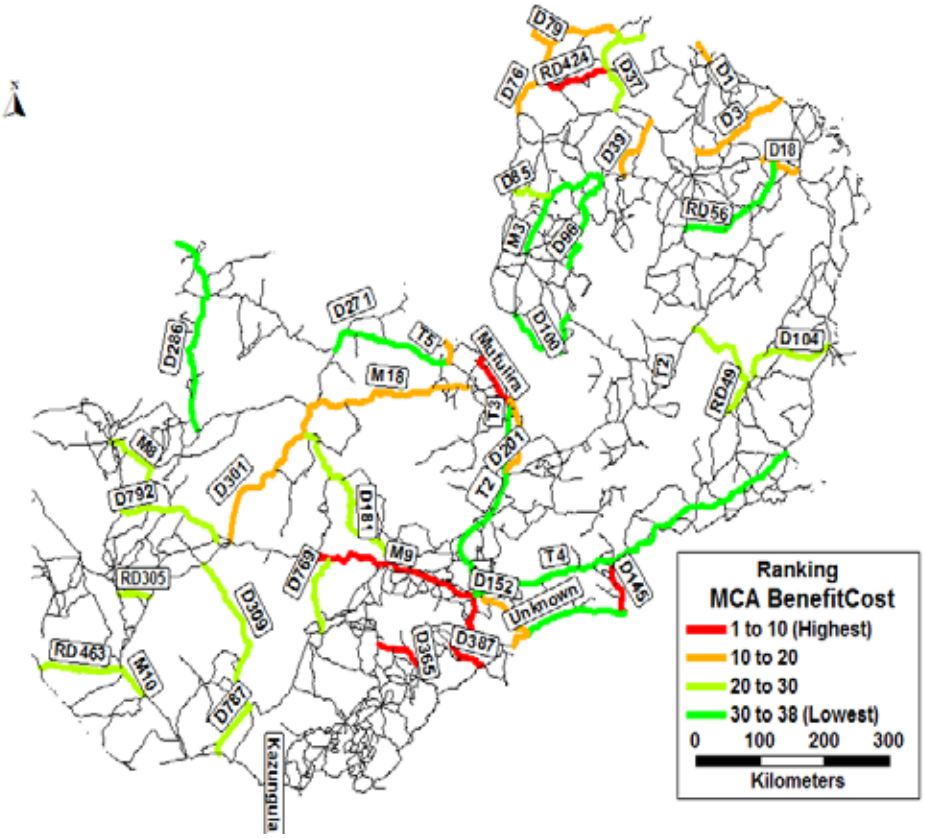
However important investment decisions can not be concluded on based on benefits analysis alone considering that the resource base from which these projects are financed is normally inadequate. Projects are therefore supposed to be evaluated with respect costs as well. It should also be noted, however, that more often the cost-benefit approach on its own unduly favors smaller projects. For that reason, it is recommended to use the benefits ranking alone to screen-out project that are less beneficial, and assuming that all retained projects will enventually be developed to priritise them using the cost-benefit appraoch.

Table 14 below shows the combined benefits and cost-benefit analysis results of the 38 projects. The results of the cost-benefit analysis are also graphically presented in Map 15. The ten (10) highest ranked projects with regard to cost-benefit analysis are coded in the red color while those that are lowest ranked are coded in green in the Map.

Table 13: Combined Results for Benefits and Cost-Benefits Analysis

Road ID	Road name	Length (km)	Status	Phase	Total points	Benefits Ranking	Cost-Benefit Ranking		
							Cost (USD, m)	CB ratio	Ranking (Best=1)
Kazungula Bridge	Kazungula Bridge between Zambia & Botswana	0.8	Construction of bridge instead of ferry	-	25.0	23	18.0	139%	1
D387	Chikankata	30.0	Upgrade to Bituminous	3	12.9	35	16.3	79%	2
D365	Monze to Niko	75.0	Upgrade and Re-Align	-	27.3	17	38.8	70%	3
T3 Junction - M4	Sabina (T3 Junction) to Mufulira to Mukambo (M4	41.5	upgrade to dual carriageway	-	27.6	16	39.4	70%	4
T2	Lusaka to Kafue	57.4	upgrade to dual carriageway	-	66.2	2	100.5	66%	5
Mufulira rd.	Ndola to Mufulira	62.0	upgrade to dual carriageway	2	25.9	22	41.9	62%	6
D36 - RD424	Mununga to Mporokoso	130.0	Upgrade to Bituminous	2	36.4	8	71.1	51%	7
M9	Kafue hook bridge, Lusaka-Mongu Rd	270.0	Maintane and rehabilitate	-	24.1	24	50.0	48%	8
D145	Luangwa to Feira including Bridge	80.9	Upgrade to Bituminous & Upgrade of bridge	-	26.5	21	59.4	45%	9
RD9	Mbala-Kaseshya Border - Kalambo	47.0	Upgrade to Bituminous	3	15.2	31	35.0	43%	10
M18 & D181	Kalulushi to Kasempa	185.0	Upgrade to Bituminous	2	38.6	5	101.2	38%	11
T3	Chingola to Chililabombwe/Kasumbalesa	45.0	upgrade to dual carriageway	2	35.1	9	103.7	34%	12
D3	Nseluka -Chitimukulu-Makasa up to D1	170.0	Upgrade to Bituminous	3	26.6	20	95.3	28%	13
T2 & D18	Isoka to Mbesuma	168.0	New road	1	21.4	26	77.1	28%	14
D301	Kasempa to Kaoma	215.0	Upgrade to Bituminous	2	31.2	12	117.6	27%	15
D39	Luwingu to Kapatu Mission to Nondo	99.2	Upgrade to Bituminous	2	14.3	33	54.3	26%	16
D152 & RD491	Katoba Basic School via Chiawa to Chirundu	120.0	Upgrade to Bituminous	1	32.5	11	124.5	26%	17
D76 - D77 - D79	Nchelenge -Chiengi-Luchinda -Kaputa	205.8	Upgrade to Bituminous Standard & Re-Align	-	34.7	10	139.2	25%	18
D201	Old Congo Road Tug Argan to Kapiri	113.0	Upgrade to Bituminous	3	14.9	32	63.4	24%	19
M3 & D85	Munganga - Kawambwa & Mwenda to Kashiba	168.0	Upgrade to Bituminous	3	16.3	29	77.1	21%	20
RD 49	Mpika - Nabwalya - Mfuwe	118.0	Upgrade to Bituminous Standard & Re-Align	1	38.0	7	183.2	21%	21
D792, D557, M8	Kaoma to Lukulu to Zambezi	275.3	Upgrade to Bituminous	2	30.7	13	150.6	20%	22
RD305	Namushakende - Nalikwanda	60.0	Upgrade to Bituminous	3	13.1	34	67.9	19%	23
D181	Mumbwa to Kasempa	284.0	Upgrade to Bituminous	2	26.8	19	145.5	18%	24
D769	Mumbwa - Itezhi Tezhi	110.0	Upgrade from gravel to bitoumen	3	10.9	38	61.1	18%	25
RD 463, M10	Matebele - Shangombo	135.0	Upgrade to Bituminous	3	30.0	14	174.3	17%	26
D104	Mwase-Lundazi-Chitungulu & Mwanya Mfuwe	290.0	0	3	27.3	18	162.7	17%	27
D787 & D309	Sesheke (Simungoma)- Luampa	450.0	Upgrade to Bituminous	3	40.3	4	252.4	16%	28
D37	Mporokoso - Nsama - Kaputa	194.9	Upgrade to Bituminous	1	16.9	28	111.0	15%	29
D96	Samfya - Musaila - Lubwe - Kasaba - Ipukusilo - Luv	176.0	Construction of new bridges	1	16.3	30	111.9	15%	30
D100	Chembe to Milenge to Kasanka	206.0	New road	-	11.2	37	81.6	14%	31
D286, M5	Kabompo to Mwinilunga to Jimbe	311.0	Upgrade to Bituminous	2	21.9	25	170.2	13%	32
T2 & T3	Lusaka to Ndola	311.2	upgrade to dual carriageway	2	71.9	1	605.7	12%	33
RD 56 & D63	Safwa to Mulilansolo via Chinsali	185.0	Upgrade to Bituminous Standard & Re-Align	1	12.8	36	133.4	10%	34
Unknown	Chiawa - Feira Rd including Bridge across R. Chon	200.0	New road	1	28.6	15	321.7	9%	35
T5	Chingola to Solwezi/Mutanda	205.0	upgrade to dual carriageway	2	40.7	3	472.4	9%	36
M3	Mansa to Chipili to Luwingu road	175.0	Upgrade to Bituminous	1	17.1	27	214.5	8%	37
T4	Lusaka to Chipata	572.0	upgrade to dual carriageway	-	38.4	6	667.9	6%	38

Map 15: Road Project Ranking based on Cost-Benefit Analysis



8. Conclusions and Way forward

This study presents a coherent project evaluation mechanism, that can be upgraded, updated and tested to incorporate any additional projects. The TDM that was developed for this project was a simplified one. This owes to the stated limitations in resources and data. However, on the whole, the evaluation process provides good results regarding project prioritization. While the project list and its attributes might not be precise due to the stated data limitations, they can be revised at any time should data of superior quality be accessible and therefore further improve the results.

Given the limited resources available for this study, the existing TDM is not as precise as initially and and doesn't include the public transport mode. It may not be unconditionally policy sensitive and but it provides sufficient scope for policy makers to make educated judgement in prioritising projects.

In this regard, it is recommended that the National Master Plan includes an update to the national TDM for multiple project planning and policy considerations. This update may include, but should not be limited to multimodal modelling encampassing railways, public transport modes, road tolling scenarios, a freight model with a pavement deterioration curve, options for peak period simulation of congestion, additional socio-economic attributes in the model structure, and additional traffic zones for other countries, to better estimate incoming and outgoing international traffic.

While the model developed as a part of this project is a good start in model development, Zambia has distinctive characteristics that necessitates a more robust policy-oriented national TDM in order to further forecast road traffic for the development of policy and other activities.

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Appendix A – List of Project (RDA)

Road ID	Road name	Province	Phase	Works	Length GIS (Km)	Cost Assessment (ZMW m)	Cost Assessment (US$ m)	Contract Cost (Works) (ZMW m)	Status	Contractor/ Consultant
D152 & RD491	**Katoba Basic School via Chiawa to Chirundu**	Lusaka	1	Upgrading to Bituminous	136.03	660	124.53		Procurement of Detailed Design Consultancy underway.	
Unknown	**Chiawa to Feira Road including Bridge across Chongwe River**	Lusaka	1	Upgrading & construction of new road	159.5	1705	321.7		Project scheduled under feasibility studies in 2013.	
D37	**Mporokoso - Nsama - Kaputa**	Northern	1	Upgrading to Bituminous	137.55	588.13	110.97	4.90	Design contract is underway. Works tender is yet to be advertised.	Bicon Zambia in association with Bicon Namibia
RD 49	**Mpika - Nabwalya - Mfuwe**	Muchinga	1	Upgrading to Bituminous Standard and Re-Alignment	193.65	425	80.19	540.83	Contract has been awarded.	Raubex Zambia Limited & China Henan International Corporation Group Co. Ltd
RD 56 & D63	**Safwa to Mulilansolo via Chinsali**	Muchinga	1	Upgrading to Bituminous Standard and Re-Alignment	192.05	342	64.53	264.90	Contract has been awarded.	Raubex Zambia Limited
D76 - D77 - D79	**Nchelenge -Chiengi-Luchinda -Kaputa**	Luapula	1	Upgrading to Bituminous Standard and Re-Alignment	78	738	139.25		Tender closing 16/08/13	
M3	**Mansa to Chipili to Luwingu road**	Luapula	1	Upgrading to Bituminous	181.93	1,137.00	214.53		Contract signed and Currently under Detailed Design	
D96	**Samfya to Musaila to Lubwe to Kasaba to Ipukusilo to Luwingu via Ipusikilo Mission**	Luapula	1	Construction of new bridges	177.60	593	111.89	20.95	Tender closed currently under evaluation.	Raubex Zambia Limited
D145	**Luangwa to Feira including Bridge**	Eastern	1	Upgrading to Bituminous and Upgrading of bridge	80.94	60	11.32		Contract signed, services yet to commence.	
T2 & D18	**Isoka to Mbesuma**	Muchinga	1	Upgrading to Bituminous	66.28	408.45	77.07		Contract signed, works yet to commence.	

Road ID	Road Name	Province	Phase	Works	Length GIS (Km)	Cost Assessment (ZMW m)	Cost Assessment (US$ m)	Contract Cost (Works) (ZMW m)	Status	Contractor/ Consultant
D365	**Monze to Niko**	Southern	2	Upgrading & Re-Alignment	70.00	296	55.85	205.47	Contract awarded, awaiting AG's clearance prior to contract signing.	BSBK Zambia Limited
M18 & D181	**Kalulushi to Kasempa**	N/ Western & Copperbelt	2	Upgrading to Bituminous	308.99	536.5	101.23		Contract to be signed by August 9, 2013	
D181	**Mumbwa to Kasempa**	N/Western	2	Upgrading to Bituminous	261.69	771.4	145.55		Tender closes on 26th July 2013 – Under Evaluation. Consulting Services for the Techno-Economic Study, Detailed Engineering Design and Tender Document Preparation for the upgrading	Under Evaluation
D301	**Kasempa to Kaoma**	N/Western & Western	2	Upgrading to Bituminous	213.42	623.5	117.64		Contract to be signed by August 9, 2013	
D792, D557, M8	**Kaoma to Lukulu to Zambezi**	N/Western	2	Upgrading to Bituminous	331.09	798.37	150.64	6.37	Contract awarded awaiting Attorney General's clearance. Consulting Services for the Techno-Economic Study, Detailed Engineering Design and Tender document preparation for the upgrading.	East Consult Limited in Association with Knight Piesold
D286	**Kabompo to Mwinilunga to Jimbe**	N/Western	2	Upgrading to Bituminous	203.55	901.9	170.17	16.16	Contract awarded, awaiting Attorney General's clearance. Consulting Services for the Techno-Economic Study, Detailed Engineering Design and Tender document preparation for the upgrading.	Jeffares & Green in Association with Zenith Consulting Company
D39	**Luwingu to Kapatu Mission to Nondo**	Northern	2	Upgrading to Bituminous	96.10	287.68	54.28		Contract to be signed by August 9, 2013	
D36 - RD424	**Mununga to Mporokoso**	Luapula	2	Upgrading to Bituminous	114.45	377	71.13		Contract to be signed by August 9, 2013	
T3	**Chingola to Chililabombwe/ Kasumbalesa**	Copperbelt	2	upgrade to dual carriageway	31.75	730	138		Expected to commence services by first quarter of 2014	
T5	**Chingola to Solwezi/Mutanda**	Copperbelt & N/ Western	2	upgrade to dual carriageway	303.11	3,116	588		Expected to commence services by first quarter of 2014	
T3 Junction to M4	**Sabina (T3 Junction) to Mufulira to Mukambo (M4)**	Copperbelt	2	upgrade to dual carriageway	17.11	209	38		Currently under detailed study, works expected to commence in first quarter of 2014	
Mufulira rd.	**Ndola to Mufulira**	Copperbelt	2	upgrade to dual carriageway	78.68	222	42.7		Currently under detailed study, works expected to commence in first quarter of 2014	
T2 & T3	**Lusaka to Ndola**	Central & Copperbelt	2	upgrade to dual carriageway	303.57	3,210.00	605.66		Consultancy Services have commenced	

R oad ID	Road Name	Province	Phase	Works	Length GIS (Km)	Cost Assessment (ZMW Mn)	Cost Assessment (US$ Mn)	Contract Cost (Works) (ZMW)	Status	Contractor/ Consultant
D3	**Nseluka -Chitimukulu-Makasa up to D1**	Northern	3	Upgrading to Bituminous	167.53	505.33	95.35		Expressions of Interest to be issued by 30 September.	
RD9	**Mbala-Kaseshya Border - Kalambo**	Northern	3	Upgrading to Bituminous	28.37	185.47	34.99		Expressions of Interest to be issued by 30 September.	
D100	**Chembe to Milenge to Kasanka**	Luapula	3	New road	149.7	432.4	81.58		Expressions of Interest to be issued by 30 September.	
M3 & D85	**Munganga - Kawambwa & Mwenda to Kashiba**	Luapula	3	Upgrading to Bituminous	66.31	408.45	77.07		Expressions of Interest to be issued by 30 September.	
D201	**Old Congo Road Tug Argan to Kapiri**	Copperbelt	3	Upgrading to Bituminous	124.38	335.89	63.38		Expressions of Interest to be issued by 30 September.	
D769	**Mumbwa - Itezhi Tezhi**	Southern & Central	3	Upgrading from gravel to bitoumen	119.95	324	61.13	3.91	Contract awarded, awaiting Attorney General's clearance. Consulting Services for the Techno-Economic Study, Detailed Engineering Design and Tender document preparation for the upgrading.	Otieno Odongo & Partners
D787 & D309	**Sesheke (Simungoma)-Luampa**	Western	3	Upgrading to Bituminous	318.70	1,337.63	252.38		Expressions of Interest to be issued by 30 September.	
RD 463, M10	**Matebele - Shangombo**	Western	3	Upgrading to Bituminous	179.51	683.68	129.00		Contract to be signed by August 9, 2013	
RD305	**Namushakende - Nalikwanda**	Western	3	Upgrading to Bituminous	53.49	236.78	44.68		Contract to be signed by August 9, 2013	
D387	**Chikankata**	Southern	3	Upgrading to Bituminous	64.23	89.18	16.83		Expressions of Interest to be issued by 30 September.	
M9	**Kafue hook bridge, Lusaka-Mongu Rd**	Western	3	upgrade to dual carriageway	283.76			3.00	Contract awarded awaiting Attorney General's clearance. Consulting Services for the Detailed Structural Assessment and Engineering Design and Tender document preparation for the repair.	Kiran & Musonda Associates Consulting Engineers
Kazungula Bridge	**Kazungula Bridge Project between Zambia and zimbabwe**	Southern	Phase 3	Construction of new bridge instead of ferry	0.89				Invitation for Prequalification	

Projects to be launched before December 2012		
No	**Project**	**Status**
1	Kitwe - Chingola Dual Carriageway	To commence by 31/12/2012
2	Lusaka - Chirundu Road	Contractor Mobilising
3	Mufuchani Bridge Resettlement Dwelling	Project commissioned
4	Lusaka L300 Project	Contract signed
5	Pave Zambia 2000	Contract approved
6	Kabwe/Kapiri Roads	Contract awarded
7	Chingola Urban Roads	Project Commissioned
8	Livingstone City Roads	Procurement of works under- way
9	Kapiri - Kabwe Road Project	Bids Evaluated
10	Ndola Kitwe Dual Carriageway	Contract to be awarded by 30/9/2012

Projects to be launched before December 2012		
No	**Project**	**Status**
11	Mansa - Nchelenge	Contract awarded
12	Great East Road - Luangwa Bridge to Mwami Border	ADB funded tenders issued
13	Chama - Matumbo Road Project	Project to be launched by 12/10/12
14	Kazungula Bridge	Design Review underway

Other Projects besides 8000 3 Phases		
No	**Project**	**Status**
1	Lusaka—Chirundu Road	Contract signed. Works have commenced
2	Mufuchani Bridge Resettlement Dwelling	Contract awarded. Works commenced in October 2012
3	Lusaka L400 Project	Contract signed.
4	Kabwe/Kapiri Road — Urban Roads	Contract signed. Works have commenced
5	Chingola Urban Roads	Contract awarded. Project launched on 07/09/12
6	Livingstone City Roads	Contract awarded. Works have commenced.
7	Kapiri — Kabwe Road Project	Contract awarded. Works have
8	Ndola — Kitwe Dual Carriageway	Rehabilitation underway.
9	Mansa — Nchelenge Road Project	Contract awarded. Works have commenced

Other Projects besides 8000 3 Phases		
No	**Project**	**Status**
10	Great East Road — Nyimba to Sinda	Contract signed. Contractor mobilizing
11	Kawambwa — Mushota Road Project	Contract awarded. Contractor has mobilized
12	Mulilansolo to Chinsali-Safwa Road Project	Contract signed. Contractor mobilizing.
13	Mufuchani Bridge Project	Works tender close on 21st June 2013
14	Upgarding of Chiengi - Kaputa road	Works tender to be advertised Wed 5th June 2013

Appendix B – Traffic Count 2011 (RDA)

Point No.	Province	District	Road No.	Road Chain (km)	Direction	Date	Traffic Class 1 Light Vehicles - Day	Traffic Class 2 Buses - Day	Traffic Class 3 Semi-Unit Trucks - Day	Traffic Class 4 Trailer/ Semi-trailer Trucks - Day	Average Daily Traffic or the Period Counted
1	Southern	Zimba	T1	0	Both	08/06/11 to 13/06/11	456	67	90	299	913
2	Southern	Monze	T1	0	Both	08/06/11 to 30/03/09	1,448	115	212	385	2,161
3	Lusaka	Lusaka	T2	0	Both	08/06/11 to 13/06/11	6,568	802	2,170	3,140	12,681
4	Central	Mkushi	T2	0	Both	20/07/11 to 25/07/11	532	48	50	237	867
5	Central	Serenje	T2	0	Both	13/07/11 to 18/07/11	273	28	73	345	720
6	Northern	Chinsali	T2	0	Both	20/07/11 to 25/07/11	52	18	30	157	257
7	Northern	Isoka	T2	0	Both	14/07/11 to 19/07/11	476	62	140	471	1,150
8	Copperbelt	Ndola	T3	0	Both	17/06/11 to 22/06/11	1,458	170	217	860	2,706
9	Lusaka	Chongwe	T4	0	Both	09/06/11 to 14/06/11	2,090	256	272	271	2,889
11	Eastern	Chipata	T4	0	Both	28/07/11 to 02/08/11	147	20	36	87	290
12	North-western	Chingola	T5	0	Both	23/06/11 to 28/06/11	388	35	78	308	809
13	North-western	Solwezi	T5	0	Both	24/06/11 to 29/06/11	650	65	65	211	991
14	Northern	Kasama	M1	0	Both	13/07/11 - 18/7/11	730	26	69	13	837
15	Luapula	Luwingu	M3	0	Both	06/07/11 to 11/07/11	27	4	10	1	42
16	Copperbelt	Mufulira	M4	0	Both	16/06/11 to 21/06/11	339	16	12	75	441
17	North-western	Mufumbwe	D286	0	Both	23/06/11 to 28/06/11	58	5	9	12	85
18	Central	Mumbwa	M20	0	Both	27/07/11 to 01/08/11	127	3	34	12	175
28	Luapula	Kawambwa	M19	0	Both	06/07/11 to 11/07/11	116	11	10	3	140

Appendix B – Traffic Count 2011 (RDA)

Point No.	Province	District	Road No.	Road Chain (km)	Direction	Date	Traffic Class 1 Light Vehicles - Day	Traffic Class 2 Buses - Day	Traffic Class 3 Semi-Unit Trucks - Day	Traffic Class 4 Trailer/ Semi-trailer Trucks - Day	Average Daily Traffic or the Period Counted
33	Southern	Mazabuka	T1	0	Both	08/06/11 to 14/06/11	1,186	140	193	327	1,847
37	Western	Mongu	D459	0	Both	27/07/11 to 01/08/11	321	5	38	3	366
40	Eastern	Mumbwa	D124	0	Both	28/07/11 to 02/08/11	29	7	9	1	45
43	Northern	Mpika	M1	0	Both	13/07/11 to 18/07/11	158	27	90	330	605
44	North-western	Zambezi	294	0	Both	24/06/11 to 29/06/11	95	0	3	0	99
46	Southern	Mazabuka	T1	0	Both	08/06/11 to 13/06/11	1,009	129	189	329	1,657
50	Lusaka	Lusaka	M9	0	Both	09/06/11 to 14/06/11	4,049	616	588	265	5,518
52	Southern	Livingstone	M10	0	Both	08/06/11 to 13/06/11	707	34	51	125	917
55	Northern	Kasama	M1	0	Both	13/07/11 to 18/07/11	100	10	62	94	266
56	Northern	Kasama	M1	0	Both	13/07/11 to 18/07/11	212	15	45	96	368
57	Eastern	Chipata	M12	0	Both	21/07/11 to 26/07/11	780	19	128	59	986
59	Western	Mongu	M10	0	Both	27/07/11 to 01/08/11	263	11	54	6	334
61	Southern	Livingstone	T1	0	Both	08/06/11 to 30/03/09	1,669	185	83	117	2,054
64	Central	Mumbwa	M9	0	Both	27/07/11 to 01/08/11	107	13	52	83	255
65	Southern	Choma	D775	0	Both	08/06/11 to 13/06/11	415	43	123	202	784
67	Southern	Siavonga	T2	0	Both	08/06/11 to 12/06/11	407	39	19	375	839
71	Central	Kabwe	T2	0	Both	16/06/11 to 21/06/11	2,178	241	310	849	3,579
72	Central	Kapirimposhi	T2	0	Both	16/06/11 to 21/06/11	2,735	200	403	891	4,228

Appendix B – Traffic Count 2011 (RDA)

Point No.	Province	District	Road No.	Road Chain (km)	Direction	Date	Traffic Class 1 Light Vehicles - Day	Traffic Class 2 Buses - Day	Traffic Class 3 Semi-Unit Trucks - Day	Traffic Class 4 Trailer/ Semi-trailer Trucks - Day	Average Daily Traffic or the Period Counted
75	Copperbelt	Kalulushi	M18	0	Both	16/06/11 to 21/06/11	500	9	73	40	621
76	Copperbelt	Kalulushi	T3	0	Both	16/06/11 to 21/06/11	3,785	357	308	1,225	5,675
78	Copperbelt	Chililabombwe	T3	0	Both	16/06/11 to 21/06/11	1,848	151	263	598	2,859
79	Luapula	Chembe	M3	0	Both	06/07/11 to 11/07/11	121	15	42	33	211
80	Lusaka	Luangwa	D145	0	Both	20/07/11 to 25/07/11	50	5	17	2	73
82	Eastern	Chipata	T4	0	Both	21/07/11 to 26/07/11	998	6	14	113	1,131
87	Northern	Mbala	M2	0	Both	13/07/11 to 18/07/11	49	18	10	4	81
88	Northern	Kasama	D37	0	Both	13/07/11 to 18/07/11	20	10	9	5	45
91	Northern	Isoka	D790	0	Both	13/7/11 to 18/7/11	17	6	8	1	32
96	North-western	Solwezi	M8	0	Both	23/06/11 to 28/06/11	234	17	15	16	281
98	Western	Kaoma	D301	0	Both	10/08/11 to 15/08/11	52	0	3	0	56
99	Western	Kalabo	D319	0	Both	27/07/11 to 01/08/11	144	1	30	3	179
102	Southern	Kazungula	M10	0	Both	06/08/11 to 13/06/11	635	36	66	78	815
103	Central	Serenje	D235	0	Both	13/07/11 to 18/07/11	112	7	12	54	186
112	Luapula	Nchelenge	D76	0	Both	06/07/11 to 11/07/11	248	19	67	18	352
114	Luapula	Mwense	D82	0	Both	06/07/11 to 11/07/11	22	1	12	1	37
115	Luapula	Mansa	D545	0	Both	06/07/11 to 11/07/11	207	17	28	22	274
117	Luapula	Mansa	D94	0	Both	06/07/11 to 11/07/11	335	23	60	144	562

Appendix B – Traffic Count 2011 (RDA)

Point No.	Province	District	Road No.	Road Chain (km)	Direction	Date	Traffic Class 1 Light Vehicles - Day	Traffic Class 2 Buses - Day	Traffic Class 3 Semi-Unit Trucks - Day	Traffic Class 4 Trailer/ Semi-trailer Trucks - Day	Average Daily Traffic or the Period Counted
211	North-western	Solwezi	T4	0	Both	24/06/11 to 29/06/11	762	61	78	197	1,098
241	Luapula	Mansa	M3	0	Both	06/07/11 to 11/07/11	386	11	46	24	467
244	Luapula	Mansa	M3	0	Both	06/07/11 to 11/07/11	29	3	8	1	40
117A	Luapula	Mansa	D451	0	Both	06/07/11 to 11/07/11	168	15	55	160	398
11A	Eastern	Katete	T4	0	Both	28/07/11 to 02/08/11	93	14	33	72	212
17A	North-western	Kabompo	D286	0	Both	23/06/11 to 28/06/11	36	1	4	0	41
66A	Southern	Mazabuka	T2	0	Both	08/06/11 to 13/6/11	2,169	169	417	815	3,569
66B	Lusaka	Mazabuka	T2	0	Both	08/06/11 to 13/06/11	782	55	136	449	1,423
72A	Central	Kapirimposhi	T3	0	Both	16/06/11 to 21/06/11	1,716	218	350	1,118	3,402
72B	Central	Kapirimposhi	T2	0	Both	06/07/11 to 11/07/11	384	42	173	413	1,012

Appendix C – Traffic Count 2013 (RDA)

Point No.	Province	District	Location	Road No.	Road Chain (km)	Link No.	Link Chain (km)	Lattitude	Longitude	Direction	Count Date	Count Duration	ADT - Traffic Class 1 ht Vehicles	ADT - Traffic Class 2 ses
40	Eastern	Chipata	kasenengwa	D124	29.916	D124_01	29.916	-13.7148	32.3257	Both	8/May/13	08-05-13 to 13-05-13	204	6
80	Lusaka	Luangwa	Counsel Barrie	D145	3.845	D145_01	3.845	-15.0132	30.2203	Both	1/May/13	01-05-13 to 06-05-13	87	7
103	Central	Serenje	Mukando	D235	1.228	D235_01	1.228	-13.0084	30.4587	Both	24/Apr/13	24-04-13 to 29-04-13	259	30
17A	North western	Kabompo	Kachikenge	D286	10.045	D286_01	10.045	-13.3579	24.2911	Both	1/May/13	01-05-13 to 06-05-13	166	1
98	Western	Kaoma	Lalafuta bridg	D301	215.357	D301_03	0.679	-14.7720	24.7959	Both	22/May/13	22-05-13 to 27-05-13	65	1
37	Western	Mongu	Limulunga	D315	5.420	D315_01	5.420	-15.1751	23.1580	Both	17/Apr/13	17-04-13 to 22-04-13	204	5
99	Western	Kalabo	Namatindi Car	D319	179.040	D319_01	179.040	-16.2430	23.2359	Both	8/May/13	08-05-13 to 13-05-13	164	1
88	Northern	Mporokoso	Nsama	D37	5.989	D037_01	5.989	-9.3113	30.1369	Both	22/May/13	22-05-13 to 27-05-13	247	9
117A	Luapula	Samfya	Musaila	D451	0.668	D451_01	0.668	-11.3580	29.4935	Both	17/Apr/13	17-04-13 to 22-04-13	339	17
112	Luapula	Nchelenge	Nchelenge	D76	74.236	D076_02?	12.033	-9.3502	28.7377	Both	22/May/13	22-05-13 to 27-05-13	485	48
65	Southern	Choma	Batoka	D775	105.800	D775_01	105.800	-16.7735	27.2484	Both	1/May/13	01-05-13 to 06-05-13	559	14
28	Luapula	Kawambwa	Mbereshi	D79	94.050	D079_02	11.290	-9.7365	28.7861	Both	15/May/13	15-05-13 to 20-05-13	304	40
91	Muchinga	Isoka	Mwaiseni	D790	0.396	D790_01	0.396	-10.1468	32.6733	Both	22/May/13	22-05-13 to 27-05-13	225	24
114	Luapula	Mwense	Kashiba board	D82	0.931	D082_01	0.931	-10.4412	28.6488	Both	8/May/13	08-05-13 to 13-05-13	119	2
115	Luapula	Mansa	Bahati	D821	8.736	D821_01	8.736	-11.0506	28.8489	Both	1/May/13	01-05-13 to 06-05-13	224	29
117	Luapula	Samfya	Musaila	D94	70.048	D094_01	70.048	-11.3526	29.4893	Both	17/Apr/13	17-04-13 to 22-04-13	403	18
14	Northern	Kasama	Nseluke Turn	M1	223.510	M001_06	10.312	-10.1317	31.2518	Both	22/May/13	22-05-13 to 27-05-13	333	16
43	Muchinga	Mpika	Shilombe Kas	M1	37.373	M001_01	37.373	-11.5896	31.2953	Both	17/Apr/13	17-04-13 to 22-04-13	179	34
55	Muchinga	Mpika	Kasongo	M1	140.772	M001_04	4.245	-10.8285	31.1199	Both	24/Apr/13	24-04-13 to 29-04-13	145	25
56	Northern	Kasama	Nkole Mfumu	M1	202.695	M001_04	66.168	-10.2897	31.2149	Both	1/May/13	01-05-13 to 06-05-13	143	21
52	Southern	Livingstone	Simonga	M10	63.835	M010_05	0.355	-17.7668	25.2792	Both	17/Apr/13	17-04-13 to 22-04-13	768	31
59	Western	Mongu	Namatindi	M10	485.469	M010_09	82.021	-15.4400	23.2258	Both	24/Apr/13	24-04-13 to 29-04-13	283	4
102	Southern	Kazungula	Border Post	M10	17.033	M010_03	6.353	-17.8047	25.7100	Both	17/Apr/13	17-04-13 to 22-04-13	829	33
57	Eastern	Lundazi	Katuwa	M12	9	M012_02	1.892	-13.5707	32.6139	Both	8/May/13	08-05-13 to 13-05-13	532	23
75	Copperbelt	Kalulushi	Council Barrie	M18	7.470	M018_04	0.873	-12.8538	28.0885	Both	8/May/13	08-05-13 to 13-05-13	1,574	52
87	Northern	Mpulungu	10km west of	M2	14.900	M002_03	10.000	-8.8716	31.2676	Both	8/May/13	08-05-13 to 13-05-13	409	53
18	Central	Mumbwa	Kembe	M20	31.400	M020_02	22.997	-14.9028	27.7780	Both	1/May/13	01-05-13 to 06-05-13	253	6
15	Luapula	Luwingu	16km west of	M3	261.997	M003_06	99.748	-10.5399	29.1611	Both	22/May/13	22-05-13 to 27-05-13	143	8
79	Luapula	Mansa	Chembe	M3	419.107	M003_14	54.471	-11.7843	28.7469	Both	17/Apr/13	17-04-13 to 22-04-13	134	20
241	Luapula	Mansa	Lukangulu	M3	358.375	M003_12	6.877	-11.2595	28.8772	Both	24/Apr/13	24-04-13 to 29-04-13	156	17
244	Luapula	Kawambwa	Munganga	M3	0.655	M013_01	0.655	-10.5347	29.1571	Both	8/May/13	08-05-13 to 13-05-13	202	27
16	Copperbelt	Ndola	Sakania	M4	10.617	M004_02	3.513	-12.8975	28.5536	Both	1/May/13	01-05-13 to 06-05-13	570	52
17	North western	Mufumbwe	Kashima west	M8	264.270	M008_04	70.000	-13.2321	24.5487	Both	15/May/13	15-05-13 to 20-05-13	72	10
96	North western	Solwezi	Mumena	M8	20.310	M008_01	20.310	-12.5496	26.1516	Both	22/May/13	22-05-13 to 27-05-13	199	25
50	Lusaka	Lusaka	Chabota Scho	M9	6.996	M009_01	6.996	-15.4197	28.2134	Both	24/Apr/13	24-04-13 to 29-04-13	5,863	114
64	Central	Mumbwa	Nalusanga	M9	186.828	M009_09	33.346	-14.9730	26.7223	Both	22/May/13	22-05-13 to 27-05-13	172	35
44	North Wester	Zambezi	Dipalata	RD294	0.730	RD294_65	0.730	-13.5068	23.1002	Both	15/May/13	15-05-13 to 20-05-13	101	1
1	Southern	Kalomo	Zimba	T1	84.129	T001_07	30.678	-17.3303	26.1895	Both	24/Apr/13	24-04-13 to 29-04-13	837	64
2	Southern	Monze	Roads Dpt	T1	294.259	T001_41	1.392	-16.2954	27.4837	Both	1/May/13	01-05-13 to 06-05-13	1,486	82
33	Southern	Mazabuka	Kaleya	T1	347.145	T001_49	4.756	-15.8970	27.6772	Both	17/Apr/13	17-04-13 to 22-04-13	1,610	231
46	Southern	Mazabuka	Magoye	T1	331.101	T001_47	0.062	-15.9999	27.5953	Both	24/Apr/13	24-04-13 to 29-04-13	1,688	214
61	Southern	Livingstone	Kaleya Victori	T1	7.317	T001_02	6.084	-17.8813	25.8571	Both	24/Apr/13	24-04-13 to 29-04-13	2,413	177
3	Lusaka	Lusaka	Kabangwe	T2	146.843	T002_20	2.426	-15.3279	28.2756	Both	24/Apr/13	24-04-13 to 29-04-13	7,453	466
4	Central	Mkushi	Myaffi	T2	414.479	T002_43	9.387	-13.6802	29.2433	Both	17/Apr/13	17-04-13 to 22-04-13	1,185	114
5	Central	Serenje	East Mukando	T2	578.696	T002_51	0.327	-13.0185	30.4644	Both	24/Apr/13	24-04-13 to 29-04-13	802	64
6	Muchinga	Mpika	Chikwanda sc	T2	781.845	T002_56	2.631	-11.8127	31.4510	Both	8/May/13	08-05-13 to 13-05-13	502	28
7	Muchinga	Isoka	Ntipo School	T2	1048.004	T002_61	3.243	-10.1188	32.6739	Both	15/May/13	15-05-13 to 20-05-13	401	47
66A	Southern	Mazabuka	Weigh Bridge	T2	81.313	T002_5	0.697	-15.8456	28.2438	Both	17/Apr/13	17-04-13 to 22-04-13	2,764	230
66B	Southern	Mazabuka	Turn park	T2	80	T002_04	6.667	-15.8529	28.2522	Both	15/May/13	15-05-13 to 20-05-13	918	42
67	Southern	Chirundu	Slavenga Tan	T2	17.886	T002_03	0.050	-16.0283	28.6945	Both	1/May/13	01-05-13 to 06-05-13	1,290	113
71	Central	Kabwe	Landless Corn	T2	206.055	T002_27	0.068	-14.8798	28.0608	Both	1/May/13	01-05-13 to 06-05-13	2,983	295
72	Central	Kapiri Mposhi	Post Office	T2	342.504	T002_38	0.728	-13.9318	28.6663	Both	1/May/13	01-05-13 to 06-05-13	2,556	305
72B	Central	Kapiri Mposhi	Check Post	T2	348.043	T002_39	4.811	-13.9194	28.7094	Both	24/Apr/13	24-04-13 to 29-04-13	1,140	184
8	Copperbelt	Ndola	Kafulafuta	T3	72	T003_04	18.667	-13.3035	28.6873	Both	8/May/13	08-05-13 to 13-05-13	1,792	212
72A	Central	Kapiri Mposhi	Weigh Bridge	T3	4.030	T003_01	4.030	-13.8929	28.6594	Both	24/Apr/13	24-04-13 to 29-04-13	1,849	335
76	Copperbelt	Kalulushi	Mukulumpe E	T3	191.648	T003_28	0.218	-12.6903	28.0970	Both	15/May/13	15-05-13 to 20-05-13	3,625	311
78	Copperbelt	Chililabombw	Checkpoint	T3	232.125	T003_32	1.875	-12.4926	27.8466	Both	15/May/13	15-05-13 to 20-05-13	2,795	196
9	Lusaka	Chongwe	Silverest	T4	23.225	T004_05	1.285	-15.3543	28.4850	Both	17/Apr/13	17-04-13 to 22-04-13	2,412	166
11	Eastern	Chipata	Industrial area	T4	561.880	T004_18	33.650	-13.6605	32.5719	Both	22/May/13	22-05-13 to 27-05-13	1,854	135
82	Eastern	Chipata	Former Roads	T4	585	T004_27	0.035	-13.7058	32.7410	Both	15/May/13	15-05-13 to 20-05-13	883	56
12	North Weste	Chingola	Kingovwa	T5	81.385	T005_02	67.444	-12.3470	27.1571	Both	8/May/13	08-05-13 to 13-05-13	591	62
13	North western	Solwezi	Mwajimambw	T5	215.253	T005_04	12.294	-12.4061	26.1366	Both	22/May/13	22-05-13 to 27-05-13	694	33
211	North western	Solwezi	Kyabankaka	T5	190.933	T005_03	24.860	-12.3029	26.2775	Both	15/May/13	15-05-13 to 20-05-13	1,075	72
11A	Eastern	Katete	5km South of	T6	11.588	T006_03	6.808	-14.1511	32.0664	Both	22/May/13	22-05-13 to 27-05-13	90	1

Appendix D – Consultations List

DATE	OFFICIAL	INSTITUTION	PURPOSE OF MEETING
15/08/13	Mr. Friday Mumba	MoF	To hand over the signed contracts .
15/08/13	Mr. Zali Chikuba	ZIPAR	To introduce the company and state our commitment to the two projects. Introduce ourselves to the Executive Director.
15/08/13		World Bank	To gather any information that the bank may have regarding the Link Zambia 8000 project.
15/08/13		ADB	To find out more about the projects from the funding agency.
15/08/13		MTWSC	To meet the Deputy Director of Transport. We had a brief general discussion about the projects to discuss highlights regarding how the projects are to be executed.
16/08/13		LCC	To meet with the officials of the GIS department. We briefly discussed the trip modeling project for the City of Lusaka .
17/08/13		ZIPAR	A meeting organized by the institute to meet with officials from other institutions working on Transport Research activities.
07/09/13	Mr. Nelson Nyangu	MTWSC	To introduce the company and commence with the projects. Gave a brief description of the methodology to be used in executing the project. Gained support and cooperation for the project.
09/09/13	Dr Pamela Kabaso & Mr. Zali Chikuba	ZIPAR	Introduction meeting Mr. Cohen. Announce the official start of the projects and explain the details of the projects. Outlined the methodology/objectives of the projects and listened to the client's expectations. Discussed the time table with emphasis on the inception report.
09/09/13		CSO	Met with officials at the Department Information Dissemination and Research to ask for specific data from different surveys.
09/09/13	Mr. Mutelo	RDA	Discussed projects related to Link Zambia 8000. Proposed incorporation and modification of the scope of work to accommodate projects that were noted as contradictory to the original TOR. Solicited data on Link Zambia 8000.
10/09/13		CSO	To deliver a letter requesting specific data needed for review of projects.
10/09/13	Mr. Mutelo	RDA	Further discussion on the Link Zambia 8000 project. Collected necessary data, which was packaged as requested
10/09/13	Mr. Zali Chikuba	ZIPAR	Met to highlight some observations regarding the terms of reference for the Link Zambia project with regard to the information gathered from our desk research.
27/11/13	Mr. Zali Chikuba	ZIPAR	To discuss how to proceed with the project and revision of reports/outcomes

"Working towards the formulation of sound economic policies".

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