# AN ASSESSMENT OF THE QUALITY OF RURAL ROADS IN LUSAKA PROVINCE OF ZAMBIA

By

Ephraim Sakala

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## DECLARATION

I, **Ephraim Sakala**, hereby declare that the work presented in this thesis is the result of my research work and that it has not previously been submitted for a degree, diploma or other qualification at this or any other University, and that all sources of information have been duly acknowledged.

Author
Full name: Ephraim Sakala

Signature……..Date……..

**Supervisor**
Full name: Dr Erastus Mishengú Mwanaumo.

Signature……..Date……

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## APPROVAL

This dissertation by Ephraim Sakala entitled ‘An assessment of the Quality of Rural Roads in Lusaka Province’ is approved as partially fulfilling the requirements for the award of the degree of Master of Engineering in Project Management of the University of Zambia.

| **Name of examiner** | **Signature** | **Date** |
|---|---|---|
| Dr Michael.N Mulenga | | |
| Dr Chabota Kaliba | | |
| Dr Franco Muleya | | |

**Board of Examiners Chairman**

| | | |
|---|---|---|
| Prof Levy Siaminwe | | |

## ABSTRACT

The state of rural roads in Zambia is very poor and in a deplorable condition. Drainages are missing, or where they exist, they are narrow, inadequate and not constructed correctly. Bridges are missing, old, inadequate or wrongly constructed and usually very poorly maintained. In most roads, the shoulders are not stable.

From reviewed literature, several gaps in the planning, design, specifications, funding and general roads management in Zambia were identified as being the root causes of poor quality rural roads. A triangulation approach was used to validate the data obtained from secondary sources using journals, rural road construction handbook, peer reviewed articles, dissertations and the internet. In-depth interviews were further carried out with the staff at Ministry of Finance, Road Development Agency, National Road Fund Agency, National Council for Construction, Rural Road Unit and also the Royal Highnesses and their subjects in Chongwe and Lusaka North areas.

The results show that the planning is adequate but the problem lies with the planning personnel who are inadequately trained to undertake the tasks. While, designs and specifications needed to take into account the alignment requirements, technical performance, pavement solutions, material requirements and structures that are specific to an area, results indicate that planners use a one size fits all approach kind of designing. This is compromising the quality.

This research will assist government in developing and disseminating improved policies that will assist in better planning, constructing and maintaining rural roads. It introduces mitigatory actions and recommendations which the government can utilize in coming up with sustainable and reliable quality rural roads.

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## DEDICATION

This dissertation is dedicated to my late dad who always said education was the best gift that he could ever give me

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## ACRONYMS

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| AADT | Annual Average Daily Traffic |
| AIDS | Acquired Immune Deficiency Syndrome |
| AU | African Union |
| CAADP | Comprehensive African Agricultural Development Programme |
| CIA | Central Intelligence Agency |
| CRN | Core Road Network |
| CSO | Central Statistical Office |
| DCP | Dynamic Cone Penetrometer |
| etc | Etcetera |
| FNDP | Fifth National Development Plan |
| GDP | Gross Domestic Product |
| GIS | Geographical Information System |
| h | Height |
| HIV | Human Immunodeficiency Virus |
| IMT | Intermediate Mode of Transport |
| IT | Information Technology |
| kg | Kilogram |
| km | Kilometre |
| km/h | Kilometre per hour |
| L | Length |
| LVR | Low Volume Road |
| m | Metre |
| MDG | Millennium Development Goal |
| mm | Millimetre |
| NCC | National Council for Construction |
| NRFA | National Road Fund Agency |
| NMT | Non - Motorized Transport |
| OECD | Overseas Economic Commission for Development |
| PFR | Primary Feeder Road |

| | |
|---|---|
| RDA | Road Development Agency |
| RSAWP | Road Sector Annual Work Plan |
| SNDP | Sixth National Development Plan |
| TMD | Trunk, Main, District |
| UNESCO | United Nations Emergency |
| US$ | United States Dollars |
| VPD | Vehicles per Day |
| VLVR | Very Low Volume Road |
| ZICTA | Zambia Information Communication and Technology Agency |
| ZMW | Zambian Kwacha |

# CHAPTER ONE - INTRODUCTION

## 1.1 Introduction

This chapter presents an overview of the research. It provides a background to the problem, magnitude of the problem and the research objectives.

## 1.2 Background: Definition of Rural Roads in Zambia

In Zambia, according to The Public Roads Act, 2002, the low volume roads are called Rural Roads. They are defined as public roads within a local authority area which may be designated as rural roads by The Minister on the recommendations of the Agency, by statutory order, on the application of the Permanent Secretary of the province in which they are situated.

The standard cross section of rural roads in Zambia is one having a carriageway of 5.5m, with gravel coarse of 5m span, side slope of 1.2m, a ditch of 1m and a back slope of minimum 3:1 and a maximum of 1:1

Rural roads represent the grassroots of the road network which feed traffic into the District, Main and Truck roads thereby providing access to the rural communities (IT Transport, 1997). Yet inadequate and unreliable infrastructure services are common in the majority of rural communities in Africa (Rural Infrastructure in Africa, 2012)

This scenario is very similar to the current state of affairs in Zambia. About 57.9% of our population lives in rural areas (SNDP, 2017) and having a good rural road network is vital to uplifting their lives. Putting up good and sustainable rural roads will not only save the country scarce and meagre resources but it will help in developing the rural areas as most people will opt to live there.

Quality transport infrastructure is vital for economic growth, poverty reduction and service delivery in low income areas (OECD, 2011 and DFID, 2012). At the extremes, without transport infrastructure poorer areas are characterized by subsistence economies (DFID, 2012). Increases in the amount of transport infrastructure, or improvements in the quality and reliability of infrastructure and

transport services, enable households to increase outputs, productivity and incomes, and thereby increase growth (Pinstrup-Anderson and Shimokawa, 2010). An estimated 3,100,000 people live further than two kilometres from an all- weather road (Torero and Chowdhury, (2004)). This limits their ability to engage in markets, access essential services and increase their opportunities for diversifying and improving their livelihoods. Isolated communities often have less voice and are left on the edge of development (Growth Research Team, 2014- 2020)

Rural roads are the last link of the transport network (Robinson, 1999). However, they often form the most important connection in terms of providing access for the rural population. The permanent and/ or seasonal absence of rural road access is a constraining factor in terms of providing rural communities with essential services such as quality Education, Primary Health care, Water supply and Sanitation, local markets as well as availing economic opportunities (Donnges, 2003). The availability of such services and opportunities are difficult to sustain without a good quality and well- maintained rural road network, which provides regular and efficient transport availability and access throughout the year.

Building good quality rural roads is a particular skill in itself requiring proper planning, adherence to design standards and specifications, experienced supervision, good workmanship and the selection of the correct technology and work methods (Johannessen, 2004). Rural roads provide a critical link in a road transport network, facilitating access to and development of the rural areas. While these roads form the majority portion of the road network, they often carry low volumes of traffic (DFID, 2012). Despite this, their design and construction need to cater for all types of vehicle loads and allow access throughout the year and in all kinds of weather conditions.

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These features place specific challenges on the ministries and road agencies in charge (Johannessen, 2008). On the one hand, there is need to find good engineering solutions addressing the functional requirements relating to maintaining all- weather access and on the other hand, due to the size, volume and the extensive distribution of rural roads, the ministries and road agencies are under pressure to find low cost solutions that allow authorities to build and maintain an extensive network of roads.

The role of rural roads in improving rural connectivity, catalysing economic growth and reducing poverty, managing natural disasters and manmade crises, sustaining rural livelihoods, and enhancing liveability cannot be over emphasized. In a study in Ethiopia on 15 villages between 1994 and 2004, Dermon et al., (2008), concluded that access to all- weather roads reduced poverty by 6.9% and increased consumption by 16.3%

### 1.3 Magnitude of the poor rural road problem in Zambia

The seriousness of rural transport bottlenecks across Zambia has been underscored by the country's Seventh National Development Plan which states that a sustained commitment to infrastructure development should be the main focus of our developmental program (SNDP, 2017). Better market incentives to farmers would be blunted if the physical barriers and economic costs of transporting goods to and from local markets are too high. Recent experience in Zambia indicates that supply response of structural adjustment operations has been stifled by rural transport deficiencies. The effectiveness and sustainability of past programs for rural roads have been hampered by the lack of a coherent policy framework and institutional focus for planning, funding and maintenance.

Zambia has a total road network of 67, 067km: approximately 40,265 km of core road network, with most of it in poor condition (RDA Annual Report, 2015). Only about 13, 000km is paved. The rest is unpaved and consisting of both gravel and earth. Rural roads feed into the main network and link rural communities to districts. Zambia's road density of 12.1 km per km² (2001) is generally much lower than that of other countries like Namibia that has a road density of 21.6km per km² (Rural Infrastructure in Africa, 2012). Low population densities, low levels of income and weak road planning and maintenance capabilities combine to make the country altogether under-equipped and overburdened in terms of rural road infrastructure. Total needs for rehabilitation of existing roads and for expansion of rural road networks are enormous and have generally not been recognized by planners and policy-makers.

Rural roads provide a critical link in a road transport network, facilitating access to and development of the rural areas. While these roads form the majority portion of the road network, they often carry low volumes of traffic averaging 10% of what is carried on the main road. Only a handful of countries such as Nigeria, Ethiopia and Malawi have rural roads carrying an average of 20% of traffic that is carried on the main roads (African Monitor, 2012). Despite this, rural road design and construction needs to carter for the common type of vehicle loads and allow access throughout the year and in all kinds of seasons (Johannessen, 2008).

Building good quality rural roads is a particular skill in itself, requiring proper planning, experienced supervision, good workmanship and the selection of the appropriate technology and work methods (Johannessen, 2008). This places specific demands on the road agencies charged with the responsibility of rural road infrastructure. In one breathe, there is need to find good engineering solutions that can address the functional requirements relating to constructing all – weather rural roads and in the other, due to the size and the extensive distribution of these roads, to find low cost solutions that allow authorities to build and maintain an extensive network of rural roads.

The research looked at the planning framework, the design and specification framework, the size and time of funding and the management. The research also reviewed the skills required from technical staff responsible for carrying out rural road construction and rehabilitation works. This part of the research was achieved by having the researcher attached to a live project for a period of four months.

## 1.4 The Research Problem

Huge sums of money are spent on rural roads every year but the quality that is realised and the length of roads done is not impressive. The durability of these roads does not meet to the required 3 to 5 years and most of the features that are supposed to be on these rural roads are missing or inadequate. This research seeks to interrogate the reasons why and come up with recommendations.

## 1.5 Justification

Investments in rural roads of around k200 million per annum (Road Sector Annual Work Plan, 2014) are enormous but when done using local resources, does create decent jobs, supports local economic growth and strengthens local commerce. This investment is therefore important for poverty reduction and local economic and social development. The direct consequence of investing in rural roads is the generation of jobs, incomes and business opportunities, particularly if the quality, development and maintenance of these rural roads are targeted in favour of local resource based methods. More and longer lasting impacts such as improved access to goods and services and production, and productivity enhancing impacts further contribute to sustainable poverty reduction and local economic and social development. Impacts however, will only be sustainable if the rural roads are constructed according to design standards and specifications and fully supervised by the procuring agency.

Rural roads are characterized not only by traffic volume, but also in terms of social and geographic context. These roads are a lower order of worldwide land transport. They begin where the animal track and walking trail end. They are at the beginning of world economy and are the lifelines for rural communities. Everything that sustains us—grown, mined, or drilled—begins on a rural road. They transcend language, culture, topography, and climate. Due to their basic necessity, they tend to drive innovation in design, material use, maintenance, and social development. Nearly 30 million km of rural roads connect the world's population, yet, according to the World Bank, 31% of the world's population (1 billion people) still do not have adequate access to transport (Faiz, 2012). Three-quarters of the population of 21 least-developed countries do not have access to all-weather roads, which are a key diagnostic measure of development (World Bank, 2010).

## 1.6 The Importance of Rural Roads

The need for a better rural transport infrastructure in Zambia is pressing and obvious. If we are to achieve the structural transformation from subsistence to market economy, we need to pay more attention to the construction of quality rural roads. The potential gains in agricultural outputs and incomes, which is unlikely to occur without improved, reliable and quality rural roads, would be sufficient to make the economic case for the level of expenditure. A rapid expansion of rural road networks wouldn't be feasible unless adequate financial and institutional arrangements for planning, designing, construction and maintenance can be put in place.

The importance of rural roads in our economic development has been recognised in the past and has been recently underscored in the country's Seventh National Development Plan and The Vision 2030. Despite the country's long experience in financing rural road projects, the effectiveness and sustainability of past programs for rural roads have been hampered by the lack of a coherent policy framework and institutional focus for planning, funding and maintenance. Research and policy analysis are needed to understand why the state of our rural roads continues to be deplorable and to devise effective ways to develop and promote quality and sustainable rural road construction.

The objectives of the research are to help government in developing and disseminating improved policies that will assist in better planning, financing, building and maintaining rural roads. A review of the country's road policy since 1964 was done and the findings discussed.

The findings of the work- to- date shows that the government must develop rural road strategies which are closely tied to other road classes. Similarly, developmental projects and agricultural development strategies need to be linked to rural road programs. These strategies require, on the part of government, long term commitment, as well as continuity for developing the policy framework and institutional capabilities for rural roads planning, improvement and maintenance. With the prevailing financial constraints, designs and specifications should be adhered to and at times, changed so that emphasis is placed on spot surface

improvements and also drainage improvement rather than concentrating on the carriageway. It is very important also to systematically promote, as National Council for Construction is doing, the development of capacity for labour based methods in the country.

This research is the first of its kind on the assessment of the quality of our rural roads which attempts to address the policy issues related to the state of our rural roads. The present findings should provide a basis for follow up work to develop rural road strategies that will ensure good quality rural road network in the country.

## 1.7 Rationale

This research has never been done before and the data generated will help inform policy on the construction of quality rural road network in Zambia. It will also help in introducing mitigatory actions and recommendations which the government can utilize when planning and implementing rural road construction.

## 1.8 Research Aim

The research is to interrogate the reasons why rural roads in Lusaka province are in a perpetual deplorable state even after government interventions through constructing new roads and maintaining the existing ones.

## 1.9 Research Objectives

1. To review whether the planning of rural road construction in Lusaka province is adequate.
2. To determine whether the design standards and the technology used in Lusaka province are appropriate.
3. To assess the difficulties associated with mobilization of financial and other resources in Lusaka province.
4. To determine whether the deficiencies in institutional and management arrangements in Lusaka province have an effect on the quality of rural roads.

## 1.10 Research Questions

1. To what extent is the planning of rural road construction performed in Lusaka province?
2. Are the design standards and technology used in Lusaka province appropriate?
3. Are there difficulties associated with mobilization of financial and other resources in Lusaka province?
4. To determine whether the deficiencies in institutional and management arrangements have an effect on the quality of rural roads in Lusaka province.

## 1.11 Research Method

A comprehensive literature review was carried out on studies to do with rural roads and their construction. The researcher has identified a gap in Zambia about the causes of poor quality rural roads and this research will employ both primary and secondary techniques in order to answer the research questions and the research objectives.

### 1.11.1 Primary Technique

Primary data was collected through three check lists that were filled with data collected through observations, interviews and measurements of the selected rural roads. The researcher had to undergo Rural Road Construction and Maintenance training with The National Council for Construction for a period of four months and this programme consisted of two parts: The theory part comprising Mathematics, Road Rehabilitation and Maintenance, Construction Materials, Construction Management, Pricing and Bidding, Communication Skills and Entrepreneurship and the practical part comprising Road Rehabilitation and Maintenance only.

Three areas were arbitrary picked and two rural roads per area were also picked arbitrary. Quality tests were conducted on the full length of these rural roads. The first test was the road dimension test using tapes. The second test was the road profile test using the line level to check the camber of the carriageway and the

longitudinal profile of the carriageway and the final test was the visual test that was used for checking the presence of culverts, culvert rings, wing walls, headwalls, ramps, outfalls, mitre drains, scour checks, laybys, ditch and the shoulder and the data was presented in the form of check lists

### 1.11.2 Secondary Technique

The secondary data was collected through the use of journals, rural road construction hand books and the actual design contracts in order to understand, and get informed about what is involved in rural road construction. These reports were analysed with the help of staff from Rural Road Unit, National Council for Construction, Ministry of Finance and Ministry of Works and Supply. The design of this study was to address the problem statement and to achieve the research's objectives which brought a clear perspective about the possible causes of poor quality rural roads in Lusaka.

### 1.11.3 The Study Area and Sample

The target group being the sampled area was divided into three regions namely Chongwe, Lusaka West and Lusaka North within Lusaka province.

### 1.11.4 Qualitative and Quantitative data collection Instruments

**I. Qualitative**

This approach involves the collection of extensive narrative data in order to gain insights into the phenomenon.

This involved;

i. Journals
ii. Contracts
iii. Guidelines on rural road construction
iv. Design standards and specifications
v. Handbooks on rural road construction
vi. Data on rural road funding from Ministry of Finance
vii. The Planning Framework

**II. Quantitative**

This involves the collection of numerical data in order to explain, predict, and/ or control phenomenon of interest. Data analysis was mainly statistical.

This involved;

i. Interviews
ii. Field Measurements
iii. Field Observations

### 1.11.5 Data Collection Procedure

This involved getting permission from relevant authorities and officers and collecting information about funding, number and kilometers of roads done per year and the planning and implementation of rural road construction. Ethical considerations were also put into consideration.

### 1.11.6 Data Analysis

After the qualitative and quantitative approaches of data collection, excel spread sheets were used to analyse the data.

## 1.12 Research Organisation

Chapter one provides the background to the study. It highlights the significance of the study and its problem statement, research questions and its objectives and its delimitations.

Chapter two presents literature from journal papers, books, conference papers and the internet. It gives an introduction of the history of rural roads, its composition and significance. An overview of how rural roads are planned, designed, constructed and maintained in Zambia is also given.

Research methodology presents an outline of the research and the manner in which it was designed and conducted. It describes the research tools and their design, the

method that was used to collect data, the sample area and sampling design. Finally, it explains the method used to interpret the results.

Results and Discussion chapter presents the findings of the research. Data is presented in form of tables, graphs and also in a more descriptive way. It further on discusses the results pertaining to what was obtained.

## 1.13 Chapter Summary

This chapter introduced the research and gave the background, the magnitude of the poor rural road problem in Zambia, the research problem, justification, the importance of rural roads, the rationale, research aim, research objectives, research questions, research methods, and finally the research organisation. The next chapter deals with literature review.

# CHAPTER TWO - LITERATURE REVIEW

## 2.1 Introduction

The previous chapter gave an overview of the background to the study. It also defined certain terminologies, problem statement and justification for undertaking this study. The objectives of the study were outlined along with the research questions. In this chapter, literature involving the history of rural roads, planning and preparation of works, causes of poor quality roads and intervention measures are explored through reviews of journals, books and published studies.

## 2.2 Background Review

### 2.1.1 The history of Rural Roads

Nearly 30 million kilometres of low- volume roads connects the world's population, yet according to the World Bank, 31% of the world's population (One billion people) still do not have adequate access to this infrastructure (Faiz, 2012). Three quarters of the population of 21 least developed countries do not have access to all- weather roads, which are a key diagnostic measure of development (Faiz, 2012). He further indicates that about 33.8 million kilometres of roads girdle the Earth's land mass of 148.9 million km² (an average 0.23 km/km² of land area); about 57% of it is paved (i.e., sealed with an engineering bituminous, concrete, or stone surfacing). Nearly all the unpaved roads (13 million km) and an estimated 85% of paved roads (17 million km) are Rural Roads with an average daily traffic (AADT) of 1,000 vehicles per day (vpd) or less (Faiz, 2012).

Global Asset Value of Rural Roads is conservatively estimated at about US$7.6 trillion, a lower bound estimate, (Faiz, 2012). The global public road network increased by 3.9 million kilometres (a 13% increment) in the first decade of the new millennium and there was a quantum increase in the quality of roads with 4.2 million kilometres upgraded or constructed to paved standard. Despite the huge public outlays on asset management and advantages in geographic information systems (GISs), it is yet not possible to obtain an accurate assessment of the length and

condition of rural roads globally, except in the more advanced industrialised countries. Most countries have only a rudimentary inventory of their rural road system. As one would expect, the geographical distribution of roads is dominated by countries with large land masses or large populations; just eight countries (with United States in the lead) account for about 59% of the global road network (Table1). The majority of these countries have a federal (decentralised) system of government, which poses its own peculiar governance challenges related to the funding and management of rural roads

Table 2.1: Growth in the global classified paved public road network (1998 – 2008)

| **World** | **2008** | | **1998** | |
|---|---|---|---|---|
| | Total length of Road (million km) | Percent Paved out of total length (%) | Total length of Road (million km) | Percent Paved out of total length (%) |
| **Countries** | 33.839 | 57.4 | 29.912 | 50.8 |
| United States | 6.494 | 67.4 | 6.310 | 59.0 |
| China | 3.730 | 53.5 | 2.210 | 18.0 |
| India | 3.320 | 52.0 | 3.010 | 49.0 |
| Brazil | 1.633 | 12.9 | 1.630 | 9.6 |
| Japan | 1.204 | 79.8 | 1.152 | 74.9 |
| Canada | 1.042 | 39.9 | 0.902 | 35.3 |
| France | 1.027 | 100.0 | 0.893 | 100.0 |
| Russia | 0.982 | 79.0 | 0.948 | 67.2 |
| Sub- Saharan Africa | 2.496 | 15.2 | 1.837 | 13.1 |

Source: Faiz, 2012

### 2.1.2 Statistics of rural roads

Africa's transport network is inadequate, in terms of density, distribution in relation to the population, and quality, compared to other regions of the world. The situation is worse in rural areas, where existing roads are predominantly narrow, unpaved and in bad condition due to lack of regular maintenance. The poor accessibility of rural areas in selected African countries is illustrated by Table 2-2, which is based on household surveys undertaken in late 1990s and early 2000s. The table shows that

several African countries have rural access rates of less than 50 per cent and that this could be as low as 5 per cent as is the case of Chad and as high as 80% in Botswana (AU et al., 2005)

Table 2.2: Estimates of rural transport access indicators for selected Sub Saharan African countries

| **Country** | **Rate (%)** | **Country** | **Rate (%)** | **Country** | **Rate (%)** |
|---|---|---|---|---|---|
| Benin | 32 | Ethiopia | 27 | Mali | 51 |
| Burkina Faso | 19 | Ghana | 44 | Niger | 52 |
| Burundi | 19 | Kenya | 44 | Nigeria (8 States) | 47 |
| Cameroon | 20 | Madagascar | 67 | Tanzania | 38 |
| Chad | 5 | Malawi | 38 | Zambia | 51 |

Source: AU et al., 2005

The table 2.2 shows rural accessibility for selected African countries based on household surveys that were conducted between 1990's and early 2000's.

Africa currently has about a million kilometres of rural roads. There are approximately 700,000 kilometres of rural roads out of a total of 1.02 million kilometres of roads in Sub Saharan Africa (Table 2-3), with concentrations in a few countries. Three countries (Nigeria, Cameroon and Cote d Ívoire) have more than half the rural roads in West Africa, while Democratic Republic of Congo, Madagascar and Tanzania account for more than two thirds of East African rural roads.

Table 2.3 shows total distances of road and rural road and the road densities in Africa

| REGION | ALL ROADS (km) | RURAL ROADS (km) |
|---|---|---|
| Western Africa | 430,937 | 286,425 |
| Eastern and Southern | 589,943 | 398,972 |
| TOTAL | 1,020,880 | 685,397 |

Source: World Bank Appraisal Reports

Africa's national road density is substantially lower than that in other developing regions: 0.204km/km² with only one quarter paved, compared with a world average of 0.944km/km² with more than half paved. That density is less than 30% of the next – lowest region, South Asia (World Bank, 2010)

The density of rural roads is low compared with other parts of the world. Western Africa has densities of 32 metres per square kilometre while Eastern and Southern Africa has densities of 36 metres per square kilometre. Nigeria has about 90 metres of rural road per square kilometre, but an acceptable 'target' density, based on Indian experience in areas with similar population densities to those in Nigeria would be about 730 metres per square kilometre (World Bank: Appraisal Reports, 2010). Density also varies widely within countries. In Kenya, highly populated provinces with abundant natural resources have 400 to 500 metres per square kilometre, falling to less than 30 metres per square kilometre in non-productive areas. Sparse populations and low agricultural productivity mean that the burden of providing and maintaining an adequate rural road network falls more heavily on Sub Saharan African populations than it does, for example, on the heavily populated and productive countries of South East Asia. Whereas road lengths per head of population are high, they are still low per unit of area.

### 2.1.3 The road network in the SADC region

The total length of the SADC classified road network is just over 930,000km of which approximately 20% is paved. More than half of the region's total network (511,000km) is in South Africa. There is also a large network of rural roads in the SADC region, approximately 430,000km, which consists mainly of 2-lane all-weather gravel roads and seasonal earth tracks. The current replacement cost is in excess of US$50 billion (SATCC Guidelines, 2010)

### 2.1.4 Road Classification

Table 2.4: AADT for SADC region

| Design Class | Traffic flow (AADT) | Typical Surface Type |
|---|---|---|
| **A** | >2,000 | Paved |
| **B** | 500 – 2,000 | Paved |
| **C** | 200 - 500 | Paved/ Unpaved |
| **D** | 50 - 200 | Unpaved |
| **E** | <50 | Unpaved |

Source: SATCC Guideline on Low Volume Roads

Table 2.5: Total Road Networks (km) in selected countries

| COUNTRY | TOTAL ROAD NETWORK (km) | RURAL ROAD (km) |
|---|---|---|
| **Uganda** | 78,100 | 35,000 |
| **Zambia** | 67,671 | 40,265 |
| **Zimbabwe** | 88,330 | 35,370 |
| **Ghana** | 66,220 | 42,192 |
| **Botswana** | 17,916 | 11,800 |
| **Namibia** | 44,427.6 | 26,549 |
| **India** | 3,329,000 | 2,650,000 |
| **Nepal** | 50,835 | 40,000 |

Source: Growth Research Team, 2014 – 2020

Zambia's total road network is 67,067 kilometres of which 40,265 kilometres forms the core road network. The density of roads in Zambia is 0.0899km/km² which is below the average in Africa and other parts of the world

The Core Road Network is either gravel or earth road and is mainly concentrated in rural areas. The vast majority of these rural roads are in a very deplorable state. Road features such as culverts, drainages, mitre drains, shoulders, side slopes, splashes, drifts, and scour checks are either missing, wrongly constructed, inadequate or poorly maintained.

This has been recognised in the Seventh National Development Plan Development and Outcome Number 6 has indicated that improved transport systems and infrastructure have the potential to reduce the overall cost of doing business in the country, thereby contributing to the attainment of a diversified and resilient economy for sustained growth and socio – economic transformation. An improved transport system and infrastructure will enable efficiency in the movement of goods and people within Zambia. Further, as a land – linked country, with eight neighbouring countries, Zambia requires its transport infrastructure to be in good state to link principal ports and serve as a hub for goods in transit.

### 2.1.5 Accessibility and quality of rural roads

According to The Rural Accessibility Index, only 34 percentages of the African rural population lives within two kilometres of rural roads, compared to 90 percentages in East Asia and The Pacific's. (Fifty nine percentages of rural populations in Latin America have this type of access as well). In Africa, The Rural Infrastructure Index (2007) ranges from 5 percentages access in The Sudan to over 80 percentages access in Botswana. Seventeen countries (using data from 43 countries) have access to rural roads which is less than 32 percentages (African Monitor, 2012)

Zambia has a rural access rate of 50% according to the Seventh National Development Plan and the government has proposed to address the challenges in the transport infrastructure sector so as to remove impediments to growth, economic diversification and human development. It has noted a key focus on construction,

rehabilitation and maintenance of infrastructure. The Plan also reiterates that a sustained commitment to rural infrastructure development would be the main focus and has set an ambitious target of 80% of its rural households to be within 2km of an all- weather road. This is above the continents 34% average.

Table 2.6: Africa's tertiary road condition dataset

| Continent | Poor | Fair | Good |
|---|---|---|---|
| Africa | 40 | 23 | 33 |

Source: Africa Infrastructure Country Diagnostic

Some explanations given for the poor rural road quality are the lack of local resources to fund road maintenance and severe neglect (William, 2011). Moreover, the road sector has not always been managed or seen as part of the market economy and is regarded as a social service. This means that funding for the road maintenance usually comes from general revenues and is thus the first to be cut during difficult periods (Addo-Abedi, 2007).

According to Foster and Briceno - Garmendia, (2010), the large variation in road quality throughout the various Sub Saharan African countries reflects several interacting factors. Firstly it relates to affordability where the GDP per capita is most strongly correlated with the percentage of the main road network in good condition, signifying that richer countries tend to spend more on maintenance. They note that no such clear relationship exists for rural roads. The second factor relates to topographic and climatic influences where mountainous and wet countries normally have poorer road conditions, in both main and rural networks. Foster and Briceno - Garmendia also found that countries with road funds and road agencies have considerably better road conditions than those that have neither. Furthermore, both the road fund design and the level of the fuel levy appear to significantly affect the quality of the main road network, although the effect on rural road quality is much less pronounced.

A number of African countries have embarked on reforms in the last few decades supported by four building blocks. These are: Ownership, Financing, Responsibility

and Management (Addo-Abedi, 2007). The reforms are designed to address the large backlog of deferred maintenance and the acute shortage of funds and the ineffective institutional arrangements in the management of the sector. The main aim has been to manage roads as a business and bringing them into the market place by charging for road use on a fee-for-service basis. The most significant outcome of the reforms has been the establishment of independent 'second generation' road funds and autonomous or semi-autonomous road agencies.

### 2.1.6 Importance of quality Rural Roads

It is very important to have a good drainage system which enables the water to flow off the road and away from it as quickly as possible. The drainage system is the most important of all the different components of engineered earth rural road construction. If it fails the whole road may become virtually impassable or even washed away. Equally important is to ensure that the design standards are adhered to during construction. The absence of key features like culverts, shoulders, side drains, ditches, mitre drains and scour checks shows a lack of adherence to standards.

Going forward, appropriate technology suitable to the area must be encouraged. The technical nature of the road needs to be interpreted by competent persons, preferably trained at a minimum level of NCC certification. The use of local resources such as materials and labour should be encouraged so as to have minimal adverse effect on the environment and create jobs for the locals.

### 2.1.7 Planning and preparation of works

**i.** ***Planning Framework done by Central government***

Planning is carried out at several levels. The general features of a programme include information on which areas will be covered by a specific programme, annual targets, programme budgets, who will carry out the works and the type and amount of resources required. Planning consists of setting specific targets and goals and specifying in detail the necessary resources and actions to reach those targets.

**ii.** ***National Plans prepared by Central government***

The various types and levels of planning carried out in the road sector are normally organised within a framework of general policy documents, guidelines and procedures. Physical works planning start with comprehensive plans covering the nation as a whole.

**iii.** ***Transport Sector Plans prepared by Central Government***

In line with the contents of the National Development Plans, each sector commonly prepares a set of long term planning documents, often referred to as sector studies, implementation strategies or strategic plans. These plans usually contain an analysis of the current situation in terms of existing infrastructure assets, current transport patterns, on – going development programmes, levels of current budgets and improvement budgets.

**iv.** ***Annual Programmes and Budgets prepared by Central Government***

Annual budgets are the first set of concrete plans for which specific resources are dedicated. The annual work programmes and budgets for the road sector form an integral part of the annual programme and budget prepared by the central government for all sectors.

**v.** ***Local Plans prepared by Local Authorities***

In addition to the annual work programmes, rural roads work agencies will need to develop long term plans for the development and maintenance of the road network under their respective jurisdictions.

**vi.** ***Project Plans prepared by Local Authorities***

Project plans commonly relate to specific development projects, normally involving the construction or improvement of one particular road section. Project plans provide details on the basis of which approval and funding decisions are made. Equally, these plans form the basis for the detailed engineering plans.

**vii.** ***Detailed Plans prepared by Local Authority***

Detailed plans are the working documents which the technical staff refers to in relation to the scheduling of individual work activities, supply of equipment and

materials and hiring of staff and labour. Detailed plans are prepared for various time horizons, ranging from the entire duration of the project, to monthly, weekly, and daily work plans. The main purpose of the detailed plans is to secure proper management of all resources used as inputs to produce the planned outputs.

### viii. *Maintenance Plans prepared by Local Authorities*

Planning is often associated with new development initiatives, however, a substantial part of planning carried out by any road works agency relates to the optimal and most effective ways of utilizing available resources to maintain already existing infrastructure assets.

### ix. *Typical Routine Maintenance Activities for Rural Roads*

- Inspection and removal of obstacles
- Cleaning of drainage structures and their inlets and outlets (Culvert splashes)
- Repair of culvert headwalls, approaches and aprons of splashes
- Repair of culvert drains/ catch water drains and excavations to original sizes
- Cleaning of side drains and excavation to original size
- Filling of potholes in carriageway
- Repair of shoulders and side slope
- Light reshaping of carriageway (Camber formation, corrugation, ruts, etc.)
- Maintenance of erosion controls in drains
- Cutting of grass on shoulders and side drains
- Clearing bush

### x. *Typical Periodic Maintenance Activities*

- Heavy reshaping of road or road section (By labour, drag, towed grader)
- Installation or reconstruction of small drainage structures
- Rehabilitation of road or road section
- Rehabilitation of major structures (Bridges, Drifts)
- Reshaping and regravelling/ resealing of road or road section
- Provision of gravel stacks along the road to be used for routine maintenance activities

**xi.** ***Typical Emergency Maintenance Activities***

- Reconstruction/ repair of culverts (washouts, erosion or breakage)
- Reconstruction or repair of structures (washouts, erosion, damage from high floods)
- Clearing of landslide, tree fall or rock fall
- Reconstruction/ repair of a road section (washout or serious erosion)
- Reconstruction/ repair of drainage systems (serious silting up or erosion)
- Reconstruction/ repair of erosion protection (serious washout, landslide, etc.)

**xii.** ***Maintenance Roadmap***

- Maintenance work
- Organise maintenance work
- Quantify maintenance work
- Estimate maintenance work for funding purposes
- Instruct maintenance work to the maintenance personnel

To limit construction and future maintenance costs, road carriageways should be kept at minimum dimensions that still allow sufficient space for the traffic to operate. Access roads with low volumes of traffic need a single lane of 3 to 3.5 metres wide. In remote regions with traffic levels of less than 30 per day or in mountainous terrain where it is difficult (or expensive) to establish a full carriageway width, it is common to consider a narrower road width of 2.2 to 2.5 metres. This road width will cater for the largest vehicles expected on a rural road. A typical double axle truck has an overall width of 2.2 to 2.5 metres.

**xiii.** ***Legal Framework***

The Local Road Authority (LRA) is responsible for the management of the networks in the districts in collaboration with Ministry of Local Government and Housing. All road projects fall under the jurisdiction of City, Municipal and district councils that coordinate everything from a central point and these form part of the public services provided by the government. The investment made in the development and maintenance of road assets are normally made from government funding, and as a

consequence the created (and maintained) assets are regarded as the property of the government. Ownership issues such as who are in charge of the operation of these infrastructure assets are defined in legal provisions, often consisting of national legislation combined with specific regulations following the general provisions in national laws.

### xiv. *Regulatory Framework*

The implementation of a road works programme is regulated by a series of procedures and guidelines.

### xv. *Road Classification*

Roads providing access to and for local communities are often under the jurisdiction of the local authorities.

### xvi. *Setting Work Standards*

The government develops a set of design guidelines. These design guidelines include general directions on the geometric features of the roads, such as appropriate dimensions of the road cross – section and curvature, surfacing options, drainage solutions, road reserves, etc. For example the standard cross section of rural roads in Zambia is a Carriageway of 5.5m, Gravel coarse 5m, Shoulder 1.2m, Side slope 1:4, Ditch 1m and Back slope 3:1

### xvii. *Other Standard Procedures*

All public expenditure is governed by a comprehensive set of procedures and directives detailing how funds are to be used and accounted for. These procedures include budgeting and accounting procedures as well as detailed regulations on the contracting arrangements which is done by Road Development Agency under the Ministry of Works and Supply and Ministry of Infrastructure.

### xviii. *From Plans to Implementation*

The planning process forms the basis for all budgeting and resource scheduling required in civil works projects.

### xix. *Road Selection*

Roads to be constructed, improved or maintained under a particular programme are not selected in an arbitrary manner. These are done in distinct stages;

#### *a) Initial Identification*

The initial identification is the first step in the preparation of a list of proposed roads to be improved and maintained. This initial list is in most cases prepared with the involvement of the local communities and it must meet the pre – determined criteria by the central government.

#### *b) Screening*

This is done in order to qualify or disqualify those roads that meet or don't meet certain criteria, are or aren't technically or economically feasible or are likely or not likely to have the expected impact. Local participation in the ranking of projects for screening was through elected representatives.

#### *c) Appraisal*

A more detailed assessment for supporting investment Cost needs to be estimated and socioeconomic data assembled. This section has benefited from two recent reviews of appraisal methods suitable for very low volume rural roads (Lebo and Schelling, 2001; Government of Ghana, 2001). Formal quantitative methods of appraising transport sector investments in developing countries were introduced around the late 1960s and early 1970s, and uptake was comparatively slow (Howe and Richards, 1984). Both in theory and practice the emphasis of early cost – benefit methodologies was firmly economic. Indeed expert advice was that 'social effects are not quantifiable and the approach must be limited to economic aspects' (UNESCO, 1971).

#### *d) Ranking*

After the screening and the appraisal stage, roads will need to be selected against the limited resources. The roads will be ranked based on social impact, economic impact, and environmental impact.

### *e) Approval*

The road with the best score will be selected

### xx. *Selection Criteria*

As in all infrastructure works, there are essentially three main criteria namely;

- Technical feasibility
- Economic justification
- Social considerations

## 2.1.8 Design Standards and specifications

### *i) General*

An important part of a plan is to describe how the works will be done including work methods, choice of equipment and materials, dimensions and levels of quality of completed works. Contractors need assurances in regards to how the work outputs will be assessed and paid for. A considerable amount of the works in terms of describing how works should be carried out and measured can be reduced by establishing standard designs and work specifications.

For Zambia, the standard cross section of the rural road is one having a Carriageway of 5.5m, Gravel coarse 5m, Shoulder 1.2m, Side slope 1:4, Ditch 1m and Back slope 3:1. With standardized work specifications, it is also possible to prescribe certain minimum quality requirements for the sector as a whole. Quality assurance measures in work specifications may be in the form of specifying work methods, setting minimum standards for the end product and finally establishing clearly defined procedures for how and when tests are carried out.

Design standards are developed by a national body and distributed in the form of design guidelines, instructions, work specifications and/ or technical manuals. The scope of design work at central level is limited to general considerations – not to specify individual project plans. The decisions on final details require local knowledge of terrain, soil quality, placement of structures, location of quarries, etc. Need for field surveys are very important.

Design standards have the following aspects:

- Alignment requirements
- Technical performance
- Pavement solutions
- Material requirements
- Structures

The selection of design standards is related to rural road function, traffic volume and terrain. The design deals with these main steps:

- Establishing the road function
- Assessing the design traffic
- Assessing other factors affecting the design terrain, type and strength of sub grade, availability and cost of construction materials, etc.)
- Selecting a geometric design standard (road cross – section, design speed and speed related standards)
- Selecting an appropriate pavement design (thickness, and type of materials for each pavement layer)
- Assessing the need for road structures (bridges, culverts, retaining walls, etc.)
- Assessing the availability of labour in the vicinity of the road work sites
- Assessing the availability and skills of local contractors

Rural roads are often characterized by their dispersed geographical coverage in order to reach all communities, thereby providing all – weather access to the entire population living in the rural areas. An affordable rural road network with cost effective solutions which meet essential performance requirements and essentially keep the roads open and accessible throughout the year in all types of weather is what is desired.

Equally important is the need to arrive at technically sound design solutions that keep future maintenance costs at a minimum. The rural roads need to be properly designed and built to withstand the prevailing weather conditions as well as being able to cater for the expected type and volumes of traffic. Selected design must

always be justified economically and the optimum choice of design depends on the total life cycle cost, including both the costs of construction and ensuring maintenance.

### *ii) Traffic Volume*

Average daily traffic for rural roads is normally in the range of 50 to 200 vehicles per day (SATCC Guidelines, 2010), however, in more densely populated areas traffic numbers may increase to 400 to 500 vehicles per day. Permitted axle load is usually the same as found on the main roads.

### *iii) Standard Cross – Sections for Rural Roads*

Size One

Table 2.7: Type one standard cross section of rural roads

| | |
|---|---|
| Carriageway | 5.5m (2.75m – 2.75m) |
| Gravel Coarse | 5m |
| Side Slope | 1.2m (1:4) |
| Ditch | 1m |
| Back Slope | Min 3:1 Max 1:1 |

Approximately 790m³/km of gravel. 0.15m of gravel when compacted reduces to 0.12m (Source: Contractor's handbook for Labour – Based Roads Works of 2004)

Size Two

Table 2.8: Type two standard cross section of rural roads

| | |
|---|---|
| Carriageway | 5m (2.5m – 2.5m) |
| Gravel Coarse | 4.5m |
| Side Slope | 1m (1:4) |
| Ditch | 0.8m |
| Back Slope | 0.5m Min 3:1 Max 1:1 |

Approximately 710m³/km of gravel. 0.15m of gravel when compacted reduces to 0.12m (Source: Contractor's handbook for Labour – Based Roads Works of 2004)

Size Three: Reduced cross – section for very low traffic volumes

Table 2.9: Type three standard cross section of rural roads

| | |
|---|---|
| Carriageway | 4m (2m – 2m) |
| Gravel Coarse | 3.5m |
| Side Slope | 1m (1:4) |
| Ditch | 0.5m |
| Back Slope | 0.5m Min 3:1 Max 1:1 |

Approximately 470m³/km of gravel. 0.125m of gravel when compacted reduces to 0.1m (Source: Contractor's handbook for Labour – Based Roads Works of 2004)

Size Four: Mountainous road cross – section for severe terrain and very low traffic volumes

Table 2.10: Type four standard cross section of rural roads

| | |
|---|---|
| Carriageway | 3.5m |
| Gravel Coarse | 3m |
| Side Slope | 0.8m (1:4) |
| Ditch | 0.5m |
| Back Slope | 0.3m Min 3:1 Max 1:1 |

Approximately 410m³/km of gravel. 0.125m of gravel when compacted reduces to 0.1m (Source: Contractor's handbook for Labour – Based Roads Works of 2004)

Size Five: Black Cotton soil cross – section

Table 2.11: Type five standard cross section of rural roads

| | |
|---|---|
| Carriageway | 5.5m |
| Gravel Coarse | 3m |
| Side Slope | 1.5m (1:4) |
| Ditch | 1.5m |
| Back Slope | 1m |

Approximately 1500m³/km of gravel in 2 layers which reduce to 0.2m when compacted (Source: Contractor's handbook for Labour – Based Roads Works of 2004)

Size Six: Embankment

Table 2.12: Type six standard cross section of rural roads

| | |
|---|---|
| Carriageway | 7m |
| Gravel coarse | 5m |
| Side Slope | 1.5m(1:4) |
| Initial Camber | 0.35m |

Approximately 790m³/km of gravel layer 0.12m compacted, Black Cotton 0.2m

(Source: Contractor's handbook for Labour – Based Roads Works of 2004)

Size Seven: Super elevation

Table 2.13: Type seven standard cross section of rural roads

| | |
|---|---|
| Carriageway | 5.5m |
| Gravel Coarse | 5m |
| Side Slope | 1.2m (1:4) |
| Ditch | 1m |
| Back Slope | 0.5m |

Approximately 820m³/km of gravel which reduces to 0.12m when compacted (Source: Contractor's handbook for Labour – Based Roads Works of 2004)

### *iv) Design Speed*

Design speeds are normally 30km/h on rural roads. This allows the road curvature to be fitted gently into the existing terrain thereby reducing the amount of excavation works. Since most rural roads have a limited length so the design speed is not as important as for highways. Important function is to provide basic all – year access. Savings in travelling time due to higher design speeds and resulting straighter curvature is of less importance.

### *v) Road Gradients*

Four wheel drive vehicles can climb gradients of up to 20 per cent while two wheel drive trucks can successfully negotiate gradients of up to 15 per cent, except when heavily loaded. Steep gradients severally limit the performance of animal drawn carts. Maximum gradients on rural roads are mainly justified from a maintenance perspective, as roads with steep longitudinal gradients are difficult to maintain. Rural

road gradients should be kept below 8 per cent on gravel or earth roads. If necessary, limit to short distances. In this case stronger pavements are needed and installing preventive measures to limit the erosive effect of run – off water.

***vi) Camber***

The drain system begins with the camber of the road surface. The rain falling on the road surface must be drained off by the shortest possible route. This is normally across the road surface to the side drains. The side slope of the road surface is called the camber. This camber is extremely important in the earth rural road construction. If water is allowed to run along the road (parallel to the centerline), then it quickly gathers sufficient quantity and momentum to cause erosion gulleys. These erosion gulleys can grow rapidly in size and the road becomes a river instead of a road. The rural road is formed by spreading the soil to each side of the centerline. This soil is heaped along the centerline during the side drains activities. Camber must be formed at 8 % (in some soils 11%) in order to achieve 5%, after compaction.

## 2.2 Benefits

Economic shocks are powerful drivers of poverty and change in the human condition. Positive shocks are likely to reduce poverty and improve human development indicators, while adverse shocks have the opposite effect. A general approach to quantifying economic and social benefits for rural roads in developing countries has been outlined (Robinson, 1999). The oldest study, on behalf of the Asian Development Bank, dates from the mid – 1980s, and concerned the social benefits associated with the sealing of a gravel road (Puvanachandran and White, 1995). The most frequently identified social benefits were reductions in dust and muddy water to roadside residents, pedestrians and vehicle users, as well as the value of travel and waiting time savings. Social change brings increased national identity, and improves government – village relations and has a positive impact on women through the provision of roads in liberating them, providing them with more opportunities, more choice and freedom from restraints of traditional society. Further, when these roads are constructed and maintained using labour based methods, they increase employment opportunities.

The economic benefits of quality rural roads stem largely from enhanced access to enlarged markets. Quality rural roads reduce maintenance and vehicle operating costs thereby increasing the accessibility of transport in the target areas. Agricultural input costs are reduced leading to increased and timely input availability that consequently results in higher agricultural productivity and less selling price. Quality rural roads result in less spoilage of crops from delayed delivery to markets and also due to dust accumulation. Good rural roads also increase the chances of better value of job opportunities, facilitate trade flows, spurs value addition and crowd – in investments (Stifel and Minten, 2008; Gollin and Rogerson, 2009).

Raballand et al. (2010) have further examined the relationship between rural road investment and agricultural productivity and rural incomes in Sub-Saharan Africa, drawing on lessons from case studies in Burkina Faso, Cameroon, and Uganda. They recommend abandoning the Rural Accessibility Index (RAI) based on a 2-km buffer zone as it is not an economic threshold. Based on empirical evidence, they postulate a rural transport trap that explains the inadequacy of rural road infrastructure in low-income countries, particularly in Sub-Saharan Africa.

Quality rural roads enable the inhabitants to reach health clinics and personnel more easily thereby contributing to good health and nutrition. More children attend school classes and isolated communities are able to retain teachers. The delivery of building materials is made easier hence more schools can be constructed. Perceived quality of life improves and there is less migration of the young men and women to towns in search of brighter opportunities.

Vehicle operating costs are reduced thereby encouraging more operators to service these routes. There are time savings and money as traffic problems are eliminated. These roads open up impassable areas and this gives easier passage for non – motorised vehicles. These roads also encourage the opportunity for modal switch as a result this provides more access for social purposes and more access to transport services.

Isolation from important facilities is eliminated and generally poverty in the areas around the road is lessened. Other benefits are economic rate of return, benefit/ cost ratio, employment effect and the payback period. For these benefits to accrue quickly, rural road construction should be supported with measures such as agricultural extension services, non – farm income generation activities, market based vocations and life skills on business creation training.

## 2.3 Causes and effects of poor quality Rural Roads

Water, particularly storm water, is one of the main causes of damage to a rural road. If water penetrates the road formation, then it lowers the carrying strength of the road and the abrasion resistance of the road. This occurs if the ground water level is high which can be exacerbated if there is too much water close to the road (ponds, dams, streams and faulty drainage systems).

Storm water damages the road by scouring away the soil on the road surface or in the side drains and thus causing erosion gulleys. Erosion is caused by large quantities of water travelling at high speed. Once begun, these gulleys can rapidly deteriorate into large water channels. It is possible to reduce the speed of the water by widening the side drains, but the best way to control erosion is by reducing the amount of water flowing down the side drains. This is done by using mitre drains to empty the side drains at regular intervals before the volume of water builds up to cause erosion.

While erosion, caused by too much water running too quickly, is the main cause of damage to a rural road, silting takes place if the water runs too slowly. Silting is caused by sand and silt settling out of water. This only happens with slow flowing or stationary water. It takes time for the particles to settle out so the further the water travels along the drain, the more time there is for silting to take place. The slope of the drain should also be designed and constructed properly so that silting does not take place. If side drains become silted the drainage no longer functions properly and the road rapidly deteriorates as water again becomes uncontrollable. In very flat terrain the slope to the side of the drain might not be sufficient and so the side drain should be emptied frequently, in order that the water has less time in the side drain for silting to occur.

## 2.4 Chapter Summary

This chapter presented literature review on the history of rural roads, causes and effects of poor quality rural roads and the importance and benefits of quality rural roads. The next chapter discusses the research methods used in this study. The merits and demerits of the various research methods will also be discussed.

# CHAPTER THREE - RESEARCH METHODOLOGY

## 3.1 Introduction

The previous chapter presented literature review on the history of rural roads. The importance and contribution of rural roads to reducing isolation, increasing service delivery and growing the economy has also been highlighted. This chapter discusses the methodology which was used to carry out the research in order to achieve its aim and objectives. An explanation about the different methodologies used for any research is given in this chapter. A triangulation approach was used to validate the data obtained from secondary sources using journals, Contractors HandBook for Labour-Based Rural Road construction, peer reviewed articles, dissertations and the internet. In-depth interviews were further carried out with the staff at Ministry of Finance, Road Development Agency, National Road Fund Agency, National Council for Construction, Rural Road Unit and also the Royal Highnesses and their subjects in Chongwe and Lusaka North areas. This chapter further explains how the problem statement is dealt with and describes the methods used in data analysis.

## 3.2 Research methods

Jonker et al. (2010) argued that 'Methodology is the field which is indisputably complex. In the academic circles, it is often said to be important, yet in everyday academic practice, it is not always treated accordingly'. Analysing the complexity of research methodology development, Knight and Cross (2012) observed that:

Developing a research methodology for a research project is a complex process that is replete with a mine field of choices for the researcher. The complex, often emotive, and at times seemingly contradictory vocabulary, even of established theory, methods, and applications of methods can often serve to further complicate this process, particularly for the early career researcher. Bearing in mind that "all research is based on assumptions about how the world is perceived and how we can best come to understand it" (Trochim, 2002).

There are various research methods available today in the world. Depending on the research type, there exist different data collection methods. The techniques can be classified as:

- Primary; and
- Secondary.

### 3.1.1 Primary data collection techniques

The method uses first hand data that a person collects. During Data collection, the technique uses methods such as direct observations, conversation with the concerned individuals, community interviews, field visits, key informant interviews, field experiments, focus group, one – time survey, panel survey, census and administration of questionnaires (Nkhata, 1997).

#### i) Direct Observation

In this method, the observer keeps a low profile by becoming part of the sampled population/data and learns ways of arriving at certain results. The aim would be to learn all their behaviour and habits. This method involves total immersion in the group being studied (Achola & Bless, 1998).

There are various ways of observing approaches an individual can use (Nkhata, 1997). These include;

a. Complete observation, where the researcher hides his or her identity, objectives and hypothesis. The group being studied does not know that they are being observed. Whilst collecting information, an observer may decide to use devices like a tape recorder.
b. Participant observer, where the researcher's role is known. The group is made aware of the objectives of the study.

#### ii) Case Study

This method involves real life situation that are detailed and thorough. This offers advantages of acquiring detailed information about the subject matter through an in-depth study. The data obtained would be more or less reliable depending on the objectivity of the researcher (Achola & Bless, 1998).

### iii) Survey Research

Here questionnaires are distributed to a sampled population. At times interviews and questionnaires are used at the same time. Descriptive and explanatory researches can use this method (Bryman, 2001).

#### a) Interviewing

This is the type of data collection that uses oral questions to individuals or groups of people. There has to be an interviewer and an interviewee. This method has advantages and disadvantages (Bryman, 2001).

Advantages being;

- It normally gives a higher response rate compared to using questionnaires.
- It provides room for clarifications
- It accommodates illiterate respondents

Disadvantages being:

- Interviews may be costly in terms of time and money; and
- The presence of the interviewer may influence responses.

#### b) Questionnaire/ Checklist

This method uses written questions in a systematic format, which are presented to respondents from the sampled population/ area in a written form. There exist two types of questionnaire surveys (Achola & Bless, 1998). These include:

- Self-Administered questionnaires which are given out to respondents to answer and are usually returned completed; and
- An administered questionnaire which is delivered by the interviewer.

When used in a survey, it has its merits and its demerits (Nkhata, 1997). Advantages of using this method are that its:

- Less expensive as compared to carry out an interview;
- Since a respondent answers questions freely without the presence of the distributor, the responses are honest; and

- Same questions are distributed to all respondents.

Disadvantages of this method are that:

- If the sampled population have some illiterates, self-administered questionnaires cannot be used;
- There is a possibility that there may be a slow response rate; and
- Some questions may be miss-understood due to the unavailability of the interviewer

There exist two types of questions: (Achola and Bless 1998):

a. Open-ended; and
b. Closed-ended or structured questions.

In open-ended questions, the respondents are free to respond in their own way. This is important when the researcher wants to get information on opinions, attitude and reactions to sensitive questions (Achola & Bless, 1998).

Advantages of using open-ended questions are that:

- The researcher is able to gain more information by exploring issues that may not have been asked;
- Information is given out openly which is more truthful than the limited answers one is expected to choose from; and
- Depending on the responses from the respondents, some answers may be used during the discussion of results and recommendations.

Disadvantages include:

- Analysing responses from open ended questions can be time consuming especially when coming to summarise the findings of the research.

Closed-ended or structured questions, this offers a list of questions and answers from which a respondent can select from and make a decision (Achola & Bless, 1998).

Advantages of closed-ended questions include:

- The researcher can quickly record the respondents answers; and

- It is easy to analyse the respondents' answers.

Disadvantages include:

- One cannot use face to face interviews with this method;
- There is a possibility to miss out some information due to lapses; and
- The respondents may not be interested in the questions being answered.

### 3.1.1 Secondary data collection techniques

These rely on information or data already gotten by someone else for their current use. The researcher was the secondary user of this information. Literature review is one example of such a technique. This has some advantages and disadvantages (Bryman, 2001).

One advantage includes:

- It is not as expensive as data is readily available either through books, journals, articles or through the internet.

Disadvantages include:

- Due to ethical issues, if a researcher is getting some information from a government institution the information may not be easy to retrieve.
- The information may be incomplete due to the method not being too clear for the researcher.

## 3.2 Research Approach and design

The research work started way back as it was observed that the rural roads were in a deplorable and poor state. It has been observed in Zambia that the rural roads take, in most cases, less than a year to deteriorate in condition. This is a source of concern in terms of both wasted time and resources and also the way we look after our national assets. The primary focus is to interrogate the reasons why this is so and help the policy makers to better understand the causes and help them to come up with better preventive ways of constructing our roads.

Primary data was collected through three check lists that were filled with data collected through observations and field measurements. To help the researcher understand how to collect this data, the researcher had to undergo Rural Road Construction and Maintenance training with The National Council for Construction for a period of four months. This programme consisted of two parts: The theory part comprising Mathematics, Road Rehabilitation and Maintenance, Construction Materials, Construction Management, Pricing and Bidding, Communication Skills and Entrepreneurship and the Practical part comprising Road Rehabilitation and Maintenance only.

The research also relied on supplementary secondary data that was readily available from;

- National Road Fund Agency
- Road Development Agency
- National Council for Construction
- Ministry of Transport, Communication, Works and Supply
- Ministry of Local Government and Housing
- Ministry of Finance

Three areas were picked because of proximity, less transport cost, security reasons, assuredly supervised roads, ease of contacting the contractors and also the ease of sourcing the contract documents from the ministries involved. Two rural roads per area were also picked at random. Road dimension tests, road profile tests and physical check of the road features were conducted on the full length of these rural roads.

The first test was the road dimension test using tapes to check the accuracy of the carriageway and the side drains. The second test was the road profile test using the line level were the camber of the carriageway and the longitudinal profile of the carriageway were checked and the final test was the visual test that was checking for the presence of culverts, culvert rings, wing walls, headwalls, ramps, outfalls, mitre

drains, scour checks, laybys, ditch and the shoulder and these were presented in the form of check lists.

### 3.2.1 Check Lists

#### 3.2.1.1 Road Dimension Tests

The standard cross section of rural roads in Zambia is one having a carriageway of 5.5m, with a gravel coarse of 5m span, side slope of 1.2m, a ditch of 1m and a back slope of minimum 3:1 and a maximum of 1:1

Type of Tests

- Simple checks on the dimensional accuracy of the construction works

Methods Used: Tapes

Table 3.1: Rural road dimension test sample

| Test | Method | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriageway | Tape | Field | 300m | +/ - 50mm |
| Width and depth of side drains | - | Field | 10m | +/ - 20mm |

Source: Ministry of Works and Supply Contractor's handbook for Labour – Based Roads Works of 2004

Type of Tests

- Check on the camber of the carriageway
- Check on the longitudinal profile of the carriageway

Methods Used

Line level

Table 3.2: Rural road profile test sample

| Test | Method | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | - | Field | 20m | +/ - 10mm |
| Longitudinal profile | - | Field | 20m | +/ - 50mm |

Source: Ministry of Works and Supply Contractor's handbook for Labour – Based Roads Works of 2004

Table 3.3: Rural road condition inventory check list

| ROAD CONDITION INVENTORY | SPECIFICATIONS | COMMENTS |
|---|---|---|
| **Soil Type** | Laterite | |
| **Surface Material** | Laterite | |
| **Road Surface Width** | 5.5m | |
| **Maximum Gradient** | 12% | |
| **Camber** | 5% after compaction | |
| **Shoulder** | 1.2m | |
| **Side Slope** | 1:4 | |
| **Side Drain Left** | 1m | |
| **Side Drain Right** | 1m | |
| **Tree and Stump Removal** | 6m clearance from centre | |
| **Sand Removal** | Must be removed | |
| **Boulder Removal** | <0.5m boulders buried along the road | |
| **Clear Side Drain** | Must be cleared | |
| **Clear Mitre Drains** | Must be cleared | |
| **Scour Checks** | 12% gradient 6m apart | |
| **Grass Planting** | Must be done | |
| **Catch Water Drains** | 5m away from the Ditch | |
| **Gravel Surface Thickness** | 125mm after compaction | |
| **Culverts per km** | For Maximum Gradients of 12%, 2 to 4 per km | |
| **Culvert Pipe Size** | 600mm | |
| **Wing Walls** | 45°<Centreline<75° | |
| **Head Walls** | 200mm | |
| **Ramp** | 20m approach distance | |
| **Layby** | 5m | |

### 3.2.2 Quality Control for Earth Rural Road Works

#### 3.2.2.1 Road Dimension Tests

Type of Tests

- Simple checks on the dimensional accuracy of the construction works

Methods Used:

Tapes

Table 3.4: Road dimension test

| Test | Method | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriageway | Tape | Field | 300m | +/ - 50mm |
| Width and depth of side drains | - | Field | 10m | +/ - 20mm |

Source: Ministry of Works and Supply Contractors Handbook for Labour- Based Road Works of 2004

#### 3.2.2.2 Road Profile Tests

Type of Tests

1. Check on the camber of the carriageway
2. Check on the longitudinal profile of the carriageway

Methods Used

Line level

Table 3.5: Rural road profile test

| Test | Method | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | - | Field | 20m | +/ - 10mm |
| Longitudinal profile | - | Field | 20m | +/ - 50mm |

Source: Ministry of Works and Supply Contractor's handbook for Labour – Based Roads Works of 2004

#### 3.2.2.3 Gravel Layer Test

Type of Test

1. Thickness of compaction
2. Degree of compaction

Methods Used

Tapes and special laboratory tests

Table 3.6: Gravel layer test

| Test | Method | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Thickness | Tape | Field | 50m | +/ - 10mm |
| Percentage of compaction | Compaction passes | Field | Always | 0 |

Source: Ministry of Works and Supply Contractor's handbook for Labour – Based Roads Works of 2004

### 3.2.2.4 Compaction

The compaction method is usually specified. The following are factors that can influence compaction;

- Moisture content
- Amount of compaction
- Thickness of layer

The research was designed to address the problem statement and achieve the objective. The study was conducted in four phases. The first was a comprehensive literature review. The second phase consisted of data collection which was done through direct observation, field visits and measurements, conversation with the people that live along the selected rural roads and interviews of the staff at Ministry of Finance, Ministry of Works and Supply, National Road Fund Agency, National Council for Construction and the Rural Road Unit. The triangulation of the various methods was done to enhance the confidence that can be placed on the research findings (Spector, 1981). The third phase was data analysis and finally the fourth phase comprised the report. Conclusions and recommendations followed thereafter.

### 3.2.3 Data Collection

### 3.2.4 Literature review

Secondary information was sourced mainly from literature dealing with rural roads. Peer reviewed conference proceedings, government reports, the internet, Journals and books were a source of information. It has been acknowledged and rightly so that rural roads should be treated as the last link of the transport network. Despite this, they often form the most important link in terms of providing access for the rural population. Their permanent or seasonal absence acts as a crucial factor in terms of the access of rural communities to basic services such as education, primary health care, water supply, local markets and economic opportunities (Donnges et al., 2007).

In a study in Ethiopia (Dercon et al., 2008) on 15 villages that were surveyed between 1994 and 2004, they concluded that access to all – weather rural roads reduced poverty by 6.9 per cent and increased consumption growth by 16.3 per cent. Dercon and Hoddinott (2005) found that, in Ethiopia, an increase of 10 km in the distance from the rural village to the closest market town had a dramatic effect on the likelihood that the household purchased inputs. Mu and Van de Walle (2007) showed that markets in Vietnam were more likely to develop as a result of rural road improvements where communities had access to extended networks of transport infrastructure.

It was shown in Uganda that benefits from improving access to basic education depended on complementary investments in infrastructure (Deininger and Okidi, 2003). Road improvements in Bangladeshi led to lower input and lower transportation costs, higher production, higher wages and higher output prices (Khandker et al., 2006). Access to rural roads in Nepal improved the productive capacity of poor households (Jacoby, 2000). Rural road rehabilitation in Georgia increased the opportunities for off – farm and female wage employment (Lokshin and Yemtsov, 2005).

Rehabilitation and maintenance of rural roads in Peru improved access and attendance to schools and child health centres (Escobal and Ponce, 2003). According to The Rural Accessibility Index of 2010 and also Torero and Chowdhury, 2004, majority of rural communities in Africa have inadequate and unreliable infrastructure services with only 34% of rural Africans living within 2 kilometres of an all - weather road compared to 59% in Latin America, 65% in East Asia and over 90% in other developed regions. Africa Infrastructure Country Diagnostic of 2010 indicated that even where feeder roads exist; the rural environment presents particular institutional challenges for road maintenance. Only half of the existing rural road network is in good or fair condition, which is much lower than the 80% found for the inter – urban network

Pinstrup – Anderson and Shimokawa in 2010 and also Fan in 2011 indicated that the provision of rural infrastructure contributed to the delivery of goods and services that promoted prosperity and growth, contributed to quality of life, including social well - being, health and safety, and the quality of the environment. It will help reduce the cost of inputs and transport to markets, also increase farmer's access to enlarged markets, facilitate trade flow and spur value addition and crowd – in investment.

Foster and Briceno – Garmendia in 2010 stated that the variation in road quality throughout the various Sub Saharan African countries reflected several interacting factors. Firstly the relation to affordability where the GDP per capita is most strongly correlated with the percentage of the main road network in good condition, signifying that richer countries tended to spend more on maintenance. No such clear relationship exists for rural roads. The second factor relates to topographic and climatic influences where mountainous and wet countries normally have poorer road conditions in both main and rural networks (Johannessen, 2008). Thirdly, they observed that countries with road funds and road agencies have considerably better road conditions than those that have neither.

Addo – Abedi, in 2007 noted that a number of African countries had embarked on reforms in the last few decades supported by four "building blocks" namely Ownership, Financing, Responsibility and Management. The main aim of the reforms was to manage roads as a business and bring them into the market place by

charging for road use on a fee – for – service basis. The mean distance to services and community assets diminished significantly due to rehabilitation of rural roads in Zambia's eastern province (Kingombe, 2011).

The objectives identified in Section 1.4 were addressed through the literature review as follows:

- Presentation and discussion of the previous related studies; and
- Identification of the possible causes of poor rural road state in Zambia.

## 3.3 The Study population and Sample

In Zambia, according to The Public Roads act, 2002, a rural road is defined as a public road within a local authority area which may be designated as rural roads by The Minister on the recommendations of the agency, by statutory order, on the application of The Permanent Secretary of the province in which they are issued.

It may also be defined as a road, street, highway, thoroughfare, or bridge that is in an unincorporated area and that is not privately owned or controlled, any part of which is open to the public for vehicular traffic, and over which the state or any of its political subdivisions have jurisdiction.

Leedy and Ormrod (2010) mention a two stage descriptive survey as one of the means of data collection. In this study, the second stage data collection of descriptive survey was used. This approach works through collection of quantitative data coming from a designed checklist. This specific checklist was used for recording measurements from field survey. The target area being the sampled population was divided into three:

a. Two rural roads in Chongwe
b. Two rural roads in Lusaka West
c. Two rural roads in Lusaka North

## 3.4 Qualitative and Quantitative data collection Instruments

### Interviews and checklist

Under qualitative analysis, structured interviews with headmen and their subjects, staff at National Council for Construction, Ministry of Finance staff, National Road Fund Agency staff, Ministry of Works and Supply and Ministry of Local Government and Housing staff were conducted. The data collected was used to come up with an informed opinion that was correlated to measurements collected. The results helped to identify the gaps in specifications and implementation. A desktop study using published literature on rural roads was also carried out.

Interviews and in depth discussions were carried out with engineers under the Rural Road Unit and The National Council for Construction. This was done in order to understand the challenges that they went through and the successes as well. The interviews were aimed at obtaining preliminary data that would enhance the measurements. The interviews were limited to participants within Lusaka, the capital city, due to the short time that was required to get preliminary data and also due to the cost implications. Security reasons were also taken into account as the field visits required walking the whole length of the sampled rural road. A check list was adopted as the main research instrument which was based on the advantages that a representative sample would be realised with little time or costs. It was explained to the participants who assisted in the measurements. It was accompanied with a cover letter.

There were cases where in-depth discussions to get a better understanding of the responses and to clarify certain questions were carried out. The questions had to be translated which ended up being in-depth interviews. The questions which involved the interview section involved brainstorming. This ensured that various questions used in the research were addressed to get a better understanding of the results. It also gave enough time for the respondents to consult where questions were not clear in order to answer more appropriately. The data collected from the interview and measurements helped to come up with recommendations on how to improve on the quality of constructed rural roads.

## 3.5 Tool used in the research

The tool that was used in the research was a semi structured checklist. Interviews were another means of data collection and field measurements. Other than that, there was also the use of secondary data. In the analysis, correlation to literature was used to interpret the results.

## 3.6 The study area

The study area was Lusaka Province. Lusaka province has Chongwe district, Chilanga district, Lusaka district and Chibombo district and is one of the 10 provinces in Zambia. It is located in the southern part of the country. Lusaka province was taken because of its proximity to the ministries hence reducing on transport costs and lodging fees. Also it was much easier to access data from the concerned institutions. Even interviews were easier to conduct with the officials as well. The language used in this research when interviewing people that live along the concerned rural roads was Nyanja. However, English was the main source of communication especially with the respondents who were in the formal sector. Efforts to prevent variability in sample size and analysis were made. The sample size was confined to Lusaka province because according to statistics, most of the rural roads are concentrated around the province.

## 3.7 Research Ethics

Following ethical and professional conduct advocated by literature, ethical issues were incorporated in the research process. This included following all due processes that were necessary in the design of the investigation, data collection, processing, analysis and interpretation. This involved getting permission from senior personnel to carry out this research in their places of work. Sensitive government information was treated with extreme care and for research purposes only. Care was also taken to ensure that data collected was accurate and reliable. External factors that could undermine the integrity of collected data were excluded as much as possible. Individual participants and collected information was guarded against any abuse of

rights committed to any person or organisation likely to be incurred during the research process. No mention of names was done during this research.

## 3.8 Limitations

This research was only conducted in Lusaka West, Chongwe and Lusaka North areas because most of the ministries and agencies responsible for rural road design, approval, procurement, construction and supervision are located in Lusaka. Coupled to this were also issues of limited resources and time constraints. Security concerns to the researcher were also considered. Only two rural roads per area were selected arbitrarily and assessed to help understand the level of the problem.

Another limiting factor was the scarce availability of data on causes of poor quality of rural roads. That which exists is often not readily available or tailored to local conditions. Engineering guidelines are either very old or have not been refined in recent years to exploit possible potential cost savings. The inadequacies in knowledge also and the issues of climate change adaptation and mitigation pose difficult questions about how to design, plan and build resilient rural roads and transport services without incurring even greater costs, either on the environment or on strained government budgets.

## 3.9 Chapter Summary

This chapter presented the methodology which was used to carry out the research and addressed its aims and objectives. In this chapter, highlights about the various methodologies that could be adopted for research purposes were discussed. The chapter further presented an explanation of how the problem was investigated and described the tools that were used to undertake the study. It also described the sampled area and the method of analysis that was employed.

The next chapter discusses the data that was collected and analysed in the study.

# CHAPTER FOUR - DATA ANALYSIS

## 4.1 Introduction

The previous chapter presented findings relating to the research objectives. The issues of planning, design and specification setting, the funding and management were looked into and the findings recorded. This chapter discusses the findings with the view of answering the research objectives. An explanation to each objectives question is given in this chapter. Both primary and secondary data are analysed in this chapter.

## 4.2 Profile of the sampled population

In Zambia, it has been noted that transport infrastructure is vital for economic growth, poverty reduction and service delivery especially in low income rural areas. When considered at the extreme ends, without transport infrastructure rural areas are characterised by lots of small and poor subsistence economies, limited ability to engage in markets, access essential services and reduced opportunities for diversifying and improving livelihoods. It has been demonstrated through research such as one conducted by the Department for International Development in 2012 that increases in the amount of transport infrastructure or improvements in the quality and reliability of infrastructure and transport services enables households to increase outputs, productivity and incomes and also reduces the distances to service centres.

For sustainability of the above, the research looked at what ought to be done in order to ensure that quality rural roads are constructed. Due to financial and time constraints, the research was limited to three areas namely Lusaka West, Chongwe and Lusaka North. Further, the number of roads was limited to two per area and these rural roads were arbitrarily picked;

a. Lusaka West had the China - Zambia rural road and the Transmitter rural road in Lusaka West. These roads were traversed, observed and measured and the results recorded in table form;

b. Chongwe had the Nyendwa - Evergreen rural road and the Primary – Evergreen rural road. These roads were traversed, observed and measured and the results recorded in table form;

c. Lusaka North had the Mpandika Palace rural road and the Spin Along rural road. These roads were traversed, observed and measured and the results recorded in table form.

## 4.3 Results Analysis

The following data was collected on six rural roads from Lusaka West, Chongwe and Lusaka North areas. The results were compared to theory with the view of finding out whether our rural roads are built to specifications, or if not, why?

In Zambia the Road Development Agency undertakes annual surveys to determine the road condition indices for unpaved roads within the Core Road Network. The variations are considerable, as can be seen in figures 4-1 and 4-2 which give the status of the condition on the Core Road Network. For example, during the period 2014/2015 over 70% of unpaved Trunk, Main and District roads and 82% of the unpaved Primary Feeder Roads were in poor condition. The condition of PFR substantially remained unchanged.

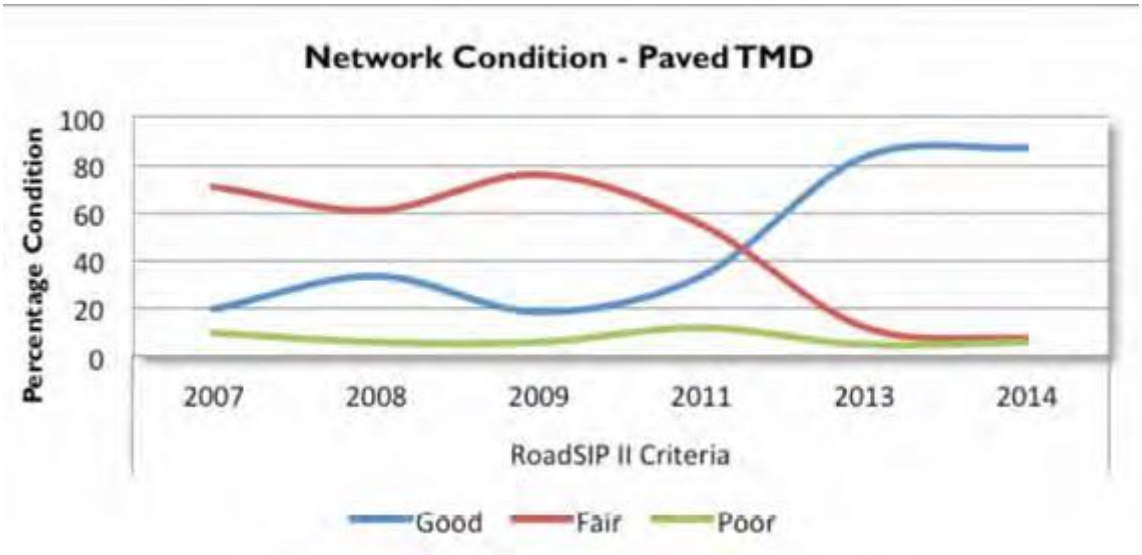


Figure 4.1: Network Condition – Paved TMD (Source: Road Sector Annual Work Plan for 2014)

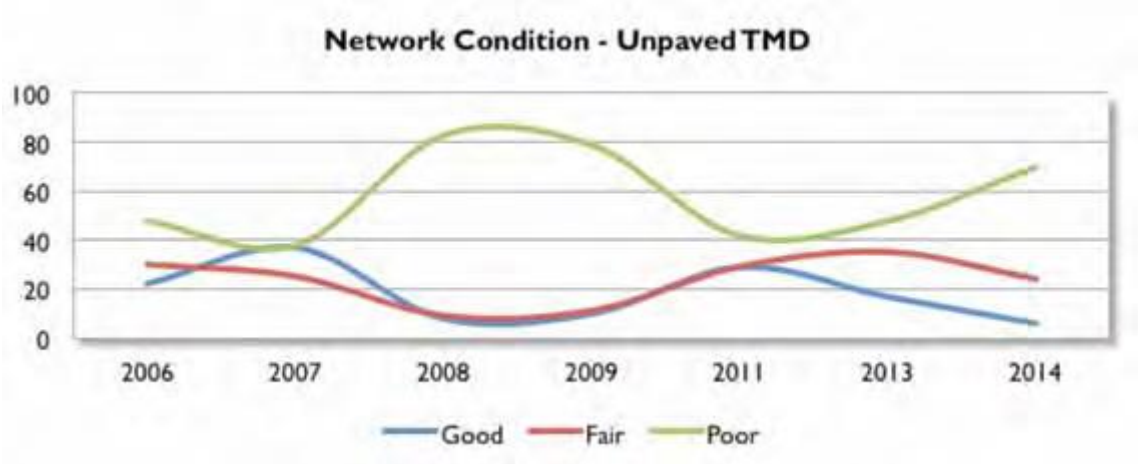


Figure 4.2: Network Condition – Unpaved TMD (Source: Road Sector Annual Work Plan for 2014)

On the spot check on six rural roads that were picked in Lusaka North, Lusaka West and Chongwe, the following data was collected;

### 4.3.1 Transmitter Road in Lusaka West of Lusaka District

Total Length of Road: 2.5km

Carriageway: 5. 5m

Rural road dimension test using the tape

Table 4.1: Transmitter Road Dimension Test

| Test | Average | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriageway | 5.5m | Field | 300m | +/ - 50mm |
| Width and depth of side drains | 0.5m, and 0.2m | Field | 10m | +/ - 20mm |

Rural road dimension test using the line level

Table 4.2: Transmitter Road Profile Test

| Test | Average | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | 0.1m | Field | 20m | +/ - 10mm |
| Longitudinal profile | - | Field | 20m | +/ - 50mm |

Table 4.3: Transmitter Road Condition Inventory Check List

| ROAD CONDITION INVENTORY | SPECIFICATIONS | COMMENTS |
|---|---|---|
| **Soil Type** | Laterite | Laterite soil present |
| **Surface Material** | Laterite | Laterite |
| **Road Surface Width** | 5.5m | 5.5m |
| **Maximum Gradient** | 12% | <6% |
| **Camber** | 5% after compaction | 5% |
| **Shoulder** | 1.2m | 1m |
| **Side Slope** | 1:4 | 0.2m |
| **Side Drain Left** | 1m | 0.5m |
| **Side Drain Right** | 1m | 0.5m |
| **Tree and Stump Removal** | 6m clearance from centre | Not adhered to |
| **Sand Removal** | Must be removed | Done |
| **Boulder Removal** | <0.5m boulders buried along the road | No presence of boulders observed |
| **Clear Side Drain** | Must be cleared | Overgrown with grass |
| **Clear Mitre Drains** | Must be cleared | Overgrown with grass |
| **Scour Checks** | 12% gradient must be 6m apart | No Scour Checks observed |
| **Grass Planting** | Must be done | Done |
| **Catch Water Drains** | 5m away from the Ditch | Present but less than 5m from the Side Drain |
| **Gravel Surface Thickness** | 125mm after compaction | Less than 50mm thickness |
| **Culverts per km** | For Maximum Gradients of 12%, 2 to 4 per km | No Culvert for the entire stretch of the road |
| **Culvert Pipe Size** | 600mm | No Culverts Pipes present |
| **Wing Walls** | 45°<Centreline<75° | No Wing Walls present |
| **Head Walls** | 200mm | No Head Walls present |
| **Ramp** | 20m approach distance | No Ramp present |
| **Layby** | 5m | No Layby found |

### 4.3.2 China – Zambia Road in Lusaka West of Lusaka District

Total Length: 1.9 km

Carriageway: 5.5m

Table 4.4: China – Zambia Road Dimension Test

| Test | Average | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriage | 5.5m | Field | 300m | +/ - 50mm |
| Width and depth of side drains | 0.8m and 0.2m | Field | 10m | +/ - 20mm |

Table 4.5: China – Zambia Road Profile Test

| Test | Average | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | <0.1m | Field | 20m | +/ - 10mm |
| Longitudinal profile | - | Field | 20m | +/ - 50mm |

Table 4.6: China – Zambia Road Condition Inventory Check List

| ROAD CONDITION INVENTORY | SPECIFICATIONS | COMMENTS |
|---|---|---|
| **Soil Type** | Laterite | Laterite soil present |
| **Surface Material** | Laterite | Laterite |
| **Road Surface Width** | 5.5m | 5.5m |
| **Maximum Gradient** | 12% | <6% |
| **Camber** | 5% after compaction | 5% |
| **Shoulder** | 1.2m | 1m |
| **Side Slope** | 1:4 | 0.2m |
| **Side Drain Left** | 1m | 0.8m |
| **Side Drain Right** | 1m | 0.8m |
| **Tree and Stump Removal** | 6m clearance from centre | Not adhered to |
| **Sand Removal** | Must be removed | Done |
| **Boulder Removal** | <0.5m boulders buried along the road | Presence of boulders observed along the road |
| **Clear Side Drain** | Must be cleared | Overgrown with grass |
| **Clear Mitre Drains** | Must be cleared | Overgrown with grass |
| **Scour Checks** | 12% gradient must be 6m apart | No Scour Checks observed |
| **Grass Planting** | Must be done | Done |
| **Catch Water Drains** | 5m away from the Ditch | Present but less than 5m from the Side Drain |
| **Gravel Surface Thickness** | 125mm after compaction | 125mm thickness |
| **Culverts per km** | For Maximum Gradients of 12%, 2 to 4 per km | No Culvert for the entire stretch of the road |
| **Culvert Pipe Size** | 600mm | No Culverts Pipes present |
| **Wing Walls** | 45°<Centreline<75° | No Wing Walls present |
| **Head Walls** | 200mm | No Head Walls present |
| **Ramp** | 20m approach distance | No Ramp present |
| **Layby** | 5m | No Layby found |

### 4.3.3 Kapepe School to Nyendwa Bar Road in Chongwe District

Total Length: 10.8 km

Carriageway: 5.5m

Table 4.7: Kapepe – Nyendwa Road Dimension Test

| Test | Average | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriage | 5.5m | Field | 300m | +/ - 50mm |
| Width and depth of side drains | 0.5m and 0.2 | Field | 10m | +/ - 20mm |

Table 4.8: Kapepe – Nyendwa Road Profile Test

| Test | Average | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | <0.1m | Field | 20m | +/ - 10mm |
| Longitudinal profile | - | Field | 20m | +/ - 50mm |

Table 4.9: Kapepe – Nyendwa Road Condition Inventory Check List

| ROAD CONDITION INVENTORY | SPECIFICATIONS | COMMENTS |
|---|---|---|
| **Soil Type** | Laterite | Laterite soil present |
| **Surface Material** | Laterite | Laterite |
| **Road Surface Width** | 5.5m | 5.5m |
| **Maximum Gradient** | 12% | <6% |
| **Camber** | 5% after compaction | 5% |
| **Shoulder** | 1.2m | 1m |
| **Side Slope** | 1:4 | 0.2m |
| **Side Drain Left** | 1m | 0.5m |
| **Side Drain Right** | 1m | 0.5m |
| **Tree and Stump Removal** | 6m clearance from centre | Adhered to specifications |
| **Sand Removal** | Must be removed | Done |
| **Boulder Removal** | <0.5m boulders buried along the road | No presence of boulders observed |
| **Clear Side Drain** | Must be cleared | Overgrown with grass |
| **Clear Mitre Drains** | Must be cleared | Overgrown with grass |
| **Scour Checks** | 12% gradient must be 6m apart | No Scour Checks observed |
| **Grass Planting** | Must be done | Done |
| **Catch Water Drains** | 5m away from the Ditch | Present at 5m from the Side Drain |
| **Gravel Surface Thickness** | 125mm after compaction | Less than 50mm thickness |
| **Culverts per km** | For Maximum Gradients of 12%, 2 to 4 per km | Two Culverts per km observed |
| **Culvert Pipe Size** | 600mm | 300mm Culverts Pipes |
| **Wing Walls** | 45°<Centreline<75° | Not to specifications |
| **Head Walls** | 200mm | Not to specifications |
| **Ramp** | 20m approach distance | < 20m approach distance |
| **Layby** | 5m | No Layby found |

### 4.3.4 Evergreen to Nyendwa Road in Chongwe District

Total Length: 9km

Carriageway: 5.5m

Table 4.10: Evergreen – Nyendwa Road Dimension Test

| Test | Average | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriage | 5.5m | Field | 300m | +/ - 50mm |
| Width and depth of side drains | 0.6m and 0.1m | Field | 10m | +/ - 20mm |

Table 4.11: Evergreen – Nyendwa Road Dimension Test

| Test | Average | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | 0.2m | Field | 20m | +/ - 10mm |
| Longitudinal profile | | Field | 20m | +/ - 50mm |

Table 4.12: Evergreen – Nyendwa Road Condition Inventory Check List

| ROAD CONDITION INVENTORY | SPECIFICATIONS | COMMENTS |
|---|---|---|
| **Soil Type** | Laterite | Laterite soil present |
| **Surface Material** | Laterite | Laterite |
| **Road Surface Width** | 5.5m | 5.5m |
| **Maximum Gradient** | 12% | <6% |
| **Camber** | 5% after compaction | 5% |
| **Shoulder** | 1.2m | 1m |
| **Side Slope** | 1:4 | 0.1m |
| **Side Drain Left** | 1m | 0.6m |
| **Side Drain Right** | 1m | 0.6m |
| **Tree and Stump Removal** | 6m clearance from centre | Adhered to |
| **Sand Removal** | Must be removed | Done |
| **Boulder Removal** | <0.5m boulders buried along the road | No presence of boulders observed |
| **Clear Side Drain** | Must be cleared | Cleared |
| **Clear Mitre Drains** | Must be cleared | Cleared |
| **Scour Checks** | 12% gradient must be 6m apart | Scour Checks observed |
| **Grass Planting** | Must be done | Done |
| **Catch Water Drains** | 5m away from the Ditch | Present and at 5m |
| **Gravel Surface Thickness** | 125mm after compaction | Spot gravelling 125mm thickness |
| **Culverts per km** | For Maximum Gradients of 12%, 2 to 4 per km | 6 Culverts |
| **Culvert Pipe Size** | 600mm | 300mm Culverts Pipes |
| **Wing Walls** | 45°<Centreline<75° | Present |
| **Head Walls** | 200mm | Present |
| **Ramp** | 20m approach distance | Ramp present |
| **Layby** | 5m | No Layby found |

### 4.3.5 Headman Mpandika's Palace Road in Lusaka North

Total Length: 4.2km

Carriageway: 5.5m

Table 4.13: Mpandika Palace Road Dimension Test

| Test | Average | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriage | 5.5m | Field | 300m | +/ - 50mm |
| Width and depth of side drains | 0.6m & 0.2m | Field | 10m | +/ - 20mm |

Table 4.14: Mpandika Palace Road ProfileTest

| Test | Average | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | 0.1m | Field | 20m | +/ - 10mm |
| Longitudinal profile | | Field | 20m | +/ - 50mm |

Table 4.15: Mpandika Palace Road Condition Inventory Check List

| ROAD CONDITION INVENTORY | SPECIFICATIONS | COMMENTS |
|---|---|---|
| **Soil Type** | Laterite | Laterite soil present |
| **Surface Material** | Laterite | Laterite |
| **Road Surface Width** | 5.5m | 5.5m |
| **Maximum Gradient** | 12% | 12% |
| **Camber** | 5% after compaction | 5% |
| **Shoulder** | 1.2m | 1m |
| **Side Slope** | 1:4 | 0.2m |
| **Side Drain Left** | 1m | 0.6m |
| **Side Drain Right** | 1m | 0.6m |
| **Tree and Stump Removal** | 6m clearance from centre | Adhered to |
| **Sand Removal** | Must be removed | Done |
| **Boulder Removal** | <0.5m boulders buried along the road | No presence of boulders observed |
| **Clear Side Drain** | Must be cleared | Overgrown with grass |
| **Clear Mitre Drains** | Must be cleared | Overgrown with grass |
| **Scour Checks** | 12% gradient must be 6m apart | No Scour Checks observed |
| **Grass Planting** | Must be done | Done |
| **Catch Water Drains** | 5m away from the Ditch | Not Present |
| **Gravel Surface Thickness** | 125mm after compaction | Earth road |
| **Culverts per km** | For Maximum Gradients of 12%, 2 to 4 per km | 3 Culverts |
| **Culvert Pipe Size** | 600mm | 600mm Culverts Pipes |
| **Wing Walls** | 45°<Centreline<75° | No Wing Walls present |
| **Head Walls** | 200mm | Head Walls present |
| **Ramp** | 20m approach distance | No Ramp present |
| **Layby** | 5m | No Layby found |

### 4.3.6 Spin-Along Road in Lusaka North

Total Length: 3.2km

Carriageway: 5.5m

Table 4.16: Spin - Along Road Dimension Test

| Test | Average | Location | Every | Tolerance |
|---|---|---|---|---|
| Width of carriage | 5.5m | Field | 300m | +/ - 50mm |
| Width and depth of side drains | 0.5m and 0.3m | Field | 10m | +/ - 20mm |

Table 4.17: Spin - Along Road Profile Test

| Test | Average | Location | Test Interval | Tolerance |
|---|---|---|---|---|
| Camber | 0.1m | Field | 20m | +/ - 10mm |
| Longitudinal Profile | Ok | Field | 20m | +/ - 50mm |

Table 4.18: Spin - Along Road Condition Inventory Check List

| ROAD CONDITION INVENTORY | SPECIFICATIONS | COMMENTS |
|---|---|---|
| **Soil Type** | Laterite | Laterite soil present |
| **Surface Material** | Laterite | In situ Laterite |
| **Road Surface Width** | 5.5m | 5.5m |
| **Maximum Gradient** | 12% | <6% |
| **Camber** | 5% after compaction | 5% |
| **Shoulder** | 1.2m | No Shoulder observed |
| **Side Slope** | 1:4 | 0.3m |
| **Side Drain Left** | 1m | 0.5m |
| **Side Drain Right** | 1m | 0.5m |
| **Tree and Stump Removal** | 6m clearance from centre | Adhered to |
| **Sand Removal** | Must be removed | Done |
| **Boulder Removal** | <0.5m boulders buried along the road | No presence of boulders observed |
| **Clear Side Drain** | Must be cleared | Overgrown with grass |
| **Clear Mitre Drains** | Must be cleared | Overgrown with grass |
| **Scour Checks** | 12% gradient must be 6m apart | No Scour Checks observed |
| **Grass Planting** | Must be done | Done |
| **Catch Water Drains** | 5m away from the Ditch | Not Present |
| **Gravel Surface Thickness** | 125mm after compaction | No gravel |
| **Culverts per km** | For Maximum Gradients of 12%, 2 to 4 per km | No Culvert for the entire stretch of the road |
| **Culvert Pipe Size** | 600mm | No Culverts Pipes present |
| **Wing Walls** | 45°<Centreline<75° | No Wing Walls present |
| **Head Walls** | 200mm | No Head Walls present |
| **Ramp** | 20m approach distance | No Ramp present |
| **Layby** | 5m | No Layby found |

## 4.4 Funding

A look at the funding for the period 2009 to 2012 presents the following picture as illustrated in the Tables 4-19 to 4-22. The average budgetary allocation for 2014 under the Road Sector Annual Work Plan (RSAWP) was ZMW 4.943 billion comprising 59% of local resources funding with GRZ contributing (25%) and Road Fund (34%) and the external support was 41% as shown in the figure 4.3.

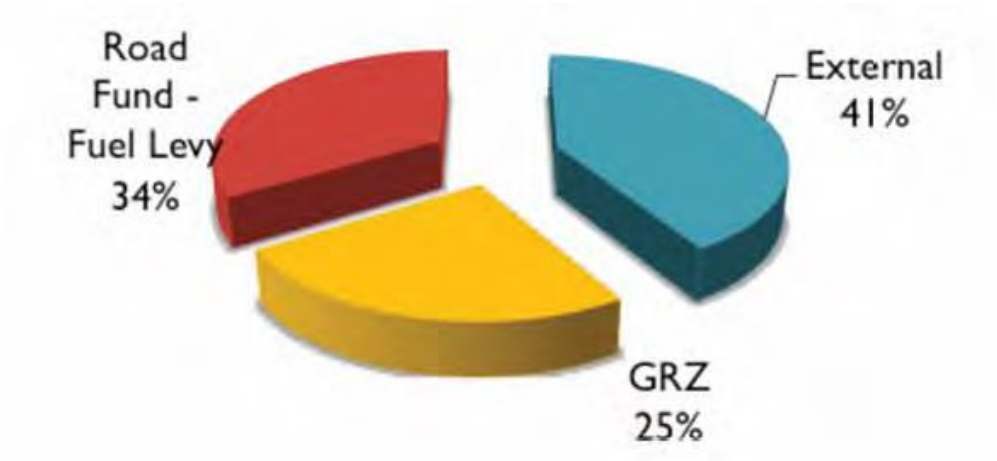


Figure 4.3: Road Sector Budgetary Allocation

The above analysis on both primary and secondary data with respect to funding on the road network shows that we as a country have been operating at an average of 32% funding for all provinces. This trend has been going on for many years. Also a check at the Ministry of Finance to ascertain when these funding's were released revealed a very disturbing picture. The Ministry of Finance released these moneys towards the end of the year and during the rainy season. This makes the implementation of the rural road projects difficult, expensive and usually unsupervised resulting in low quality works.

Usually funding profiles that are submitted to the treasury are consistent with annual work plans. Poor provision and inadequate funding of road maintenance, poor planning and provision of road infrastructure including the mal – distribution of resources all point to the reasons why our rural roads are in a deplorable state. Also there is severe neglect of rural roads and the road sector is not managed or seen as

part of the market economy. Rural roads are regarded as a social service that draws funding from the general revenue and therefore during lean years, they are the first to be cut off.

Coupled to this, are issues of inadequate financing for spare parts, insufficient finances for overall road works and the untimely release of finances that are done mostly at the end of the year. To mitigate these, the government needs to explore other sources of financing like coming up with an infrastructure bond similar to what the Kenya's did where a billion dollars was raised. In South Africa commodity – linked bonds were issued by the banks that have raised considerable amounts of money. Pension and Insurance funds can also be looked into to ease the burden on the national treasury. The government can also come up with incentives that can attract the private sector to invest their capital in rural road construction. GDP savings and economically plausible citizens can be encouraged to bank their money which can be borrowed by the government to finance the construction of rural roads. Government can also come up policies that can stop illicit financial outflows and also help leverage the diaspora remittances. Finally the country can come up with innovative financing for development.

The policy inconsistences with regard to fuel supply and subsidies have also contributed negatively to the rural road construction. Haulage of gravel for instance is very dependent on fuel supply and costing. Quality of the road can be compromised if, for example, there are delays in watering the road during compaction.

**Table 4.19:** Budget and Financing Sources for the period 2009 to 2012

| Program | Province | 2009 | | | 2010 | | | 2011 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cost in K' million | | | Cost in K' million | | | Cost in K' million | | | Cost in K' million | | |
| | | GRZ | Foreign Financing | Total | GRZ | Foreign Financing | Total | GRZ | Foreign Financing | Total | GRZ | Foreign Financing | Total |
| Rural Roads | Central | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | Copperbelt | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | Eastern | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | Luapula | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | Lusaka | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | Northern | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | N/ Western | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | Southern | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |
| | Western | 6 | 0 | 6 | 8 | 0 | 8 | 9 | 0 | 9 | 10 | 0 | 10 |

Source: Sixth National Development Plan of 2011

Table 4.20: Budget and Releases for the period 2009 to 2012

| Program | Province | 2009 | | | 2010 | | | 2011 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cost in K' million | | | Cost in K' million | | | Cost in K' million | | | Cost in K' million | | |
| | | Budgeted | Released | % | Budgeted | Released | % | Budgeted | Released | % | Budgeted | Released | % |
| Rural Roads | Central | 6 | 1.74 | 29 | 8 | 2.32 | 29 | 9 | 2.61 | 29 | 10 | 2.9 | 29 |
| | Copperbelt | 6 | 1.2 | 20 | 8 | 1.6 | 20 | 9 | 1.8 | 20 | 10 | 2 | 20 |
| | Eastern | 6 | 2.88 | 48 | 8 | 3.84 | 48 | 9 | 4.32 | 48 | 10 | 4.8 | 48 |
| | Luapula | 6 | 2.04 | 34 | 8 | 2.72 | 34 | 9 | 3.06 | 34 | 10 | 3.4 | 34 |
| | Lusaka | 6 | 2.4 | 40 | 8 | 3.2 | 40 | 9 | 3.6 | 40 | 10 | 4 | 40 |
| | Northern | 6 | 1.83 | 30.5 | 8 | 2.44 | 30.5 | 9 | 2.745 | 30.5 | 10 | 3.05 | 30.5 |
| | N/ Western | 6 | 2.34 | 39 | 8 | 3.12 | 39 | 9 | 3.51 | 39 | 10 | 3.9 | 39 |
| | Southern | 6 | 1.62 | 27 | 8 | 2.16 | 27 | 9 | 2.43 | 27 | 10 | 2.7 | 27 |
| | Western | 6 | 1.38 | 23 | 8 | 1.84 | 23 | 9 | 2.07 | 23 | 10 | 2.3 | 23 |

**Source:** Sixth National Development of 2011

**Table 4.21:** Budget performance for the year 2014

| Province Name | Resource Allocation/ Utilization | | | % Release |
|---|---|---|---|---|
| | **Budget** | **Releases** | **Expenditure** | |
| Lusaka | 18,000,000 | 7,180,904 | 7,180,904 | 40 |
| Central | 18,000,000 | 5,300,000 | 5,300,000 | 29 |
| Copperbelt | 18,000,000 | 3,600,000 | 3,600,000 | 20 |
| North Western | 17,808,000 | 7,000,000 | 7,000,000 | 39 |
| Western | 17,000,000 | 4,000,000 | 4,000,000 | 23 |
| Southern | 18,000,000 | 4,800,000 | 4,800,000 | 27 |
| Luapula | 18,700,000 | 6,500,000 | 6,500,000 | 34 |
| Northern | 19,000,000 | 5,500,000 | 5,500,000 | 29 |
| Muchinga | 18,000,000 | 5,800,000 | 5,800,000 | 32 |
| Eastern | 20,800,000 | 10,000,000 | 10,000,000 | 48 |
| **TOTAL** | **183,308,000** | **59,680,904** | **59,680,904** | **32** |

Table 4.22: Key Performance Funding Indicators For 2014

| **Programme** | **Target For 2014 (Km)** | **Achieved For 2014 (Km)** | **Per Cent (%)** |
|---|---|---|---|
| Periodic Maintenance | 389 | 142 | 36 |
| Routine Maintenance | 14, 294 | 5, 352 | 37 |
| Rehabilitation | 826 | 404 | 49 |
| Upgrading | 263 | 184 | 70 |

Source: Road Sector Annual Work Plan 2014

## 4.5 Management

The Rural Road Unit charged with the responsibility of constructing rural roads was established in 2008. Unfortunately this institution was not created out of an Act of Parliament and funding to this institution has been under the Poverty Reduction Paper. At inception, it was envisaged that each province would have 47 employees and 23 pieces of equipment. Each province would have two qualified engineers: one for civil and the other for mechanical and these would be deputized by two each diploma holders. These diploma holders would be supported by certificate holders who in turn would be looking after a pool of grade 12 holders that are trained in various fields. From inception in 2008 until 2016, The Public Service Management Division has failed to fill the vacancies.

Only four provinces have an engineer each. These are Lusaka, Central, Copperbelt and North Western provinces. Luapula, Western, Northern, Muchinga and Eastern provinces are manned by diploma holders whereas Southern province is manned by a certificate holder. Most of these employees were seconded to The Rural Road Unit from the defunct Roads Department. It is these employees that do the planning, implementation and the actual construction of the roads. It is very clear that the provinces are not adequately manned.

## 4.6 Analysis of the results

From the data collected, the following observations can be made about the research objectives;

It is clear from the findings that the planning process is followed adequately. It starts from the National Development Plans to The Transport Sector Plans. These are then incorporated into the Annual programs and Budgets. Local plans are then drawn from them. That's when Project plans are done and then the Detailed plans and finally the Maintenance plans are done. All these plans are governed by a Legal and Regulatory framework.

The Roads in Zambia are properly classified and those providing access to and for local communities are often under the jurisdiction of the local authorities. The government develops a set of design guidelines. These design guidelines include general directions on the geometric features of the roads, such as appropriate dimensions of the road cross – section and curvature, surfacing options, drainage solutions and road reserves.All public expenditure is governed by a comprehensive set of procedures and directives detailing how funds are to be used and accounted for. These procedures include budgeting and accounting procedures as well as detailed regulations on the contracting arrangements.

The planning process forms the basis for all budgeting and resource scheduling required in civil works projects. Roads to be constructed, improved or maintained under a particular programme are not selected in an arbitrary manner. These are done in distinct stages. The initial identification is the first step in the preparation of a list of proposed roads to be improved and maintained. This initial list is in most cases prepared with the involvement of the local communities and it must meet the pre – determined criteria by the central government. This is done in order to qualify or disqualify those roads that meet or don't meet certain criteria, are or aren't technically or economically feasible or are likely or not likely to have the expected impact. Local participation in the ranking of projects for screening is through elected representatives.

A more detailed assessment for supporting investment Cost needs is estimated and socioeconomic data assembled. After the screening and the appraisal stage, roads are selected against the limited resources. The roads are then ranked based on social impact, economic impact, and environmental impact. The road with the best score is then selected. As in all infrastructure works, the three main criteria for finally selecting a rural road are Technical Feasibility, Economic Justification and Social Considerations.

Results from primary data indicate that our rural roads are not constructed according to design standards and specifications. The road standard design is one having a carriageway of 5.5m, gravel coarse width of 5m, side slope of 1.2m with a slope of 1in 4 with the shoulder and a ditch of 1m.  All roads surveyed conformed to the

longitudinal alignment as specified in the design standards of 5.5m carriageway and a gravel coarse of 5m. Shoulders were not to specifications of 1.2m. The shoulders on all roads surveyed were less than the desired 1.2m. Where the ditch was present on the roads, it averaged 0.5m instead of the recommended 1m.

Culverts were missing, inadequate or wrongly constructed. The 300mm culvert ring seems to be the most preferred against the standard 600mm that is easy to clean in case of silting. Observed on some of the roads were wing walls constructed at angles outside the 45° and 75° alignment to the centreline band. Head walls were not constructed to the right height and width, and most culverts did not have ramps to protect the rings and where ramps existed, they were not of the recommended two thirds height. The outfall on most of the culverts was beyond the recommended 20m.

All the roads surveyed had few or no mitre drains at all. Where they existed, they were wrongly constructed and positioned. In some cases, instead of discharging the water from the drains, they were charging the drain. No scour checks were observed on any of the roads surveyed. And no layby was observed either.

Usually funding profiles that are submitted to the treasury are consistent with annual work plans. Poor provision and inadequate funding of road maintenance, poor planning and provision of road infrastructure including the mal – distribution of resources all point to the reasons why our rural roads are in a deplorable state. Also there is severe neglect of rural roads and the road sector is not managed or seen as part of the market economy. Rural roads are regarded as a social service that draws funding from the general revenue and therefore during lean years, they are the first to be cut off.

The analysis on both primary and secondary data with respect to funding on the road network shows that we as a country have been operating at an average of 32% funding for all provinces. This trend has been going on for many years. Also a check at the Ministry of Finance to ascertain when these funding's were released revealed a very disturbing picture. The Ministry of Finance released these moneys towards the end of the year and during the rainy season. This makes the implementation of the

rural road projects difficult, expensive and usually unsupervised resulting in low quality works.

The policy inconsistences with regard to fuel supply and subsidies have also contributed negatively to the rural road construction. Haulage of gravel for instance is very dependent on fuel supply and costing. Quality of the road can be compromised if, for example, there are delays in watering the road during compaction.

It has been noted that the institution charged with the responsibility of constructing rural roads, though established in 2008 was not created out of an Act of Parliament and funding to this institution has been over the years under the Poverty Reduction Paper. At inception, it was envisaged that each province would have had 47 employees and 23 pieces of equipment. Each province would have had two qualified engineers: one for civil and the other for mechanical and these engineers would be deputized by two personnel each with a diploma qualification. These diploma holders would have been supported by certificate holders who in turn would have been looking after a pool of grade 12 holders that were trained in various fields.

Unfortunately until 2016, The Public Service Management Division has failed to fill the vacancies. Only Lusaka, Central, Copperbelt and North Western provinces had an engineer each. Luapula, Western, Northern, Muchinga and Eastern provinces were manned by diploma holders whereas Southern province was manned by a certificate holder. Most of these employees are seconded to The Rural Road Unit from the defunct Roads Department, under the Road Development Agency.

### 4.7 Chapter Summary

The chapter introduced the data analysis and looked at the profile of the population to be sampled. Then the results were analysed. Also the chapter looked at the funding aspect and management of rural roads. The next chapter gives the conclusions and the recommendations

# CHAPTER FIVE - CONCLUSION AND RECOMMENDATIONS

## 5.1 Introduction

The previous chapter gave the analysis and discussion of the findings of the results. This chapter presents the conclusion of the study and makes recommendations on mitigating actions, procedures, and activities. These are aimed at the approving authorities that could help in mitigating the issues pertaining to poor quality rural roads. It is important to bring to the attention of the authorities what can assist in coming up with durable and better quality rural roads.

## 5.2 Conclusions

Various Research organisations like United Kingdom Transport Research Laboratory (TRL), The Council for Scientific and Industrial Research (CSIR), The Norwegian Public Roads Agency (NPRA) and The Swedish National Road Consulting AB (SweRoad) have undertaken research into aspects of rural roads in the SADC region with the aim of reducing costs and increasing the effectiveness of the provision of such roads (Gourley and Greening, 1999; Netterberg and Paige-Green, 1998; Visser and Van Niekerk, 1987).

These researches carried out in the SADC region and in other developing countries have identified many anomalies in our previous understanding and has questioned some of the accepted paradigms associated with the provision of rural roads. Results have shown that such roads can often be provided more cheaply and cost effectively with better quality and reliability and has indicated the need to re-think the whole approach (Paige-Green, 1999; Netterberg, 1993)

In Zambia, grassroots communities have been calling for the prioritization of rural infrastructure development for a long time. From the Poverty hearings of the pilot study of the Grassroots Focus Index, the cry for rural infrastructure is very loud. We as a country lack sufficient and quality rural infrastructure to adequately support smallholder farmers. Having a mere 50 per cent of the country's rural population having access to rural roads is severely inadequate.

It is very important for the country to take note of the findings of this research as these explain the reasons why our rural roads are in a deplorable state

A study that was conducted by an engineer in the ministry of works and supply found that all operators in the Rural Road Unit were former employees of the department of Roads and no one had reached grade 12. All ten provinces had five engineers; two in Lusaka, whereas Central, Northern and North Western had one each. Muchinga, Luapula and Eastern were manned by Diploma holders while Southern was manned by a certificate holder. This issue of human resource is so profound that right from drawing up annual work plans to the actual implementation of the works, it is felt.

During planning at the local level, annual work plans are done by people who are inexperienced and unqualified. The processes of identification, screening, appraisal, ranking and approval are not properly followed and in most cases they are influenced by excessive political pressure without due consideration to the social and economic significance of these rural roads.

The unfortunate result of this is having improperly designed rural roads that substantially hinder and prevent vehicle movement whether seasonally or throughout the year due to deep rutting, soft soils, slippery surfaces, poor water crossing, etc. Roads missing basic infrastructure such as culverts, bridges or poor surfaces is a common feature of most rural roads.

The specifications and standards from literature need, and must be clear and understandable, appropriate to the local road environment, capable of being applied by local contractors, aimed at producing a technically sustainable rural road, cover all relevant technical and cost issues and must be compatible with the overall regulations.

From the findings of the research, it is clear that we have a problem in adhering to the specifications and the implementation of the plans. All the roads surveyed demonstrated that quality issues were not taken seriously. The 14m bush clearing width is not adhered to. This is supposed to be the first item to be carried out on a rural road construction. Neither is the 12m tree and stump width adhered to. Also

from the quality of the culverts observed it is clear that not only didn't the vertical alignment take precedence over the longitudinal alignment of the road but also the culverts weren't constructed according to specifications.

Observed were wrong angles of wing walls that were outside the recommended 45° to 75°, wrong height of head walls, missing guard posts, excessive culvert outfall length (beyond the recommended 20m or less), silting of the culvert, silting of the culvert outfall, erosion of the culvert outfall and most of these culverts had 300mm, instead of the 600mm, bore rings that are very difficult to clean. Also, the over-fill in most cases was less than two thirds of the bore diameter. The Mitre drains were mainly inadequate, missing and not constructed according to specifications. The angles were wrong and in some cases, instead of the mitre drain discharging water away from the drainage, they actually fedback water to the drainage system thereby compromising the integrity of the road. Almost all the roads observed had no scour checks and the effect of fast flowing water was very evident on the roads: gulleys.

The procurement processes are too long such that by the time they are done, the factors on the ground would have changed resulting in incorrect works being done.

The problem of late and inadequate release of the funds seriously contributes to the poor quality of the rural roads. Despite overwhelming evidence in support of rural infrastructure as a key lever for the country's development agenda, investment in the sector has rarely been an integral part of the country's development agenda despite it being one of the pillars of the Comprehensive African Agricultural Development Program. The central government has failed to adequately allocate resources to reflect its genuine commitment. This is clearly demonstrated by the less than 50% funding that the then Rural Road Unit was receiving annually. Reasons given for this are that it is difficult to mobilise resources, private investors have little incentive to invest in rural roads and that donors have shown little inclination to bridge the financing gap. It is imperative that the government provides not only resources but leadership and commitment to catalyse the agricultural revolution that can reduce poverty and increase food security.

The RDA Annual Report of 2014 highlights the following as challenges generally encountered when working on rural roads: scarcity of construction materials on

certain projects resulting in increased unit costs as a result of long haulage distances, limited contractor and consultancy capacity to execute works at the desired rate and quality and the encroachment on the road reserves by individuals and business houses.

As a consequence of the above, most works done are purely holding works. No feasibility studies are ever done and no tests are done or instruments used. The other limitation was the securing of appointments of officials from the government and the non-keeping of time. The available data on rural road designs is scanty and quite old.

The sparse densities and low level of income in rural areas imply a heavier burden per capita. The overall weakness of rural infrastructure management capabilities severely constrains resource mobilization and maintenance. Hence, while Zambia is underequipped in relation to its potential it is overburdened by the little infrastructure that it possesses. Coupled to this is the inability of poor councils to mobilize resources.

Central government functions should be limited to coordination, guidance and oversight. Also, it must advice on policy, formulate guidelines and provide technical support in planning and contract management thereby reducing bureaucracy particularly in making payments to contractors.

Observed from the research is that there seems not to be a clear definition of roles and responsibility on who is supposed to do what. There is a serious shortage of qualified personnel as seen from the structure of the Rural Road Unit. The few that are there are overworked and underpaid. This leads to weak and irregular government supervision that compromises on quality.

## 5.3 Recommendations

The potential contribution of rural roads to the socio – economic development of Zambia cannot be overemphasised. The impact of quality rural road infrastructure could be far – reaching, going beyond poverty reduction – a goal which many leaders now view as unambitious – to sustain economic growth and structural transformation. Zambia’s large and sparsely populated landmass underscores the

relevance and important role of rural roads in the successful implementation of most, if not all, development policies. In essence, poor quality rural road systems negatively affect other sectors of the economy.

The Public Service Management Division must, as a matter of urgency, recruit qualified personnel to fill up the vacant positions. The local councils must be encouraged to employ competent people who will help, especially during the planning process, to come with detailed plans, project plans and local plans. These when forwarded to Central government will help with the formulation Annual Programmes and Budgets, Transport Sector Plans and finally National Plans.

This will assist in limiting Central Government's role to coordination, guidance and oversight, policy, formulating guidelines and providing technical support in planning and contract management thereby reducing bureaucracy particularly in making payments to contractors.

Design standards should be based on reliability and durability not just concentrating on accessibility. We need rural roads that are adequate, cost effective and sustainable. Standards such as economic road access should place importance on essential access, spot surface improvement in critical seasons, on surface drainage and essential structures rather than on geometric characteristics determined by design speed. Attention must also be paid to topography.

For the effective and efficient management of these roads, steady funding with political and economic stability to establish a climate of confidence and cooperation is needed. This must be based on a predictable workload and on timely payments for works done. The bidding procedures must be adaptable and the contract documentation must suit the nature of the works. There must be transparency and accountability in the bidding process. There must be incentives for good quality works and sanctions for poor quality works and the monitoring must be continuous. The procurement processes should be shortened as long processes lead to incorrect works being done as factors could have changed.

More and better trained personnel are needed both at supervisory and management level.

Alternative technology should be explored such as the use of environmentally friendly enzymes to minimise the use of aggregates in pavements. Some of the enzymes that can be used are Fujibeton, Terrazyme and Renolith. Also Fly ash, Steel and Copper slag, Rich husk ash and Lime sludge can be used.

## 5.4 Chapter Summary

The chapter presents the conclusions drawn and makes the recommendations to be taken in order to have quality rural roads

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# APPENDICES

## APPENDIX 1

## COVER LETTER TO THE CHECK LIST

School of Engineering,
Dept. of Civil & Environmental Engineering,
P. O. Box 32379, Lusaka.
Cell: +260977870670, *Email:ephraimsakala@yahoo.co.uk*

12th February, 2015

Dear Sir/Madam,

CHECK LIST ON THE ASSESSMENT OF THE QUALITY OF RURAL ROADS IN ZAMBIA

I am pursuing a Master of Engineering Degree in Project Management [MEng PM] at the University of Zambia. The research topic is *An assessment of the quality of rural roads in Zambia*. The study seeks to identity the reasons why rural roads are in a bad state despite the government spending colossal sums of money on them each year.

Accompanying this letter is a check list that will have to be filled in by the research. It will take a few minutes of your time to complete it. The check list has only one Section; kindly authorise to conduct the research in your area. Be assured that all the information gathered will be kept strictly confidential and will only be used for the purpose of this research. No names of individuals shall be mentioned without their prior permission.

Should there be any queries, please do not hesitate to get in touch with the undersigned or the Research Supervisor(s) using the details provided below. Your assistance and cooperation will be highly appreciated.

Thank you in advance for your time and kind cooperation.

Yours Faithfully,

EPHRAIM SAKALA (Master of Engineering Student)

Supervisor: Dr. Erastus Mwanaumo – erastus.mwanaumo@unza.zm
Mobile- 0969561353

**APPENDIX 2**

**LABOUR INPUT ESTIMATE**

ROAD No. / NAME: .../…..…… CONTRACT No.: …….

DISTRICT: ……..…….. COMPILED BY: ...……

| Item No. | Description | | Unit | Quantity | Productivity | Total Est. W/day |
|---|---|---|---|---|---|---|
| 1.1 | Setting out Centre lines | | M | 5,000 | 90 | 56 |
| 1.2 | Vegetation Control | | $M^2$ | 10,800 | 300 | 36 |
| 1.3 | Grubbing | | $M^3$ | 8,800 | 100 | 88 |
| 1.4 | Tree and Stump Removal | | NO. | 20 | 0.2 | 100 |
| 1.5 | Tree and Stump Removal | | $M^2$ | 1,200 | 200 | 6 |
| 2.1 | Setting profiles & Cuttting slots | | M | 5,000 | 40 | 125 |
| 2.3 | Ditching and Spreading | | $M^3$ | 1,800 | 2.25 | 800 |
| 2.4 | Sloping | | $M^3$ | 1,800 | 2.5 | 720 |
| 2.5 | Camber formation | | $M^2$ | 27,500 | 125 | 220 |
| 2.9 | Compaction of camber | | $M^2$ | 27,500 | 302 | 92 |
| 3.1 | Excavation of Culverts trench | | $M^3$ | 80 | 2 | 40 |
| 3.2 | Excavation of Discharge Drain | | $M^3$ | 300 | 2.5 | 120 |
| 3.3 | Supply of 600mm dia. Culvert rings | | M | 28 | 1.45 | 20 |
| 3.4 | Concrete Works | | $M^3$ | 28 | 0.47 | 13 |
| 3.6 | Installation of 600mm Culvert rings | | M | 6 | 0.56 | 50 |
| 3.8 | Masonry Works | | $M^3$ | 14 | 0.31 | 46 |
| 4.1 | Quarry Clearance | | $M^2$ | 200 | 100 | 2 |
| 4.3 | Over burden Removal | | $M^3$ | 60 | 1.8 | 34 |
| 4.4 | Excavation & Stocking of Gravel | | $M^3$ | 2,000 | 2.25 | 889 |
| 4.5 | Loading of gravel | | $M^3$ | 2,500 | 7.5 | 334 |
| 4.6 | Hauling of Gravel (Av. HD 0-1km) | | $M^3$ * KM | 1,250 | | |
| 4.7 | Offloading of Gravel | | $M^3$ | 2,500 | 15 | 167 |
| 4.8 | Spreading of Gravel | | $M^3$ | 2,500 | 15 | 167 |
| 4.9 | Compaction of Gravel | | $M^3$ | 2,500 | 39.5 | 64 |
| | | | | | | |
| | | | | | | |
| **TOTAL WORKER DAYS** | | | | | | 4188 |
| **TOTAL BILL No.** | | | | | | |

# APPENDIX 3

## PRODUCTION LABOUR FORCE

| PERSONNEL | SKILL ALLOWANCE | GANG SIZE | DAY/ WEEK | RATE/ DAY | WEEKLY AMOUNT (K) |
|---|---|---|---|---|---|
| | | | | | |
| Skilled | 50% | 4 | 6 | K45 | 1,080 |
| | | | | | |
| Unskilled | | 43 | 6 | K30 | 7,740 |
| | | | | | |
| **Total Productive Workers** | | | | | **8,820** |

## APPENDIX 4

## NON PRODUCTIVE LABOUR FORCE

| | | | | | |
|---|---|---|---|---|---|
| **Gang Leader** | 50% | 2 | 6 | 45 | 540 |
| | | | | | |
| **Store Keeper** | 50% | 1 | 7 | 45 | 315 |
| | | | | | |
| **Watchman (day)** | 0 | 1 | 7 | 30 | 210 |
| | | | | | |
| **Watchman (Night)** | 0 | 2 | 7 | 30 | 420 |
| | | | | | |
| **Water Supply** | 0 | 2 | 6 | 30 | 360 |
| | | | | | |
| **Tools Repair** | 0 | 1 | 6 | 30 | 180 |
| | | | | | |
| **Others** | 0 | 1 | 6 | 30 | 180 |
| | | | | | |
| **Total Non Productive Workers** | | **10** | **Total Amount** | | **2205** |

| **PERMANENT STAFF** | **MONTHLY SALARY (K)** | **ADD 30% SUBSISTENCE** | **WEEKLY PAY (K)** |
|---|---|---|---|
| **Foreman 200%** | 2,700 | 810 | 877.5 |
| **Assistant Foremen** | | | |

## APPENDIX 5

## COSTS AND PROFITS

| Item No. | Description | Costs (ZK) | | Profit (ZK) | Total Amount (ZK) |
|---|---|---|---|---|---|
| | | Direct Costs | Indirect Costs 19.78% of Direct Costs | 12% of Direct Costs | |
| 1.1 | Setting out centre line | 1949.80 | 385.67 | 233.98 | 2569.45 |
| 1.2 | Vegetation control | 1253.80 | 248.00 | 150.46 | 1652.26 |
| 1.3 | Grubbing | 3,062.40 | 605.74 | 367.49 | 4035.63 |
| 1.4 | Tree and Stump removal | 3,480 | 688.34 | 417.60 | 4585.94 |
| 1.5 | Tree and Stump removal | 208.80 | 41.30 | 25.056 | 275.16 |
| 2.1 | Setting profiles and cutting slots for reshaping | 4,350 | 860.43 | 522.00 | 5732.43 |
| 2.3 | Ditching and spreading | 27,840 | 5506.75 | 3340.80 | 36687.55 |
| 2.4 | Sloping | 25,056 | 4956.08 | 3006.72 | 33018.80 |
| 2.5 | Camber formation | 7,656 | 1514.36 | 918.72 | 10089.08 |
| 2.9 | Compaction of camber | 172,860.18 | 34191.74 | 20743.22 | 227795.15 |
| 3.1 | Excavation of Culvert trench | 1,392 | 275.34 | 167.04 | 1834.38 |
| 3.2 | Excavation of discharge drain | 4,176 | 826.01 | 501.12 | 5503.13 |
| 3.3 | Supply of 600mm dia. Culvert rings | 9,944.67 | 1967.06 | 1193.36 | 13105.09 |
| 3.4 | Concrete Works | 7,589.95 | 1501.29 | 910.79 | 10002.04 |
| 3.6 | Installation of 600mm Culvert rings | 1,740 | 344.17 | 208.80 | 2292.97 |
| 3.8 | Masonry Works | 9,048.96 | 1789.88 | 1085.88 | 11924.72 |
| 4.1 | Quarry clearance | 69.60 | 13.77 | 8.35 | 91.72 |
| 4.3 | Overburden removal | 1,183.20 | 234.04 | 141.98 | 1559.22 |
| 4.4 | Excavation and stocking of gravel | 30,937.20 | 6119.38 | 3712.46 | 40769.04 |
| 4.5 | Loading of gravel | 11,623.20 | 2299.07 | 1394.78 | 15317.05 |
| 4.6 | Haulage of gravel (average haul distance 0-1km) | 74,775.92 | 14790.68 | 8973.11 | 98539.71 |
| 4.7 | Offloading of gravel | 5,811.60 | 1149.53 | 697.39 | 7658.53 |
| 4.8 | Spreading of gravel | 5,811.60 | 1149.53 | 697.39 | 7658.53 |
| 4.9 | Compaction of gravel | 62,397.44 | 12342.21 | 7487.69 | 82227.35 |
| | **TOTAL AMOUNT** | **474,218** | **93800.38** | **56906.20** | **624924.90** |

## APPENDIX 6

### PRELIMINARY AND GENERAL ITEMS

| Item No. | Description | Unit | Quantity | Rate (ZK) | Amount (ZK) |
|---|---|---|---|---|---|
| 1 | Site Camp Facilities | | | | Inclusive |
| 2 | Land compensation for site camp | | | | Inclusive |
| 3 | Quarry fees or other royalties | | | | Inclusive |
| 4 | Insurance | | | | Inclusive |
| 5 | Bonds | | | | Inclusive |
| 6 | Tendering costs | | | | Inclusive |
| 7 | Supervision and transport | | | | Inclusive |
| 8 | Support staff | | | | Inclusive |
| 9 | Transport for workers | | | | Inclusive |
| 10 | Tests and samples | | | | Inclusive |
| 11 | Site meetings | | | | Inclusive |
| 12 | Notice/ bill boards | | | | Inclusive |
| 13 | Temporary offices | | | | Inclusive |
| 14 | Water | | | | Inclusive |
| 15 | Lighting and power | | | | Inclusive |
| 16 | Safety, health and welfare | | | | Inclusive |
| 17 | Temporary roads | | | | Inclusive |
| 18 | Mobilization | | | | Inclusive |
| 19 | Demobilization | | | | Inclusive |
| **TOTAL AMOUNT (40%)** | | | | | **k249,969.96** |

## APPENDIX 7

## GRAND SUMMARY

| BILL NO. | DESCRIPTION | AMOUNT (ZK) |
|---|---|---|
| | | |
| 1 | Setting out and clearance works | |
| | | |
| 2 | Earthworks | |
| | | 624,861.32 |
| 3 | Drainage works | |
| | | |
| 4 | Gravelling | |
| | | |
| 5 | Preliminary and General items -40% | 249,944.53 |
| | | |
| | Sub-total 1 | 874,805.85 |
| | | |
| | Add 10% for contingencies to be expended only | 87480.58 |
| | with the express approval from the Engineer | |
| | | |
| | Sub-total 2 | 962,286.43 |
| | | |
| | Add 16% for VAT | 153965.83 |
| | | |
| | **Total Carried to form of tender** | **1,116,252.26** |