WORLD BANK TECHNICAL PAPER NO. 496

Work in progress
for public discussion

Design and Appraisal of Rural Transport Infrastructure:
Ensuring Basic Access for Rural Communities

Jerry Lebo
Dieter Schelling

CONTENTS

FOREWORD

The purpose of this paper is to assist rural transport planners, rural road agencies, donor agencies, local governments, and communities in the design and appraisal of rural transport infrastructure (RTI) interventions. It especially focuses on how RTI can contribute to poverty reduction. *Design and Appraisal of Rural Transport Infrastructure* appears as part of a four-volume compendium of rural transport knowledge under development by the World Bank's Rural Transport Thematic Group. The other three publications are *Options for the Managing and Financing of Rural Transport Infrastructure*, published in 1998,[1] *Improving Rural Mobility*, and *Developing Rural Transport Policies and Strategies*.[2]

The poor condition of rural transport networks in many developing countries blocks poverty-reduction efforts and stifles economic growth. A period of government and donor focus on the management and financing of main road networks is beginning to yield increased institutional and financial capacity, as well as improved main roads. Coupled with the clear emphasis on poverty reduction, this has led developing countries and the donor community to show new interest in building sustainable rural transport networks.

Meanwhile, a more holistic view of rural transport has emerged. Instead of narrowly focusing on roads, it takes into account the provision and affordability of transport services, intermediate means of transport, and the location and quality of services. The sustainable provision of rural transport networks (referred to as rural transport infrastructure, so as to include tracks, paths, and footbridges) crucially depends on appropriate management and financing arrangements, including a sound approach to design and appraisal.

This paper focuses on the design and appraisal of rural transport infrastructure. The task is especially urgent considering evidence that developing countries often adopt excessively high standards of access, particularly when donor financing is involved. Given scarce resources, such an approach raises long-term maintenance costs and denies access to underserved populations. Instead, a *basic access approach* is recommended, whereby priority is given to the provision of reliable, least-cost, all-season basic access to as many people as possible.

For some time now, it has been clear that rural transport infrastructure is ill-suited for appraisal using the conventional economic cost-benefit analysis, as it is applied to highly trafficked main roads. Rather, a wider view is needed to assess the role of low-volume transport infrastructure interventions, including the social importance of ensuring a minimal level of access to resources and opportunities. Examples of economic appraisals applied in recent World Bank rural transport projects illustrate this approach.

John Flora
Director
Transport
Urban Development

ABSTRACT

Isolation contributes to rural poverty. Without a minimum of reliable and efficient access to locations of basic social and economic activities, rural life stagnates and local development prospects remain limited. Providing and maintaining a minimum level of access, referred to in this paper as basic access, is therefore a necessary element of any rural development strategy.

Overcoming isolation necessitates holistic strategies. Approaches include improved logistics to support trade and communication, the promotion of transport services and intermediate means of transport, improved quality and location of services, and the sustainable provision of cost-effective transport infrastructure. Among these, the cost-effective design and appraisal of rural transport infrastructure (RTI) is the topic of this paper.

A basic access approach to the provision of RTI is presented which gives priority to the provision and maintenance of reliable, all-season access. Basic access interventions are defined as the least-cost investments which provide a minimum level of all-season passability. In a majority of cases, this means single-lane, spot-improved earth or gravel roads. In situations where motorized basic access is not affordable, improvement of the existing path network and the construction of footbridges may be the only alternative.

Resources are scarce. Therefore the basic access approach should only employ the most appropriate and cost-effective interventions. In this context, participatory selection procedures and analytical prioritization tools are presented, and examples given, which take into account the social and economic importance of RTI.

ACKNOWLEDGMENTS

This paper is a collaborative effort of the World Bank's Rural Transport Thematic Group and partners and experts from the global rural transport community. It was prepared by Jerry Lebo and Dieter Schelling of the Transport Department (INFTD) within the Private Sector Development and Infrastructure Vice Presidency of the World Bank Group. Financing was provided by the Swiss Government and the World Bank..

Particular contributions to the design aspects of the paper were made by David Stiedl, Andreas Beusch, Arnaud Desmarchelier, and Sally Burningham. Alan Ross made valuable contributions on road safety, as did Sonia Kapoor for environmental impact mitigation. Thampil Pankaj, Rodrigo Archondo-Callao, Liu Zhi and Colin Gannon were major contributors to the appraisal aspects of the paper. Walter Osterwalder contributed both the cover photograph and valuable comments.

Valuable feedback at various stages was provided by experts from the international rural transport community including, John Howe, Collins Makoriwa, Peter Roberts, John Hine, Simon Ellis, Setty Pendakur, Richard Robinson, Peter Winkelmann, Fatemeh Ali-Nejadfard, Terje Tessem, Jane Tournee and Margaret Grieco.

A number of colleagues at the Bank provided important feedback: Moctar Thiam, Susanne Holste, Andreas Schliessler, Hatim Hajj, Louis Pouliquen, Paul Guitink, Subhash Seth and Henri Beenhakker.

We are especially grateful for the extremely useful in-depth comments and reviews provided by Christina Malmberg Calvo, Juan Gaviria, John Riverson and George Banjo.

The publication was edited by Steve Dorst of Dorst Mediaworks and formatted by Barbara Gregory and Tipawan Bhutaprateep.

ACRONYMS AND ABBREVIATIONS

AC	Asphalt Concrete
ADT	Average Daily Traffic
CBA	Cost-Benefit Analysis
CBR	California Bearing Ratio
CEA	Cost-Effectiveness Analysis
EA	Environmental Assessment
ERR	Economic Rate of Return
EMAP	Environmental Management Action Plan
HDM-4	Highway Development and Management Model – Version 4
IFRTD	International Forum for Rural Transport and Development
IMT	Intermediate Means of Transport
LGR	Local Government Road
MCA	Multi-Criteria Analysis
MOC	Moving Observer Count
MTS	Manual Traffic Survey
NMT	Non-Motorized Means of Transport
NPV	Net Present Value
PAD	Project Appraisal Document
PCU	Passenger Car Unit
RAP	Resettlement Action Plan
RED	Road Economic Decision Model
RT	Rural Transport
RTI	Rural Transport Infrastructure
RTS	Rural Transport Services
RTTP	Rural Travel and Transport Program
SA	Social Assessment
SD	Surface Dressing
SP	Shrinkage Product
SSATP	Sub-Saharan African Transport Policy Program
TOR	Terms of Reference
TRL	Transport Research Laboratory, UK
VPD	Motorized, four-wheeled Vehicles Per Day
VOC	Vehicle Operating Costs
WB	World Bank
$	United States Dollar

OVERVIEW AND CONCLUSIONS

Rural transport networks in most developing countries are underdeveloped and of poor quality. It is estimated that about 900 million rural dwellers in developing countries do not have reliable all-season access to main road networks, and about 300 million do not have motorized access at all. At the same time, resources are being spent on upgrading roads to higher than economically justified standards for populations that already have a reasonable level of access.

Rural Transport Infrastructure and Poverty Alleviation

Various studies have provided evidence that poverty is more pervasive in areas with no or unreliable (motorized) access—what are referred to as unconnected areas. For example, in Nepal, where the percentage of people below the poverty line is as high as 42 percent, the incidence of poverty in unconnected areas is 70 percent. In Bhutan, the enrollment of girls in primary schools is three times as high in connected villages compared to unconnected ones. In Andhra Pradesh, India, the female literacy rate is 60 percent higher in villages with all-season road access compared to those with unreliable access.

There is a growing body of evidence that rural transport infrastructure (RTI) is an essential, but not sufficient, ingredient of rural development and sustained poverty reduction. Additional building blocks for rural development include complementary public and private investment, such as water and energy supply, productive activities, and social and economic services.

For rural transport interventions, a new approach is emerging which requires a more holistic understanding of the mobility and access needs of rural communities. The affected communities themselves are leading this demand-driven, participatory approach. In this context, rural transport consists of three elements: (a) transport services, (b) location and quality of facilities, and (c) transport infrastructure. This approach acknowledges that intervention may be required in all three categories, not simply the latter. To effectively utilize and target available resources, country specific rural transport policies and strategies are required.

The Concept of Basic Access

Basic access is the minimum level of RTI network service required to sustain socioeconomic activity. Accordingly, the provision of basic access is often viewed as a basic human right, similar to the provision of basic health and basic education. Consistent with a basic needs focus, the *basic access approach* gives priority to the provision of reliable, all-season access, to as many villages as possible, over the upgrading of individual links to higher than basic access standard. A basic access intervention, in this context, can be defined as the least-cost (in terms of total life-cycle cost) intervention for ensuring reliable, all-season passability for the locally prevailing means of transport.

In a particular context or country, the ability to provide basic access is limited by resources. A key questions, therefore, that must be posed: what is *affordable*? Resources for RTI are typically scarce, with very limited support from the central government or other external sources.[3] Affordability therefore will primarily be determined by a population's capacity to maintain their basic access infrastructure over the long term. In cases where motorized basic access is not affordable, improvements to the existing path network and the provision of footbridges may be the only affordable alternative.

Designing Rural Transport Infrastructure for Basic Access

The majority of RTI in developing countries carries traffic of less than 50 motorized four-wheeled vehicles per day (VPD), but often a substantial number of intermediate means of transport, such as bicycles and animal-drawn carts. In most cases, the appropriate standard for these are single-lane, spot-improved earth or gravel roads[4] provided with low-cost drainage structures, such as fords and submersible single-lane bridges.

The (trouble) spot improvement approach is the key to the least-cost design. Cost savings of 50 to 90 percent can be achieved compared with fully engineered roads of equal standard throughout. However, to put this approach into practice, a variety of constraints, such as political pressure and road agency and donor preference for high-standard, high-cost roads[5] need to be overcome. More recently, some donor-financed interventions, in close collaboration with the responsible road agencies, have successfully implemented projects based on the spot improvement approach.

Labor-based approaches are best-suited for the implementation of RTI interventions. By transferring financial resources and skills to the local level, labor-based strategies can have a substantial poverty-reducing impact. They also have the potential to improve the gender distribution of income, providing employment opportunities for women where wage-employment is scarce.

Appraising Rural Transport Infrastructure for Basic Access

Due to the increasingly decentralized framework for the provision of local services, and in order to build ownership and mobilize local resources, the planning (and monitoring and evaluation) process for RTI must be participatory. Whereas simultaneously "bottom-up" and "top-down" iterative approaches are required, the starting point for the process consists of consultations at the local government and community level.

A key tool for the participatory planning process is a local government or community transport plan. Local engineers or consultants, in consultation with communities, should conduct a low-cost inventory and condition survey of the local transport network, including roads, tracks, paths and footbridges, with a focus on existing obstacles. On the basis of the information generated, and additional economic, social and demographic information, an "as is" map should be produced. Based on such information, stakeholders can cooperatively decide upon desired improvements in the RTI network, taking into account objectives and available resources.

Establishing the priorities of an RTI intervention requires a selection process consisting of a combination of screening and ranking procedures. The screening process reduces the number of investment alternatives. This can be done, for example, through targeting of disadvantaged communities based on poverty indexes, or by eliminating low-priority links from the list according to agreed criteria. The balance of the alternatives will need to be ranked according to priority. Three methodologies for ranking are discussed: (a) multi-criteria analysis (MCA); (b) cost-effectiveness analysis (CEA); and (c) cost-benefit analysis (CBA). MCA often leads to non-transparent results, and is recommended only if cost criteria are included, and if the criteria are few, relevant, and have been determined (including their relative weights) in a participatory way.

This publication proposes a specific CEA approach for the majority of RTI where traffic is less than 50 motorized four-wheeled vehicles per day. A priority index is defined for each RTI link based on a cost-effectiveness indicator equal to the ratio of the total life-cycle cost necessary to ensure basic access, divided by the population served. With this approach, a threshold CE-value

needs to be determined below which a link should not be considered for investment. The recommended method for determining a threshold CE-value is to do a sample cost-benefit analysis on a few selected links applying enhanced benefit measurement approaches for establishing a threshold CE-value.[6]

For roads where higher than basic access standards seem justified—for example, those that provide an alternative access to the same location, or experience traffic levels above 50 VPD (but below 200 VPD)—the use of standard cost-benefit analysis is recommended. Appropriate computer-assisted models exist to aid transport planners and road agencies to optimize decisions on, among others, the threshold traffic for upgrading to a higher standard gravel or bituminous surface road. Such models include enhanced CBA and RED (Box 4.4). For roads that carry above 200 VPD, the utilization of HDM-4 is recommended.

Conclusions

In order to complement poverty reduction strategies, rural transport interventions must be an integral part of rural development interventions and focus on the mobility and access needs of rural communities. Substantial gains in accessibility—for more communities, in more regions of a country—are possible if rural transport infrastructure interventions are designed in a least-cost, network-based manner focusing on eliminating trouble spots. In view of budget constraints, selecting interventions requires a participatory physical planning process undertaken jointly with concerned local governments and communities, supported and coordinated by regional or central government agencies. Simple screening methods facilitate the selection process, reducing the number of alternatives to a manageable level. Ranking is then applied to the remaining options, and in most cases (below 50 VPD) the use of cost-effectiveness methods is recommended, supported by sample cost-benefit analysis on selected links, where appropriate.