

Maintenance Strategies For The Highway In Tanzania

Julius maige¹ and Deepak juneja²

¹M.Tech scholar, Chandigarh University Juliusmaige79@gmail.com

²Assistant Professor, Chandigarh University deepakkumar.civil@cumail.in

Abstract: Road Infrastructure is an asset that contributes significant to the economic growth of the nation and reduction in poverty. However, like many other assets, roads do deteriorate with time and thus need to be maintained. Roads deteriorate due to the effect of environment and traffic loading.

Road maintenance requires a huge amount of resources and thus imposes a major challenge to many low income developing countries where there is always a competing demand for very limited resources available. An economic evaluation of different road investment strategies becomes therefore necessary in order to have scientific criteria for the most economic utilization of the little resources available.

In this research, a section of the TANZAM Highway in Tanzania (Igawa – Mbeya Section 115 Km) was selected for case study. Relevant information about road maintenance in Tanzania was gathered. A road condition survey was done on the case road to identify the existing typical pavement defects and their probable causes. The HDM-4 model was used to predict the life cycle pavement deterioration and to investigate the optimum maintenance strategies from an economic point of view.

The study revealed that road maintenance financing is one of the biggest challenge facing the government. The visual road condition survey revealed that many of the typical defects observed were probably caused by poor construction quality and vehicles overloading. The section Igawa – Chimala was observed to be in comparative poor condition. Reasonable lifecycle pavement deterioration patterns were obtained by the use of HDM-4 model. However the model has not yet calibrated and adapted for the local conditions thus the output results must be treated with great care.

1 Introduction

According to Ahmad (2002) efficient road transport system is seen by most countries as an essential pre-condition for general economic development. Investment in roads is closely related to reduction in poverty, increase in trade and general economic growth. Most roads in developing countries are in pathetic state, poor roads conditions is one of the main causes of Africa's low competitiveness, Africa's high transport costs are major burden on competitiveness and growth.

According to Limao and venables (1999) weak infrastructure accounts for most of Africa's poor trade's performance.

It is evident that Africa needs good roads and already pays for good roads. If Africa's does not spend the requirement maintenance costs for good roads, it is then paying for them through higher vehicles operating costs, travel time, accident costs as well as through opportunity costs for lower economic growth World bank (2020), Road maintenance reduces the rate of deterioration, its lower the cost of operating vehicles on the roads by improving the running surface and it keeps the road open throughout the year.

In developing countries, there is a competing demand for very limited resources available. The low and diminishing level of funds available for roads maintenance in the most developing countries has resulted in an alarming rate of deterioration of the roads network as a whole. With explained benefits obtained for having good roads, it obvious that the roads sector shall receive the priority attention that it deserves and thus, timely maintenance interventions and appropriate pavement rehabilitation is very necessary.

It is known that every one – dollar (1.0 USD) of essential maintenance postponed in Africa's increases the cost of operating a vehicle in the current period by more than three dollars (3.0 USD), the case of doing maintenance appropriate and timely is above possible debate.

2 TANZANIA AS A CASE STUDY

According to census (2012) Tanzania is the one of developing country in Africa, in this chapter the discussion on the general information about Tanzania will be briefly highlighted.

Tanzania vision 2025 with respect to the road sector they have the plan to undertake an economic transformation that will enable it to move from the category of least developed countries to medium economic but due to fast economic growth in Tanzania the country reach medium economic in 2020. In the process the transport sector is expected to have an extensive road network that is well maintained, serving all parts of the country as well as neighboring countries.

Since 1998 the Tanzania road sector has been undergoing far – reaching reforms. The establishment of the Road Fund Board (RFB) in 1998, a dedicated Road Fund to finance road maintenance and semi-autonomous agency, Tanzania National Roads Agency (TANROADS) in 2000 to manage the road network is part of the ongoing road sector reform process.

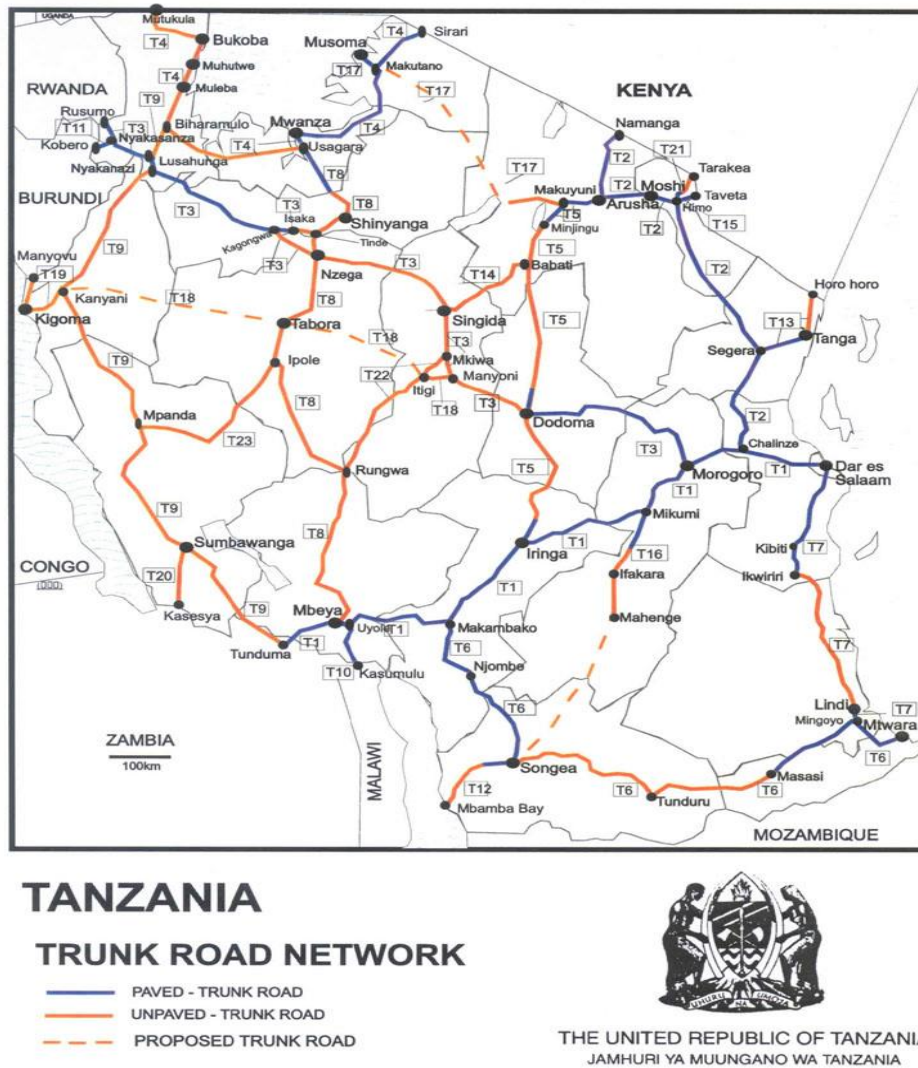


Figure 1 shows roads network in Tanzania Source Road Fund Board Report 2020

3 HDM-4

Is a computer software for Highway Development and Maintenance Management System, it is decision making tool for checking the engineering and economic viability of the investments in road projects. There are four main areas of application.

- Strategic Planning
- Roadwork Programming
- Project Analysis
- Research and Policy study

➤ **Strategy Analysis**

The concept of strategic planning of medium to long term road expenditures requires that a road organization should consider the requirements of its entire road network asset. Thus, strategy analysis deals with the entire network or sub-networks managed by TANROADS

Strategy analysis may be used to analyze a chosen network as a whole, to prepare medium to long term planning estimates of expenditure needs for road development and conservation under different budget scenarios.

➤ **Programme Analysis**

This deals primarily with the prioritization of a defined long list of candidate's road projects into a one year or multi-year work programme under defined budget constraints. The candidate projects have been identified, the HDM-4 programme analysis application can then be used to compare the life cycle costs predicted under the existing regime of pavement management (without project case) against the life cycle costs predicted for the periodic maintenance, road improvement or development alternative (with project case).

➤ **Project Analysis**

Project analysis concerns the evaluation of one or more road projects or investment options. The application analysis a road link or section with user selected treatments, with associated costs and benefits, projected annually over the analysis period. Economic indicators are determined for different investment options.

Project analysis may be used to estimate the economic or engineering viability of road investment projects.

➤ **Research and Policy studies**

HDM-4 can be used to conduct a number of road sector policy studies including:

- Funding policies for competing need eg feeder versus main roads
- Impacts of road transport policy changes on energy consumption
- Impact of axle load limits
- Pavement maintenance and rehabilitation standards

4 Results

The analysis results have shown that the cement bound subbase course layer must have been failed completely in the section of Chimala - Igulusi and Mswis – Mbeya which were observed. The analysis showed that the failure must have occurred when the bound base reached the equivalent granular base phase. However, the visual road condition survey observations revealed several asphalt damages that include fatigue cracks. The results have showed also that the asphalt layer for section Mswisi – Mbeya must have been degraded. This is also is contrary to what has been observed during the condition survey. These mismatches are believed to be caused by the application of the method not developed for the Tanzania conditions. The SAMDM transfer functions have been developed for use in South Africa where the conditions are quite different from those in Tanzania. The analytical calculations have also assumed materials characteristics which are believed to be different from the characteristics of the materials applied, thus causing this contrary.

35 mm Virgin AC wearing Course	
65mm New AC Binder course with 30% to 50% asphalt recycling	
50mm AC Bituminous surface	 new 150 mm natural sand stabilized with cement
	Milled Existing 50mm AC for recycling
150 mm Crushed aggregates base Course CRR	➡ 150 mm existing CRR Base course with cement

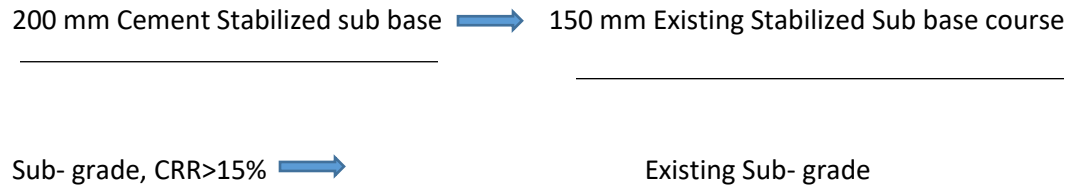


Figure 1.8: Pavement structure before (left) and after (right) the reconstruction along Igawa – Mbeya

5 Conclusion

It has been shown in this chapter that Tanzania road sector has been undergoing far reaching reforms since 1998. Three important organizations, Road Fund Board (RFB), Tanroads and Tarura have been established since then. This is a positive move towards the better road maintenance management in the country.

Only 30% of entire road network of around 90,525 km is paved which include Trunk and Regional roads, this implies that much of the work is still to be done. As explained in the background information of this report, poor road condition is major cause of Africa's low competitiveness. In order for the country to achieve general economic development, it is a must to invest in road transport system.

It has been shown in this chapter also that the RFB revenues have comparatively increased over the last two years. The increase has been explained by the decision of the government to allow all vehicles to stop paying motor vehicle license and to increase the fuel levy by 100%. Although this results in increase in revenues for the road maintenance, however this has an impact on the increase in the transport costs. High transport costs have been identified by several researchers to be a major burden on competitiveness and growth.

The observations from the visual road condition survey revealed that the section Igawa – Mbeya is comparatively in poor condition. The typical defects observed in this section are probably caused by aging, the design period has been completed as I explained the last overlay was done on 1990, also an increase of industrialization causes the increase of super single type of vehicles which increase high wheel pressure on the moving load.

6 Recommendations

Base on the conclusions made on section 5 above, the following are the recommendations:

➤ Road Maintenance Financing

It is obvious that road infrastructure is a key to the economic growth and poverty reduction. To deal with the challenges regarding the prevailing poor road condition and the prevailing road maintenance financing gap, it is recommended that the government shall continue to prioritize the road sector and continue to invest in road maintenance to close the gap. Apart from improving the government budgetary allocation which depend heavily on fuel levy and solicit funds from donor agencies, the possibility of involving the private sector in road maintenance through the Public Private Partnership (PPP) arrangements shall be taken into consideration. However, research on the suitable PPP model for Tanzania conditions has to be done before

➤ **Poor Construction quality**

This is another big challenge ahead of the government and road authorities. Use of scarce maintenance funds will not be efficient if poor construction quality prevail. It is recommended therefore that:

- The government shall continue to invest in capacity building training programmes for local contractors and construction industry personnel through relevant institutions. Low contractors capacity and low supervision capacity have large contribution to the poor construction quality.
- Inadequacy of essential plants and equipment's for road works also play a role on poor construction quality. The government shall make conducive environment for investors to invest in plants and equipment's for road works.
- Awarding contractors based on the lowest priced tender and not the lowest evaluated tender contributes also to the poor quality of work. In many cases the lowest priced tenderer will temper with the quality of works to avoid the loss from the project. Adoption of long-term performance based road management and maintenance contracts is preferred option. However, the typical contracts are relevant only when there is a capacity within the contractors and the policy and legal framework are put in place.
- The government shall continue to conduct technical auditing of construction projects and implement the auditing recommendations.

➤ **Vehicle overloading**

Vehicle overloading accelerates the destruction of the road infrastructure. This was identified to be also one of the biggest challenges the road authorities have recommended in this study that:

- Axle load control program shall be enhanced and routine axle loads measurements in the road network shall be done. Emphasize shall also be given to the standard quality of vehicles operating in the road network.
- Because the rate of vehicle overloading has not significantly slow down despite the amendments of several regulations. A study has to be done to clearly identify what exactly is behind this problem. If the problem is identified difficulties in enforcements, finance or corruption, then the relevant authorities shall play their role to combat the problem.

➤ **Conflict of Interest**

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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