

THE ESTIMATION OF THE IMPACT OF RURAL ROAD INVESTMENTS ON SOCIO-ECONOMIC DEVELOPMENT

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ABSTRACT

Socio-economic development and subsequent economic growth on the African continent is hampered by several limiting factors, including the lack of adequate roads infrastructure. Investment in transport infrastructure in Africa plays a significant role in stimulating development.

Rural roads infrastructure in Africa is a specific area of concern, as the development of such infrastructure has been neglected to a large extent in the past, thereby imposing significant limitations on growth and development of rural communities. An increased interest in rural roads investment potential has developed in recent years. This is mainly due to the need for development of rural as well as the positive impact that road investment could generate on rural communities, should they have an adequate support roads infrastructure network that is sustained over the long term.

It is however a complex task to establish the impact of especially rural road investments, as the benefits received through this investment are difficult to quantify. The impact of road investments on socio-economic development and economic growth is also an important indicator for the justification of the considerable costs involved.

The aim of this paper is to discuss the impact of rural road investment on socio-economic development. The paper also indicates the benefits of rural road investments as well as the type of mechanisms used in practice to estimate its impact.

1. INTRODUCTION

Rural road investment is one of the main priorities of Governments in Africa as a mechanism towards reducing poverty. It is also an important aspect considered by the development community in the poverty alleviation process and the provision of more equitable opportunities for rural citizens.

Currently several factors, including the lack of adequate road infrastructure, are hampering socio-economic development and subsequent economic growth on the African continent. Against this background it is appropriate to state that investment in rural transport infrastructure in Africa plays a significant role in socio-economic development and economic growth of the continent.

However, to be able to state that investment in rural transport infrastructure contributes to socio-economic development and economic growth, methodologies are required to estimate the extent of the impact of such investments on socio-economic development and economic growth. As this is not always an easy task, the main objective of this paper is to review the available methodologies for estimating to what extent investment in rural roads contributes to socio-economic development, and ultimately economic growth and development through poverty alleviation.

This paper firstly provides a brief introduction to the relationship between poverty alleviation, road investment and economic growth in general, road investment in Africa and constraints of inadequate road investment. Secondly, the paper focus on the typical available methods used for the estimation of the impact of rural road investment on socio-economic development as well as the benefits of rural road investments, through a brief review of some case studies in this regard.

The paper lastly reaches conclusions with respect to the impact of rural road investments on socio-economic development.

2. ROAD INVESTMENT, RURAL TRANSPORT, POVERTY ALLEVIATION AND ECONOMIC GROWTH

Road Investment

Roads are the primary mode of transport in Africa for both freight and passengers. In the Southern Africa Development Community [SADC] region road transport carries over 80% of the region's goods and services [Pinard 2004].

However, the road network in Africa is characterized by several constraints that limit economic growth and development within African countries. Work related to NEPAD [Food & Agriculture Organization (FAO) of the United Nations 2002] indicates that apart from North Africa, Africa's rural infrastructure is generally inadequate and underdeveloped, with the lowest density of paved roads of any of the regions in the rest of the world. For example, there are an estimated 1.8 million km of roads in Sub-Saharan Africa, of which only 284 000 km (approximately 16 %) are paved.

One of the major constraints is the availability of sufficient funds. This results in lack of capital funds to develop and expand the road network and also lack of funds for routine and periodic maintenance of existing roads. External investment in economic infrastructure¹ from 1990-1996 for Sub-Saharan Africa was in the region of US\$26.7 billion, compared to US\$ 41.4 billion for Latin America and the Caribbean and US\$ 101.9 for Asia [Food & Agriculture Organization (FAO) of the United Nations 2002].

Based on the above it is evident that the financing needs with respect to road network development in Africa is quite substantial. The challenge therefore first of all lies in the determination of road financing needs, through the execution of an accurate assessment of the nature and extent of a country's road network, i.e. the road asset value and road network condition, and secondly in the identification of financing sources and accordingly to attract sound and sustainable road investment.

Inadequate road investment results in road networks not being able to be developed and expanded and existing roads not being maintained. The consequence is deterioration of the road network that not only limits accessibility, mobility and regional connectivity of a country, but also results in increased production and transport costs. Deterioration of a road network therefore causes significant ripple effects, ultimately creating a negative impact on the overall macro-economy, and subsequently impeding on poverty alleviation, socio-economic development, and overall macro-economic growth and development. To avoid this, continuous road investment should form the basis of any country's actions in place to address road infrastructure deterioration, development and maintenance.

As an adequate road transport infrastructure network is an essential component for economic growth and development, continuous road investment is just as essential for the development and maintenance of the road network of a country. Frequent and continuous investment in transport infrastructure is required in all modes of transport to ensure an adequate transport infrastructure network that supports economic growth and development and subsequently contributes to poverty alleviation, thereby increasing the day-to-day living standard of communities.

Rural Transport

Rural transport depends on appropriate infrastructure, where rural infrastructure consists mainly of rural roads, tracks, trails and footpaths. These may vary in quality, depending on weather, season, construction and maintenance. As rural households, and in particular women, spend a large amount of time and effort on transport activities to fulfill their basic needs, they are very often severely hampered by the lack of an adequate rural roads network. As a result of this significant limitations of growth and development of rural communities have been experienced in the past, and are also being experienced today. Poverty is very often far worse in rural areas than in urban centers, as a result of lack of integration with urban centers due to lack of adequate accessibility and mobility, and local roads and tracks are often impassable, thereby proving it very difficult and in some cases nearly impossible for rural families to have access to the local rural economy.

¹ Include transport, communications, energy, water and sanitation.

Because rural communities could potentially play a considerable role in the economic growth and development of a country, and also for purposes of own socio-economic growth and development, it is important that investment in rural roads be supported to provide sustainable rural roads infrastructure network over the long term.

Poverty Alleviation

Poverty alleviation is one of the major challenges of countries on the African continent. The World Bank states that in various studies evidence has been provided that there is a definitive link between areas with no or insufficient accessibility and poverty, indicating that transport infrastructure is an essential component of sustained poverty alleviation [World Bank 2001].

Road infrastructure provides accessibility and mobility, leading in turn to increased transport operations, economic activity, subsequent economic growth and ultimately a healthy and sound economy. An adequate road infrastructure network also provides an advantage to a country in terms of improved regional integration, which helps to promote regional and international trade and significantly enhances the economic growth and development of a country and consequently alleviates poverty.

Lack of adequate road infrastructure, especially in rural areas, results in significant limitations for communities. These limitations occur in terms of access to socio-economic and cultural centers such as schools, clinics, markets and other business centers. Limited access to schools hamper educational access for learners, lack of access to clinics hamper health development and limited access and mobility to markets and other business centers places limits on trade opportunities, and subsequently also limits the potential opportunity for earning an income and a subsequent improvement in the day-to-day living standard. The result is a poor socio-economic development standard.

Economic Growth

From the afore-mentioned it is evident that economic growth and development in any country can be linked to the road network of a country as transport improvements stimulate economic development. The existence of an adequate and efficient road infrastructure network is crucial and a prerequisite for the provision of accessibility and mobility to the citizens of a country. Rural roads infrastructure is essential and a prerequisite for economic growth and development in Africa.

3. ESTIMATION OF THE IMPACT OF RURAL ROAD INVESTMENT ON SOCIO-ECONOMIC DEVELOPMENT

To estimate the impact of road investments is a complex task, as all rural road investment benefits to rural communities cannot be measured in monetary terms. This impact of road investments on socio-economic development and economic growth is therefore an important indicator for the justification of the considerable costs involved in road infrastructure investment.

3.1 Estimated Impact of Rural Roads Investments in Non-Quantifiable Terms

Socio-economic aspects are a significant part of overall economic and human development. Rural roads play a major role in facilitating and enabling access to socio-economic centers in rural areas and ultimately contribute to achieving equity in a country.

Several studies have been carried out over time to estimate the impact of rural roads investments on socio-economic development. Although many studies in the past focussed on the direct impact, through the application of relevant software tools, the estimation of the indirect impact on socio-economic development is becoming more and more prevalent.

Since measuring social benefits is difficult, this only needs to be done if transport cost savings and time savings approach does not provide enough justification in terms of the economic rate of return [ERR] estimates [World Bank 2000]. In most cases, the ERR estimates for rural low volumes roads will not be able to justify investments.

A socio-economic impact assessment was recently carried out regarding feeder road improvements in the Copperbelt of Zambia [Africon 2004]. The assessment focused on the current situation in the Copperbelt Province and the project areas, and investigated the impact that improvements to the feeder road network could have on the socio-economics. The socio-economic assessment also focused on labour-based construction and maintenance of the feeder road improvements, with the view on especially employing people living in the catchment areas.

The study indicated that economic activities involve self employment among both men and women, and constitute a wide range of economic activities such as trading, logging, saw milling, carpentry, wood fuel selling, vending, beer brewing, baking, sewing, knitting and vending in makeshift markets. Agriculture is seen as an alternative economic activity to mining, for economic growth. To enhance agricultural production, communities have also been encouraged to form co-operatives. The study indicated that many individual farmers organize their own transport to market places in the urban centers due to a lack of a mechanism such as an agricultural marketing board to coordinate collection and transportation of agricultural produce to the markets. Subsistence farmers usually transport their produce on bicycles. As they are not able to transport much on a bicycle, subsistence farmers are not able to make much profit on their produce. Areas without feeder roads or with poorly maintained roads and bridges make it difficult for farmers to transport their agricultural produce. Inability to take the produce to the market often leads to establishing markets by the road sides. From the study it was evident that transport plays a significant role in the daily lives of the communities and that they will benefit from the improvement of the feeder road network.

Parallel work [World Bank 2001] indicated that a significant improvement in socio-economic living conditions was estimated with rural roads investment. The estimated benefits included the following:

- improved accessibility to social infrastructure [schools and health centers], increased opportunities to access education and health facilities and improved social interaction and mobility, which are important for social and economic development;
- improved access to markets by reducing transport costs;
- improvement of the marketability of perishable goods through timely and cheaper transport that will provide a direct incentive for more market-oriented agriculture, with more profitable cash crops, an increase in rural income and also additional employment opportunities.

Hine indicate that in the past few years there has been a need to formerly introduce social benefits directly into a cost benefit framework for planning rural roads [Hine 2003]. Hine indicated that in the case of the Ghana Feeder Road Prioritization procedure social access benefits were perceived to be a function of population and the predicted change in unit transport costs. Under the prioritization procedure social access benefits were calculated from the reduced transport costs of every person in the area of influence of the road making five return trips per year of a given length. The implication is that the greater the change in unit transport costs and the larger the population affected, the greater the rural access benefits. These benefits were then added to total benefits within the prioritization procedure.

A recent study [Bryceson 2006] investigated how effective road investment is in addressing mobility and social service accessibility in rural areas by using comparative data from Ethiopia, Zambia and Vietnam. It also investigated the question of whether roads can end geographical isolation and economic and social marginalization for poorer communities. The findings of the paper indicated that rural road investments have the potential to facilitate development and poverty alleviation, subjective to other key factors and basic preconditions that are linked to the realization of benefits. These include (1) the existing density of the rural road network, (2) the level of social and economic infrastructure provisioning, (3) the level of ownership and access of motorized transport in the rural population and (4) the level of purchasing power of rural households to access public transport. The study indicated that when roads enhance mobility it occurs in association with motorized transport, thereby providing easier movement for communities. This could result in poverty alleviation when the savings in travel time and the travel distances covered provide more economic opportunities or improved access to social services.

Socio-economic household surveys carried out in early 2006 in the rural mountain areas of Lesotho, as part of a study [Africon 2006] to determine the feasibility of rural road investment in this area, aimed to obtain the views of communities with respect to the expected impact of the rural road investment on their day-to-day living standard and overall socio-economic conditions.

The results of the surveys indicated that, in terms of the views of the communities, the proposed rural road investment would pose significant socio-economic, or indirect, benefits. The surveys indicated that the proposed road investment could potentially create

several short-term employment opportunities through road construction, and also long-term employment opportunities through continuous road maintenance through the lifespan of the road. The surveys furthermore indicated that daily activities and living conditions of communities in the project road area will be impacted upon positively, in the sense that there will be improved accessibility and mobility due to an improved road, with a subsequent improvement in day-to-day access to public, family and social activities and also improved accessibility to work opportunities. The study results further indicated that factors that are highly correlated with poverty (unemployment, limited to no income, low or no education level, etc) are also related with low access in the sense that men and women can afford little to no transport services, thereby constraining their mobility and accessibility. Furthermore, communities without access to an all-weather road network definitely have lower access to other facilities, as the specific project road in question in this regard appears to be inaccessible during summer raining, and especially winter snowing conditions.

In addition, the survey indicated that accessibility is impacted upon by the income and location of households. As most households in the Lesotho rural mountain areas earn less than \$135 per month, very few households are in a position of own a private vehicle or make use of public transport on a daily basis. This can tend to limit accessibility to business-, social- and cultural centers that are not within walking distance of households. Households that are also located deep into the valleys and mountains and not directly adjacent or at least close the road also have limited accessibility as it is difficult for public transport vehicles to access the valleys and mountains.

3.2 Estimated Impact of Rural Road Investment in Quantifiable Terms

Although there are no specific mechanisms for estimating and quantifying the impact of rural road investment on socio-economic development specifically, general cost-benefit appraisal / analysis can be applied to rural road investment projects in a similar manner, to determine the same benefits as those benefits derived in other road investment projects.

Against the above background, the following methodologies are reviewed to estimate the impact of rural roads investment on socio-economic development, through a review of the following features:

- a) Road investment benefits;
- b) Appraisal techniques;
- c) Alternative impact assessment techniques.

a) Road Investment Benefits

The impact of rural road investment can be measured in terms of the following main benefits:

- Direct benefits;
- Indirect benefits;
- Induced benefits.

Direct benefits refer to those benefits that are a direct positive impact on the road user and include the following:

- Savings in Vehicle Operating Costs (VOCs);
- Travel time savings;
- Reduced accident costs due to the upgrade of the proposed roads;
- Possible savings in road maintenance costs.

Direct benefits are usually quantifiable and can be expressed in monetary terms. It is therefore easier to establish these benefits accurately to a certain extent.

Indirect benefits refer to those benefits that do not impact directly on the road user and have a wider impact, such as employment opportunities that are related to road investment.

Induced benefits refer to those benefits that can be attributed to local economic development as a result of the road investment. These include enhanced self-sufficiency, increased production and efficiency as a result of, amongst other, improved access to markets for agriculture produce, improved access to social services such as healthcare and educational facilities, and an increase in household income and subsequently a more equal distribution of income.

b) Appraisal Techniques

Historical Cost-Benefit Appraisal (CBA) is the most frequent-used mechanism for the estimation of the impact of road investment on economic development in general. CBA entails that the impact of the proposed investment is usually determined through a comparison of the relevant and related project costs and benefits.

The software tool most commonly known and utilized to execute cost-benefit appraisal to determine the estimated impact of road investment is the Highway Development and Management Model (HDM) that was developed by the World Bank under co-ordination of the University of Birmingham. The latest operating version is HDM-4, which is an updated version of the highly popular and extensively used HDM-III program. HDM-4 is aimed at supporting decision-making on road management and the expansion of traffic capacity and is specifically designed to appraise projects, develop road programmes and evaluate long-term road system investment alternatives. HDM-4 has the following main operating characteristics:

- Economic evaluation of projects where vehicles per day (VPD) are higher than 200.
- Detailed input data with respect to the road network, vehicle fleet, respective traffic components and work standards (maintenance and improvement actions) are required;
- Benefits are expressed mainly in terms of savings in vehicle operating costs, travel time and accident costs.

Traditional methods of economic appraisal are generally not suitable for the appraisal of low volume roads. However improved appraisal methods are increasingly able to capture the social benefits arising from the provision of adequate road infrastructure (Pinard 2004). As rural roads are most often characterized by low traffic volumes appraisal should ideally be done with a tool specifically designed for low volume roads. The need for the RED Model was based on the fact that the HDM-4 model mainly focus on higher volume roads, where the VPD are more than 200. For these purposes the Roads Economic Decision Model (RED) was developed by the World Bank (World Bank 2003).

By adopting appraisal methods that are able to capture the non-economic benefits of low-volume road provision, e.g. the Roads Economic Decision (RED) Model, the socio-economic impact of rural road investment can be determined. This model is specifically aimed at improving the decision-making process for the development and maintenance of low-volume roads and can perform an economic evaluation of road investment options. The RED Model is aimed at improving the decision-making process for the development and maintenance of low-volume roads. The model performs an economic evaluation of road investment options. Benefits are calculated for the respective traffic components (i.e. normal, generated, induced and diverted traffic) and are also expressed mainly in terms of savings in vehicle operating costs, travel time and accident costs.

RED address the following main concerns related to low-volume roads:

- Reduce the input requirements;
- Takes into consideration the higher uncertainty related to the inputs;
- Allows for the incorporation of induced / development traffic;
- It computes internally the generated traffic due to the decrease in transport costs based on a defined price elasticity of demand;
- Quantifies the economic costs associated with the days-per-year when the passage of vehicles is further disrupted by a highly deteriorated road condition;
- Optionally, it use vehicle speed as a substitute parameter to road roughness to define the level of service of low-volume roads (vehicle speeds and possibility);
- Includes road safety benefits;
- Includes in the analysis other benefits (or costs) such as those related to non-motorised traffic, social service delivery and environmental impacts, if they are computed separately;
- It allows the use of MCA indicators to assist in the ranking of individual projects.

The following table summarise some of the main characteristics / differences between HDM-4 and RED and also indicate why the RED model is more applicable to roads with lower volumes of traffic:

HDM-4	RED
High volume roads (VPD > 200)	Low volume roads (VPD < 200)
More detailed economic evaluation	Simplified economic evaluation

Detailed input data required	Little input data required
Difficult to apply to economic evaluation of low-volume roads	Easy to apply to economic evaluation of low-volume roads
Do not allow incorporation of induced / development traffic	Allow incorporation of induced / development traffic
Exclude Non-Motorised Transport (NMT) benefits	Include Non-Motorised Transport (NMT) benefits
Feasibility indicators: B/C Ratio ² , NPV ³ & IRR ⁴	Feasibility indicators: B/C Ratio, NPV, IRR & MIRR ⁵

A literature study also indicates the application of techniques such as Multi-Criteria Analysis (MCA) and Cost-Effective Analysis (CEA) to support project appraisal of road investments through software tools such as HDM-4 and RED [World Bank 2001].

MCA is a technique used to rank Rural Transport Infrastructure (RTI) investments, and is typically applied when traffic volumes are less than 50 vehicles per day and too low for conventional consumer surplus measures to make sense [World Bank 2000], but there is still a strong belief that there will be important social benefits.

CEA compares the cost of interventions with their intended impacts and differs from traditional Cost-Benefit Analysis in the sense that it works in a situation where total expenditures for a programme are fixed. In such a case one only needs to decide how to allocate the budget in the best possible way and there is no need to use a consistent metric of benefits that could be the basis for comparisons with other programmes or resource uses. Therefore, although Cost-Benefit and Cost-Effective Analysis both measure benefits to costs, the 'benefit' units are different. Although CEA is specifically used to appraise investments in the social sector, it has rarely been applied in the transport sector. This has been mainly as a result of the view that the impacts of transport interventions are mainly economic in nature and that it should be measures. However, with the increased focus of African countries on poverty alleviation as main objective in the process towards economic growth and development, and the focus on social impacts of transport investments, CEA has recently received more attention.

The above appraisal methods all represent the more direct benefits that are related to project investment and that can be determined.

² The B/C ratio refers to the ratio of the present value of the economic benefits stream to the present value of the economic cost stream, each discounted at the economic opportunity cost of capital. The investment is viable if the B/C ratio is greater than 1.

³ The NPV of a given instrument is obtained by subtracting the present value of the costs from the present value of the future benefits. The benefits as well as the costs are discounted at the OCC discount rate. The investment is viable if the NPV is positive.

⁴ The IRR of a given project is defined as the discount rate at which the present value of benefits and the present value of costs are equal. It is a measure of the marginal efficiency of capital. For a project to be viable, the IRR has to be greater than the OCC rate.

⁵ The MIRR refers to the rate of return which equates the initial investment with a projects terminal value, where the terminal value is the future value of the cash inflows compounded at the required rate of return (the opportunity cost of capital). This better reflects the profitability of a project, as standard IRR assumes the cash generated from the project is reinvested at the IRR, whereas MIRR assumes that cash is reinvested at the firm's cost of capital.

c) Alternative Impact Assessment Techniques

Whereas direct benefits focus more on the direct impact on the road user, these benefits can be used as the basis to establish a link to, and determine the impact of, road investment on socio-economic development, or the so-called indirect- and induced benefits.

This can be supported by additional data collection methods through which the proposed impact of rural road investment can be estimated and measured by obtaining views from communities with respect to the expected impact on socio-economic conditions on communities.

The most often used method in this regard is the execution of socio-economic household surveys. The main benefit of socio-economic household surveys is that questionnaires can be structured in such a manner that optimal information regarding the perceived benefits of the rural road investment can be obtained. Socio-economic household surveys typically collect information with regard to the following aspects:

- The perceived impact of the proposed rural road investment on the activities of the communities living adjacent to the road;
- Existing transport problems experienced as a result of insufficient road investment;
- How the proposed rural road investment is expected to solve existing transport problems with respect to public, family and social activities;
- What impact will the project have on daily activities and living conditions;
- Whether people living in communities without a proper rural roads infrastructure and related access also tend to have lower access to other facilities;
- Whether people living in communities without access to an adequate rural roads infrastructure tend to spend more time and travel longer distances in the course of their daily activities;
- Whether accessibility to facilities vary by income and location;
- Impact of the rural road investment on both women and men.

4. CONCLUSION

This paper focused on a review of mechanisms to do estimation of the impact of rural road investments on socio-economic development. The paper indicates that the provision of rural roads infrastructure is an essential service that should be in place to enable and stimulate rural socio-economic growth and development.

Several appraisal techniques and software tools exist through which the impact of rural road investments can be determined. Although most of these techniques focus mainly on the determination of direct benefits that are easier to quantify and accurately determine, there is an increasing trend and movement towards the application of methods to also determine the larger impact of rural road investment on socio-economic development, and ultimately economic growth.

Rural social infrastructure such as education and health facilities is an essential source of economic growth and it is of imperative importance that accessibility and mobility be provided to such infrastructure, through the provision of continuous rural roads investment, to provide sustainable rural roads infrastructure over the long term. Of even more importance is the measurement of the impact of rural road investment on socio-economic development. The continued investigation into appropriate methods to estimate such impact is also essential, to continuously monitor the impact of rural roads investment, whether through existing techniques that determine direct- as well as indirect benefits, or through the investigation into, and exploration of, new techniques that can be applied to more accurately determine, and even possible quantify, the larger indirect effects on socio-economic development and subsequent national economic growth. Rural roads investment should be a main concern in the fight towards poverty alleviation and economic growth.

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