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International Center for Public Policy
Andrew Young School of Policy Studies
Georgia State University
Atlanta, Georgia 30303
United States of America

Phone: (404) 651-1144
Fax: (404) 651-4449
Email: hseraphin@gsu.edu
Internet: <http://aysps.gsu.edu/isp/index.html>

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Rural Roads: The Challenge of Decentralized Implementation

Simon D. Ellis
Aurelio Menendez
World Bank

1) Introduction

The benefits from investments in rural roads are well understood both by the communities who demand them for improved access to essential economic and social facilities and the policy makers who see their impact on poverty reduction and economic growth. However, rural roads pose particular challenges in terms of their effective management and sustainable use. Rural roads usually make up the majority of the road network in any country but only carry a fraction of the traffic. The extent and physical isolation of the network poses problems for managing construction and long term maintenance and the local authorities tasked with management of the network very often don't have the expertise, financial resources or incentive structure to effectively carry out their responsibilities. It is therefore important to have close coordination between the various stakeholders involved in rural roads provision from the national government to the beneficiary communities.

Particular emphasis has to be given to effective mechanisms for managing and financing long term maintenance. The sustainability of many rural roads programs have been compromised through inadequate maintenance. Maintenance requires an appropriate incentive framework, a steady and sufficient flow of funds, and effective management systems but crucially the involvement and engagement of the community. For this reason some of the most successful rural roads maintenance schemes have involved community based contractors working in parallel with public works departments.

This paper will review the key elements required for effective decentralized implementation of rural roads programs. It will review the range of options available and the evidence for successful implementation where it exists. Section 2 makes the case for the importance of rural roads and sets out the evidence for the socio-economic benefits. Section 3 addresses the responsibilities for implementation and critical importance of having clarity over network ownership. Section 4 highlights the difficulties of finance, particularly for longer term maintenance, and sets out options for improving allocations and the reliability of receipt for those allocations. Section 5 sets out the project cycle from planning, design, implementation, maintenance and subsequent evaluation. Section 6 summarizes the key issues and highlights the main policy considerations.

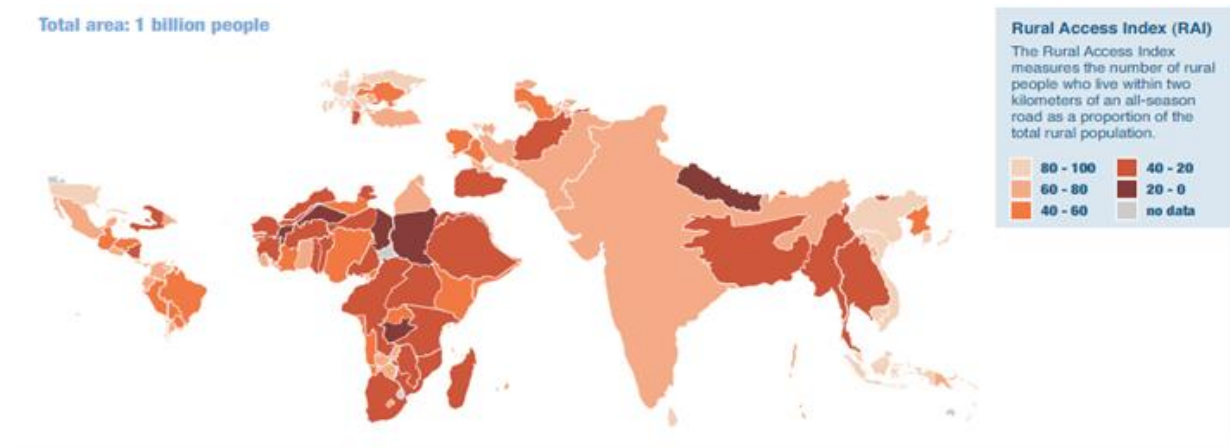
2) The objectives and nature of rural road infrastructure and transport services

Transport accessibility represents a key factor that influences livelihood conditions and opportunities. The time distance to reach social services or markets affects the possibilities of receiving adequate health care or education and of bringing products to markets or opting to a range of labor prospects. The literature on transport access as a necessary element (though not sufficient) for the reduction of poverty and the induction of productive development is varied and extensive, and it encompasses situations in both urban and rural settings. This paper focuses on rural settings and discusses the dimensions that are necessary for the appropriate provision of transport access to and from rural communities and the division of responsibilities between national and sub-national (local) entities.¹ The

¹ This paper focuses on road infrastructure and not on urban streets of local towns or secondary cities where the responsibilities tend to be well defined and entirely in the hands of the local municipalities/governments.

importance of rural accessibility in the reduction of poverty and access to essential social and economic services is reflected by one of International Development Association's (IDA) core indicators which is the percentage of the rural population who live within 2km of an all-season road. Figure 1 shows a transformed map indicating the extent of the rural inaccessibility is particularly acute in Africa and South Asia.

Figure 1: Transformed map indicating areas most affected by rural inaccessibility.



Source: World Bank (2007)

Rural transport consists on the rural roads—the infrastructure—and the services provided to transport people and products between rural communities and social and market facilities or higher level of infrastructure or transport services. The definition of “rural transport” or “rural roads” is not the same across countries. The term can be defined as the set of infrastructure or services that are provided to facilitate the access to and from rural communities, usually on roads of reduced standards, of widths of up to 6 meters that allow traffic in both directions but at moderate speeds of less than 50 km/hr.

These roads usually represent the last link of a network of roads categorized by the type and level of service they can provide and the size of the communities or cities they connect. Primary or national roads are the backbone of the road network, linking the major urban centers and generally paved to support traffic that includes trucks of all sizes and weights (up to the maximum allowed by the law) and of high volumes (requiring in some cases roads with two or more lanes in each direction). The so-called secondary roads flow into the primary network and connect medium-sized communities or the last links of the tertiary or rural networks. The secondary roads have the standards for traffic of medium weight and, depending on the stage of development of the country, can be to a greater or lesser extent paved. Most countries also have a network of district roads (sometimes combined with rural roads) which link the secondary roads to district centers. The rural roads are the last links that connect the more distant rural communities to the medium size cities, secondary and district roads. These roads carry low volumes of traffic and are often unpaved or sealed with a thin bituminous surface. As indicated before each country has a slightly different categorization of the roads; all represent the capillary channels through which people and products move around and facilitate the social interconnections and

economic interchanges. Table 1 shows a classification in a selected number of countries and highlights the challenge for managing the rural road network which often represents over 60% of the network but typically carries less than 20% of the traffic.

Table 1: Road classification and length in kilometers of selected number of countries

| Country | National Highways | | State/ Provincial Highways | | District Roads | | Rural roads | | Total |
|-----------|-------------------|---------|----------------------------|---------|----------------|---------|-------------|---------|-----------|
| | Km | % total | Km | % total | Km | % Total | Km | % total | |
| India | 70,934 | 2 | 163,898 | 4 | 1,005,327 | 25 | 2,749,805 | 69 | 3,989,964 |
| Vietnam | 17,295 | 8 | 21,841 | 10 | 45,250 | 22 | 124,994 | 60 | 209,380 |
| Rwanda | 2,860 | 20 | - | - | 1,840 | 13 | 9,300 | 67 | 14,000 |
| Honduras | 3,284 | 22 | 2,771 | 19 | - | - | 8,685 | 59 | 14,740 |
| Peru | 24,092 | 19 | 24,953 | 19 | - | - | 80,244 | 62 | 129,289 |
| Argentina | 39,000 | 8 | 195,000 | 38 | - | - | 285,000 | 55 | 519,000 |
| Colombia | 17,382 | 9 | 38,315 | 20 | - | - | 135,679 | 71 | 191,376 |

Enhancements to rural accessibility often take place in the form of improvements to the infrastructure through the upgrading of road conditions, improvements to surface conditions and reconstruction of structures such as bridges and draining systems. These enhancements are then expected to encourage users to provide more, better, and safer transport services, through the incorporation of vehicles of higher standards and more frequent scheduling of those services. The upgrading can also help in facilitating the use of non-motorized transport (bicycles or rickshaws) or motorcycles, which are cheaper to acquire and can provide the level of accessibility for certain activities in rural areas. The basic premise is that improved roads will encourage lower transport costs through the use of more efficient vehicles (e.g. head loading to bicycles, pick-up trucks to trucks or just the more efficient use of existing vehicles). These lower transport costs then promote more competitive and productive rural economies and improved access to essential social services.

The number of studies that have demonstrated the benefits from improved road conditions and enhanced accessibility has expanded over the years as it was seen that reduction in poverty and, particularly, extreme poverty and the achievement of the Millennium Development Goals (MDG) required access to health and education facilities. Much of the initial work on rural roads and poverty reduction was carried out in the 1980's and 1990's with work that focused on the impacts of improved roads on household incomes, agricultural production and wage rates (Howe and Richards, 1984; Gannon and Liu, 1997). More recently the International Food Policy Research Institute has looked at the most effective use of scarce public expenditures on reducing poverty in rural areas and they have found that behind agricultural extension rural roads in many countries including China, India, Vietnam and Uganda

that expenditures on rural roads are the most effective ways of reducing poverty (Fan et al, 2007). Increasingly however, there has been a focus on the broader poverty impacts of improved rural roads including on access to health and education facilities and how they affect education and health outcomes (Mu and van de Walle, 2007; Bell and van Dillen, 2011).

Box 1: Socio-economic impacts from improved rural access

Public investments in rural roads provide some of the best returns in terms of reducing poverty and promoting agricultural and non-agricultural growth. A paper by Mu and van de Walle (2007) which analyzed the impacts of a rural roads project in Vietnam found the following: "There are indications of significant impacts on the development of markets and commercialization. Some outcomes, such as food goods availability, responded rapidly to the new and improved roads. Others, such as the presence and frequency of markets and non-food goods and services availability, took two years more on average to emerge. The project resulted in households switching from agriculture to non-agricultural, mostly service-based, activities. Perhaps most notable, the project had significant, sustained and robust, impacts on primary school completion rates. Yet there are many indicators of local area development for which we find little significant impact attributable to better roads."

A paper by Bell and van Dillen (2011) analyzed the effects of providing all-weather roads to some villages in a poor, drought-prone region of India. The paper looked at effects in three domains: 'commercial' (output and trade), education and health. The following were the main results: "(i) an all-weather connection measurably reduced unit transport costs; (ii) pupils in all three levels of the school system lost substantially fewer days of schooling due to bad weather, in large part because their teachers had fewer such absences; (iii) the acutely sick received more timely treatment and were more likely to be treated in a hospital than in the nearest primary health clinic; and (iv) the respondents ranked the ensuing benefits in the domains of health and education at least as high as those in the 'commercial' domain."

These studies have shown that improvements to rural accessibility, when properly designed (as explained later in this paper), can lead to substantial reduction in poverty rates (and of extreme poverty, which is more prevalent in rural areas). In projects and studies carried out in Chile and Peru, among others, it was also seen that coordinating investments in rural roads along with those in other infrastructure sectors (water and sanitation, telecommunications, and electrification) in tandem with the potential productive activities in a defined rural territory has a robust potential for jumpstarting the local economy and multiply several times over the impact of the rural roads investments (Escobal and Torero, 2005). Institutional coordination represents the biggest challenge in these investment efforts. Studies have also shown that in some areas the building of a road doesn't necessarily attract improved transport services and policy makers need to consider the mobility needs of the communities concerned (Starkey et al, 2002).

In all cases, it is seen that benefits do not come all at once but rather they start with enhancements to transport indicators and then expand later to increased prices to agricultural and local product and eventually to increased local incomes. In this vein, the causality of benefits takes place starting with the reduction in transport operating costs and travel times, lower freight and passenger tariffs and hence the ability of the producer to keep a higher proportion of the final market price i.e. farm-gate prices increase. The reductions in tariffs is also allowed through the reduction in the spoilage of rural products (generated by lower transit times, more reliable service, and smoother rides) and in accidents (as a

consequence of safer riding conditions—though this requires the appropriate road safety features and enforcement as speeds normally increase as a consequence of improved road conditions).

Ensuing economic benefits are realized by a greater competitive edge of the rural territory, greater interpersonal connections, and an enhanced setting for innovation and access of productive extension services, particularly for agricultural products. In the longer term, the safer and shorter travel times lead to higher attendance to school by children and a faster access to health facilities by people in need of medical attention (particularly pregnant women and infants—with a reduction in death of expecting mother and in infant mortality rates) and a more sustained presence of teachers and medical personnel and school and hospital administrators, all leading to medium term improvements to health and educational indicators and achievements. In a broad analysis carried out in China, the additional benefit was an opportunity to expand the relationships among populations and the opportunities for marrying.

The above benefits include also another very important one: the improvement to the living condition and generally livelihoods of women. As explained earlier, rural accessibility brings education and health benefits that accrue to a greater extent to women given their childbearing and often child caretaking responsibilities. Improved access can further facilitate women's opportunities to undertake activities related to local economic endeavors, from participation in agriculture, livestock, fisheries, or local artifacts, to the actual participation in road maintenance and rehabilitation works.

Higher accessibility however has also led to higher migration rates and the depopulation of rural areas or secondary cities, though this can be seen as a natural consequence of the lack of competitive edge of specific rural economies and a natural process of transfer of economic activity to areas with higher productive potential. It is also related to deforestation and generally the destruction of the natural habitat, though this is more a question of properly addressing the potential negative impacts on the environment through incorporation early on (starting at the planning stage through the design of strategic environmental plans, for instance) of appropriate environmental management practices and sustaining those practices when civil works or maintenance activities are carried out. In fact, the adequate consideration of environmental management practices in rural roads can help enhance environmental conditions and the mitigation of natural disasters that can happen in the event of extreme weather events.

3) Responsibilities

Along with the classification of roads along three levels (principal or national, secondary or feeder, and tertiary or rural), legislations across countries tend to assign responsibilities to a similar three tier levels of government, with the national/central government in charge of the primary network, departments or regional governments in charge of the secondary network, and rural communities or provincial governments in charge of rural networks. This is the natural consequence of a perspective that assigns responsibilities to that level of government elected by the population that benefits from the services provided by the different types of roads. For rural roads, it is understood that the benefits provided by those last links of the network accrue largely or solely to the inhabitants of the rural communities they

serve. From that perspective, countries like Bolivia or Colombia, assign the entire responsibility for the upkeep, upgrading, or expansion of the rural roads networks, and the financing required by any of these interventions, to the lower tier of the government.

There are however several shortcomings to that perspective given that the ultimate benefits to the country as a whole go beyond the boundaries of the rural communities, territories, or populations. As discussed earlier, rural roads can lead to enhanced livelihood conditions in rural areas, leading to reduced poverty rates and a more equal prosperity in the country, a benefit that has been demonstrated reverberates in more sustained growth rates for the country as a whole. The increase levels of educational achievement and health indicators is an added benefit that expands beyond the rural boundaries and produces positive effects in national wellbeing. When seen from the perspective of these benefits the involvement of national governments in ensuring adequate rural access becomes justified and necessary.

This involvement is required as the third tier of government will tend to underprovide the required level of rural road infrastructure as a consequence of three key factors: (a) limited planning and technical capacity to define investments and technological solutions, at least at early stage of a rural roads development program; (b) limited financial capacity to address the needs, at least as far as local revenue raising capacity is not well developed; and (c) governance structures that may affect the definition of proper plans when both (a) and (b) are not well structured. These factors however may not be necessarily adequately addressed by involvement of national entities as they themselves may also face issues of lack of capacity and the existence of weak governance structures (that can lead to political patronage and poor investment decisions). Nonetheless, it is likely more feasible to produce a core professional cadre of specialists and a supporting management and financial framework from a national entity that can then gradually help strengthen the capacities and procedures at the local level. Figure 2 provides an institutional framework for rural roads development in India. As discussed above the Government of India has decided that there should be a role for national government both in the finance and planning of the rural roads network but at the same time is trying to strengthen its local level institutions to implement and manage maintenance over the long term.

Figure 2: Institutional arrangements for the decentralized implementation of rural roads in India

| | Roads Administration | Responsibilities |
|-----------------------|---|--|
| National Level | National Rural Roads Development Agency (NRRDA) | NRRDA is an agency under the Ministry of Rural Development and is responsible for policy, standards, monitoring and funding for the national rural roads program. |
| State Level | State Rural Roads Development Agency (SRRDA) | The SRRDA either sits under the Public Works Department (PWD) or Agricultural Department at the State level and is responsible for planning, prioritization, implementation, and the funding and execution of maintenance. |
| District Level | Project Implementation Units | Responsible for day to day implementation and supervision of new works and maintenance. |
| Block / village Level | Panchayat Raj Institutions ?? | The law calls for local level Panchayat Raj Institutions to implement and manage the local level network of roads. In reality most implementation takes place at the District level due to finance and capacity constraints at this level. |

Source: Adapted from International Labor Office (2005).

The coalescence of the two tiers of government—national and local—however should not diminish the need to entrust responsibilities to local/sub-national levels of government taking into account the closer relationship between the location and function of the infrastructure and the major beneficiaries from that infrastructure. This is particularly relevant and appropriate in engaging local communities and governments in defining priorities and designing investments that are appropriate for the needs, resources, and potential of the communities. There is also a need to establish the ownership of those communities and governments in the management and maintenance of rural networks. This collaboration and coordination should help in defining a set of common objectives for the achievement of benefits that intersect at both the realms of local and national authorities.

This discussion helps establish the key dimensions that need to be considered when discussing the allocation of responsibilities for a program of rural roads, as follows:

- Capacities: how structured/ready are the local governments to plan, design, manage, finance, and maintain the rural road infrastructure?
- Needs: what are the expected short-, medium-, and long-term needs of the rural territory and the extent to which improvements to the rural roads can address those needs? What are the size and characteristics of the population that will receive the benefits and the level of spillover effects beyond the rural territory? This dimension requires careful definition of the territorial

unit of analysis as depending on how that unit is defined the extent and scope of the needs can vary substantially.

- Impacts: what are the potential environmental, social, institutional, and financial impacts of meeting the identified needs and what are the alternative mechanisms to address them?

The location of a country along that set of dimensions will help dictate the level and form of engagement of the various tiers of government (the depth and scope of the decentralization) and the set of collaborative interventions towards establishing a path for enhancing rural accessibility and strengthening the methodological and institutional process that can help achieve that objective (and ultimately the goal of reducing poverty and sharing the economic prosperity of a country).

4) Financing

Fiscal resources available at the local level will delimit the scope of the investment plans of local authorities. The objectives and benefits of rural roads—the extent of the spillover effects that this infrastructure can have beyond the borders of the territories they serve—will dictate the definition of a fiscal framework that will bring the sharing (or transfer) of resources from the national level. This is normally required if the objectives of reduction of extreme poverty—or, generally, poverty—or reduction in inequalities through the sharing of prosperity are to be achieved. Furthermore, the lack of capacity to plan, prioritize, or procure either rehabilitation/reconstruction or maintenance works can lead to the national level to take full or partial responsibility for their financing. Often, matching transfers or revenue sharing mechanisms that help create the incentives for appropriate performance by local authorities (and their contribution to demonstrate commitment and ownership of the interventions) are prevalent.

At the local level, revenues generated through local taxation such as property taxes or transfers from national taxes such as Value Added Tax (VAT) or fuel levies are used for the purpose of financing activities in rural roads, as they are understood to have a relationship with or benefit from good access. Other revenue raising alternatives include tolls or charges for the use of infrastructure or taxes raised from the licensing or registration of vehicles or the issuance of driving licenses. In the context of rural communities and low volume roads however these revenues tend to be rather small (or non-existent when the administrative costs of their collection surpasses or is closer to the amount of revenues that can be potentially raised). The revenues from property taxes tend also to be very limited due to deficient property cadaster and low taxation rates. Transfers from national taxation on the other hand have a stronger base but since they are also charged nationally the portion that comes back to the local level is often insufficient. As such an agreed formula should be developed such that local authorities get a fair share and also have some certainty over future revenue streams. In Peru, for instance, by law, a portion of the national value-added tax (a revenue source selected because it is correlated—albeit imperfectly—to the same formula used for the allocation) is transferred to local authorities for the purpose of maintaining rural roads in good condition. Table 2 sets out the main sources of revenue at the local level.

Table 2: Sources of local revenue for building and maintaining rural roads

| Revenue from national transfers | | Local revenue sources | |
|---|---|---|--|
| Transfers from general taxation (income taxes, VAT etc) | In most countries the majority of local funds come from national level transfers in the form of block grants. | Property taxes | Limited revenues due to cadaster issues |
| Transfers from road funds (fuel levies) | Some countries have dedicated road funds and transfer generally a small share for local roads | Local income taxes | Limited due to limited tax base |
| Transfers from vehicle license fees/registrations etc | Limited transfers as share of revenues | Levies on agricultural marketing | Some countries, particularly where there are marketing boards, will levy charges for up-keep of roads |
| | | Community contributions (in-kind or cash) | This can be substantial source of revenue where countries have this tradition |
| | | Toll revenues | Very limited due to difficulty of tolling rural roads and administrative costs of collection compared to revenue potential |

In many cases, contributions from the national governments have tended to focus on support to capital investments while local entities have been responsible for the recurrent costs of maintenance. This assignment of financing responsibilities reflects the interest at the national level on ensuring the proper allocation for investments that contribute to national goals of growth and equity, and the importance of commitments of local authorities to the recurrent activity of maintaining the assets. However, this model can cause problems where there is not full ownership at the local level or where local entities simply do not have the capacity to fulfill their responsibilities. There can be a tendency to over design roads as national government is paying which may reduce short term maintenance burdens but can make longer term maintenance unaffordable particularly at the time of renewals. A better approach is to share costs of both capital and recurrent costs between national and local authorities with a plan to phase out national level funding over time. In parallel to this there has to be a policy of shifting revenues to the control of local entities so they have resources commensurate with their responsibilities.

The challenge however in the sharing of resources for rural roads is how to define the distribution of the potential national resources to cover a larger or smaller part of either capital or maintenance costs. The distribution should be established on the basis of the ultimate goals to be achieved though also considering the efforts local authorities are ready to take on to upgrade and maintain their rural roads networks. In some instances, such as in Peru, where for the initial phases of a rural roads program supported by the national government, the sharing formula included population and size of geographic area (as a proxy of the overall needs of the territory for rural roads) and key socio-economic indicators (such as those related to the human-development index—a composite statistic of life expectancy, education, and income, the latter as a proxy for poverty levels) complemented by the level of fiscal

resources collected for the provision of municipal services as a whole or those allocated to rural roads.² In India national level grants have been provided to States based on the length of their rural road networks. However, the grants are only paid if the States have demonstrated that they have already committed their own resources to maintenance budget lines. . In a few cases, the productive potential of that territory can also enter the criteria if it can be measured with a good level of reliability (when, for instance, there is information about GDP or GDP per capita of that territorial unit). Allocations for maintenance tend to be based on existing needs and the fiscal contributions the rural government is ready to bring to cover the costs of that maintenance.

5) The project cycle

Planning and priority setting

From a bird's view of a particular rural territory, one would expect to see a very large number of needs in effectively enhancing local access. As indicated earlier, the number of kilometers of rural roads is several times that of the other networks, given the sheer size of reaching the most remote areas of the territory. The project cycle then starts with the selection of priorities and the identification of how those priorities will help achieve the economic and social needs of the territory's population. The definition of the broader development plans for the territory must then be the first step as the basis for identifying the accessibility needs.

The definition of those broader development plans can take the form of sophisticated models for larger geographic areas with multiple productive options or that include a large number of rural inhabitants or simple approaches in the case of more contained territories with a smaller, well defined population. In both cases this step requires adequate participatory processes that ensure that the views of the population are incorporated in to the identification of potential productive endeavors and impacts that are not desired by that population. (Box 2 describes the approaches followed in Chile and Peru in the definition of the plans.)

Box 2. Territorial Planning for Rural Infrastructure in Chile and Peru

For instance, in Chile, in the context of the development of a national rural infrastructure program, the mechanism used for the definition of the development plan was developed along with the then Ministry of Planning as the so-called Territorial Development Master Plans that sought to identify the potential future uses of "rural communes" and from that the needs in terms of infrastructure (including roads) and productive alliances (seeking to attract funds in support of productive activities), with consideration of potential environmental impacts. In another example, in Peru, the Rural Transport Program seeks to improve accessibility of territories in the mountainous Rural Sierra, some of which due to geographic constraints include a limited number of people and productive activities. The program works through the provincial governments and with the direct participation of the communities to identify further productive opportunities and from there the specific needs for accessibility enhancements.

²More recently the Rural Transport Program was expanded to all the 193 provinces of the country and maintenance grants are provided against confirmation of compliance with a framework that includes development, technical, administrative, and financial management criteria.

The participatory process is required given that resources are limited and likely depending on the network structure addressing development plans may lead to competing investments in roads that can contribute equally to specific requirements of that plan. The participatory process should help elucidate priorities. Also, since the road infrastructure may not be enough to reach out to the majority of the (often dispersed) population, the participatory process should help identify the requirements for lower-standards infrastructure (including those such as foot or bike paths) to facilitate the access to the major arteries of the road infrastructure and ensure that rural roads connect to critical facilities of other sectors (markets, hospitals, or schools). It can also help identify the particular needs of specific segments of the population (e.g., women, indigenous groups), ensuring the benefits, economic and otherwise, from the rural roads are adequately and effectively internalized by the communities. Participatory processes and communications with the communities can further help define appropriately the environmental and social development impacts and the management actions that need to be implemented to address those impacts.

Environmental practices are important as this infrastructure is located in areas relatively untouched by human activity (and potentially having a greater impact on biodiversity or forests) but also because of the need to manage environmental factors for the proper upkeep of the infrastructure. It is important to ensure that mechanisms are in place to ensure adequate environmental practices and adequate monitoring. For example, in Honduras, an innovative approach of payment to landowners in exchange for conservation of natural habitats has been implemented to protect an endangered species (Box 3).

Box 3. Compensation for Environmental Protection: Honduras San Lorenzo - Olanchito Rehabilitation Project

In Honduras, a thorn forest area of approximately 2,000 hectares has been placed under a legally binding, financially sustainable, and operationally effective system for long-term conservation to preserve an endangered and endemic Hummingbird species in the area of influence of a road rehabilitation project (partly financed by the World Bank). This area includes some 1,400 hectares of privately-owned lands, which have been placed under conservation through the signing of long term (10 years), renewable, Environmental Service Payments Agreements (PSA for its name in Spanish) to ensure adequate protection of the hummingbird habitat. Under said agreements, the land owners must ensure the conservation of the thorn forest and refrain from certain specified activities that could degrade the habitat, receiving a monetary compensation for any loss of income that this restraining measures may impose on them. The framework is characterized by: (i) a legal basis for the PSA contracts; (ii) clear institutional responsibilities and a functional mechanism for verifying compliance and adequate disbursement of PSA payments; (iii) a sustainable source of financing (trust fund for making current and expected future PSA payments; and (iv) a protected area overlay (or other land use zoning) that would prohibit those types of future public investments (and help discourage those private investments) that could undermine thorn forest conservation by raising the opportunity cost.

The identification of priorities should be complemented with a more rigorous assessment of the economic worth of the proposed investments. Given the low traffic volumes on rural roads, the standard methodologies for cost-benefit analysis are not normally applicable and other methods must be used, such as cost-effectiveness (accepting those priorities for whom the cost per kilometer is below a pre-defined threshold that reflects that the cost of the investments are commensurate with the expected overall benefits) or the producer's surplus approach, through which the expected incremental value of production as a consequence of the investment is compared against the cost of the

rehabilitation/construction and the annual maintenance outlays during a defined period of time (normally 15 to 20 years).

The planning and priority setting should be led by the local institutions responsible for the defined rural territory, but in the context of reduced capacities the national government has a key role to play to ensure the priorities reflect a well-defined set of interventions in line with the expected development plans. The broader development perspective however requires the involvement of national entities that do not have a stake in a particular sector but rather on the broader development of rural areas. In the case of Chile, for instance, the entity in charge of advancing the rural infrastructure program was located in the Ministry of Interior with the accountability of enhancing development and capacities at the decentralized levels of government. In Peru, a new entity—the Rural Roads Program—was initially created with autonomy and reporting to both the Ministries of Transport and Economy. The experience of these cases shows that a national entity with a comprehensive perspective of rural development can be more effective in achieving a more integrated support to local entities and, when applicable, an effective gradual transfer of responsibilities as capacities are built up at the local level.

Project design and technology

The analysis described in the previous sections should inform the decision about the type of pavement or geometric standards of the various links for the rural roads. With low volumes of traffic (around 150 vehicles per day or fewer) and limited number of heavy traffic, gravel pavements can yield the expected level of benefits and, if well maintained, sustained over long periods of time. In various countries in Latin America, gravel rural roads have sustained year-round access when upkeep has been provided on a continuous basis. Every three to five years these roads require re-graveling but in all they can provide the expected level of service for a fraction of the cost of paved roads. In a few countries, cobblestones have been used very successfully, as is the case of Nicaragua (with a far reaching program of the so-called *adoquines*, or concrete slabs that are interlocked together manually –see Box 4). Topography and climate conditions also are important elements of the design. Mountainous topography coupled with frequent and heavy rains might dictate paving even in the context of medium traffic volumes, with paving often being asphalt double treatment and, in those cases with heavier traffic, concrete (as it can be observed in rural roads in mountainous areas of China, for instance). As in the previous section, the national authorities can play an important role in sharing information and knowledge about the experience in the application of one or another technology and in measuring the effects in their application in one context of another.

Box 4: Decentralized Nature of the MCA *adoquines* model in Nicaragua

The Nicaragua “MCA *adoquines* (concrete blocks) model” is an interesting decentralized development experience that involves the central government Ministry of Transport & Infrastructure (MTI) collaborating with the local authorities (municipal government) and target beneficiaries to deliver rural road public infrastructure. First, the local authorities in consultation with MTI agree on the roads that get evaluated at the national level for priority intervention. Once roads to be intervened have been approved, a legally binding agreement is signed between the MTI and the local mayor describing the works to be undertaken and the modality to be followed in executing the works. The municipal authorities then organize a meeting to call on community members that meet the qualifications for particular posts to present themselves for constitution into community development modules (MCAs). MCAs are local entities staffed by a board of 5 directors (with the president of each MCA as the legal representative) to perform a specific road upgrading task. Each MCA has responsibility for a specific stretch of road (limited to 3km and a ceiling of US\$500,000 per MCA due to administrative and fiduciary concerns). The MCA personnel receive technical support and training from the centralized MTI from inception, and have an MTI supervisor and promoter accompanying them throughout the implementation process. The contract awarded to each MCA is signed jointly by the MTI (as the contracting party); and the Mayor and President of the MCA on the other hand (as the contracted party). Individually, each MCA hires its own local labor in order to construct a specified stretch of road. MCAs join together and use economies of scale to contract an earthworks contractor and an *adoquines* supplier. For these “group MCA contracts”, the Mayor and Presidents of all the contracting MCAs are the “contracting party” and the earthworks contractor and *adoquines* supplier is the “contracted party”. This contracting follows national competitive bidding procedures to ensure transparency and competition. Quality control is outsourced to a supervision firm. Rural road infrastructure delivery under this decentralized model has been successful with roads built on time, at reasonable cost, and with the required quality. In addition to creating short term employment opportunities, and building technical and entrepreneurial capabilities, the involvement of the local population in the infrastructure delivery process has also engendered a sense of ownership in the roads.

But local context is critical and the choice of paving technology must be further considered the universe of potential firms that can compete for the procurement of the civil works and the possibilities of using local labor for the rehabilitation or reconstruction tasks. The examples of Nicaragua or Peru show that local labor can play an important role and reduce the overall costs of the investments when the paving technology is tailored for labor intensive activities. Similarly the ultimate capacity for the maintenance of the rehabilitated roads (and the accompanying infrastructure of bridges, drainage, or culverts) and generally their management (with attention to vegetation and the environment at large) represent factors that must inform the final decision for the selection of paving technology. In this respect, as indicated earlier the need to create resilience to ensure that extreme weather events do not affect substantially the condition of the rural roads should be built into the design and maintenance strategy. The role national entities can play in establishing technical standards (for instance, in light of more frequent extreme weather events) is paramount as it is, as stated earlier, in promoting and facilitating the sharing of knowledge, with aim at helping local entities to optimize their investments and ensure their upkeep. By requiring the application of planning methodologies and technical standards (including environmental impact assessments) as prerequisite to access national resources and technical assistance, the national governments can ensure that decentralized entities adhere to appropriate engineering practices and investments in line with the expected benefits and the needs of the local populations.

On environmental issues, the basic challenge is ensuring the upgraded infrastructure does not lead to negative and irreversible effects on the area of influence of the road, such as erosion or deforestation. Overall one of the most important environmental mitigations to avoid problems is just the application of good engineering design, coupled with good planning and an environmental consciousness (Keller, 2003). Sustainable practices involve application of good long-term planning (that include strategic environmental planning that evaluate the potential environmental impacts of increasing agricultural/economic activities and the actions to prevent negative impacts—such as deforestation); adequate engineering design, such as drainage structures that are designed to last their design life (25-100 years) and that help protect water quality; the use of local materials and labor pools whenever possible; and inspection and quality control. Control of drainage and slope stabilization are two key actions that can be implemented through proper use of vegetation, and particularly deep-rooted vegetation. Attention to greener construction practices yields important economic benefits as they can help reduce the ultimate deterioration of the rehabilitated roads and the impact on the surrounding areas. National governments have an important role to play in defining the environmentally-friendly planning and engineering practices and creating the incentives for their effective application through co-financing mechanisms and technical assistance support.

Management and maintenance of road assets

One of the greatest challenges in the rural roads sector is the effective long term maintenance of the network. This requires not only a sufficient and reliable stream of resources but also systems to prioritize expenditures and mechanisms for the effective implementation of maintenance. Experience suggests that sustainability is more likely when there is a good partnership between the community beneficiaries and local public works department. The communities are the “owners” and have the “desire” for good roads, they can often provide labor (paid or unpaid), sometimes funding but also the eyes on the ground to identify problems when they arise. The public works department provides the technical expertise and equipment when this is required. Table 2 provides a summary of implementation mechanisms used around the world, all have their place.

Table 2: Summary of implementation mechanisms for maintenance

| Mechanism for maintenance | Main characteristics | Advantages | Disadvantages | Countries where system is used |
|---------------------------------------|---|--|--|--|
| Length-man system | A local person is paid to undertake routine maintenance of a set length of road | Simple to organize, uses local labor and minimal equipment requirements | Difficult to maintain consistent standards. There is a limit to the work an individual can do | Many Africa countries |
| Community – voluntary labor | Some countries have traditions where communities provide time and/or money for the maintenance of common infrastructure assets | Community ownership, less influenced by external financial/political issues. | Difficult to enforce and maintain consistent standards. | Some countries in East Asia such as China and Vietnam, some Scandinavian countries such as Sweden and Finland. |
| Micro-enterprises | Group of local people forming a company to undertake routine maintenance activities | Increases professionalism of activity, groups tend to work more efficiently than individuals | Some countries have contractual problems in appointing on a sole source basis. | Many Latin American countries but variations have also been used in China and Eastern Europe. |
| Force account | Unit with staff paid by the local authority to undertake maintenance activities | Can take longer term ownership of an asset, no procurement necessary and can be more responsive in emergency. | Can suffer from public sector inefficiencies with large percentage of costs going to overhead | All countries use some form of force account. |
| Private contract – short or long term | Through procurement a private contractor is appointed to undertake various maintenance functions either as a one off activity or over a set period. | Benefit from private sector efficiencies, reduce need for equipment/staff in public agencies, good for larger maintenance activities | Tend to have short term horizon, slower to appoint private contractors | Most countries are now moving to some form private sector contracting |
| Area wide contracts | As above a private contractor is appointed to maintain a number of geographically close road segments as part of an area wide contract. These contracts will tend to be for longer time periods and include performance criteria. | Outsources road agency functions to benefits from private sector efficiencies | Require strong contract management. Over time public monopoly can be replaced by private monopoly. | Increasing common in high income and middle income countries. |

Successful approaches at the local level for the maintenance of rural roads have been put in place in countries as varied as Peru, Chile, Nicaragua, Vietnam and Nepal. These successful approaches have often relied on use of local labor and local entrepreneurship to sustain year-round access and longer useful life for the rehabilitated infrastructure. These decentralized mechanisms consists usually in the formation of small enterprises of local labor (called microenterprises in many countries) that are contracted (initially on a sole source basis but later can be subject to competition) for a period of time (normally a year, renewable as pertinent) and paid on the basis of performance standards. These microenterprises cover a length of road that varies from 10 to 30 kilometers depending on topographic and weather conditions. The contract often includes resources for the acquisition of simple tools and their reposition when they have reached their useful life. In a few cases, the contract also includes acquisition of mechanized equipment. The microenterprise approach has been generally successful because it establishes a virtuous circle by means of the incentives built into the contract and by the fact that the members of the micro-enterprises are also members of the communities served by the rural roads, communities that rely on the availability of the access to achieve its development plans. Microenterprises have increasingly included women, both as administrators or as labor. Their participation has been highlighted as an opportunity for women to earn income and assert themselves as full members of the communities they live in.

Table 2: List of countries with microenterprises (include activities in national and rural roads)

| Country | Name | Start | #ME | KM | Surface |
|-----------|---|-------|-----|--------|---------|
| Bolivia | Administradora Boliviana de Carreteras - ABC | 2003 | 302 | 8,228 | Paved |
| Colombia | Instituto Nacional de Vías – INVIAS | 1984 | 318 | 14,157 | Paved |
| Ecuador | Unidad de Caminos Vecinales – UCV | 2001 | 36 | 420 | Unpaved |
| | Ministerio de Obras Públicas - MOP | 2003 | 84 | 2,259 | Paved |
| | Municipalidad de Azuay | 1998 | 20 | | Unpaved |
| Guatemala | Unidad Ejecutora de Conservación Vial - COVIAL | 1997 | 130 | 4,200 | Paved |
| Honduras | Fondo Vial | 2000 | 70 | 2,762 | Paved |
| Nicaragua | Programa de Mantenimiento Rutinario por Microempresas | 1997 | 37 | 2,140 | Paved |
| | Programa de Apoyo al Sector de Transporte | 1999 | | | Unpaved |
| Paraguay | Programa Nacional de Caminos Rurales – PNCR | 2000 | | | Unpaved |
| Peru | PROVIAS Rural | 1996 | 600 | 14,251 | Unpaved |
| | PROVIAS Nacional | 2003 | 127 | 7,256 | Paved |
| Uruguay | Dirección Nacional de Vialidad – DNV | 1996 | 10 | 1,613 | Paved |

Source: Cartier van Dissel (2008).

The planning of maintenance is normally a local responsibility with road entities at the local level taking charge and held accountable for the procurement and supervision of the maintenance contracts and the

planning of maintenance activities (that become part of the contracts). In the initial stages of rural roads development, the national government plays a critical role of building up capacities at the local level. This has been the case of Peru where over the course of about 10 years the national entity was initially responsible for the upkeep of rural roads and gradually transferred that responsibility to local road entities (the so-called Provincial Road Institute or IVP for its Spanish acronym) with currently 193 local entities (one per almost every province of Peru) being responsible for the maintenance of about 17,000 km of maintainable rural roads.

Transport services

In some countries the building of rural roads will provide sufficient incentives for the private sector to provide transport services. In other countries, particularly where there is a low density of demand, the market may not respond and communities are as isolated as before they had a new road. Transport services (passenger buses or trucking) on the rural roads are ultimately the means by which the majority of people and cargo are transported to its destinations. In rural areas, the number of individual private modes of transport is very limited and very often non-motorized modes of transport are used for shorter distances. While those transport services are self-financing, the regulatory framework (and the oversight of its application) can play an important role to ensure that the benefits from improved roads are transferred to the end users in the form of greater availability of transport services and lower passenger and freight tariffs. The regulatory framework includes legislation or procedures that seek to encourage a competitive environment while requiring safe driving and operating practices. The definition of the regulatory framework corresponds to the national level, while the oversight of its application usually relies on local authorities (or local entities to whom a national delegation has been established).

Ex-post evaluation

The project cycle closes with the evaluation of the impacts of rural roads over a period of a few years after the upgrade of the infrastructure. The results of these evaluations represent a critical input to inform the next round of investments.

These evaluations however present important methodological challenges, given that proper scientific evaluation requires counterfactual cases that help identify the net impact of a with-project situation compared to a similar case of a without-project situation—that is, the changes in the values of various economic and social indicators in a rural community subject to the upgrade of its rural roads compared to another area with overall similar social and economic conditions but not subject to improvements in its rural network. Since there may be other intervening factors, the search for a comparable situation can pose important challenges. Alternatively, though not as precise but more practical to identify trends, the changes in the conditions of the rural area can be compared to average changes for rural areas as a whole in the country to identify whether or not the interventions have yielded changes significantly different from the average values for the whole set of rural areas. Improvements in geographic information systems and in data collection (through such instruments as living standards

surveys or poverty assessments) can help in facilitating the ex-post evaluations. National entities have a critical role to play in advancing them.

In sum, the project cycle encompasses a set of analyses with an objective at taking into account the best use of the limited resources to achieve the goal of enhancing rural access and with it underpinning improvements to rural economies and livelihood conditions. While most of the activities should be undertaken by entities at the local level, national entities have a critical role to play in building up local capacities in planning, priority settings, technical design, and the dissemination of knowledge and experiences in the application of alternative options.

6) Conclusions

To summarize the discussion above there are a number of dimensions that should be considered when designing a rural roads program or developing policy in support of rural roads development:

Rural roads and development: There is a significant body of research which demonstrates the positive impact of rural roads development in reducing poverty, improving access to essential social services and providing access for rural communities to participate in the wider economy. However, there are significant challenges in successfully implementing rural roads programs where networks are often large, lightly trafficked and in remote areas. Often local level capacity is inadequate both in terms of its financial and human resources which poses challenges for the long term management and maintenance of the network. Any interventions in the rural roads sector have to give sufficient consideration to the long term management of the network.

Institutional responsibilities: It is important that there is clarity on who will plan, design, manage, finance and maintain the networks even if responsibilities shift through the project cycle. A major issue in many countries is that there is insufficient clarity over who owns the network and by extension who has subsequent responsibility for maintenance and management. This is particularly a problem where roads are built under a national program without sufficient consultation with local communities and thought over subsequent management responsibilities. If any of these functions will be undertaken by local government a capacity assessment should be undertaken to ensure that they have the necessary human and financial resources to undertake the work. In all cases the ultimate beneficiaries need to be consulted and where possible involved in each step of the project cycle.

Financing: In many countries the financial resources are not available at the local level for both capital and maintenance works. Very often there is some form of national level financing at least for capital works that also helps to signal priorities to local levels. However, alignment is required so that national transfers or grants, and their equity or equalization objectives, create the right incentives for adequate planning (including environmental planning), engineering designs, and maintenance practices. Where possible some form of local level contribution is required to ensure the necessary ownership and incentive structure for subsequent maintenance. It is common that roads are handed on to the local authority following construction without a sufficient funding mechanism for their long term maintenance. This can be a particular problem where funds come from central government as a block grant and maintenance activities usually take second place to new construction activities.

The project cycle: The project cycle includes planning and priority setting, project design and implementation, the management and maintenance of the assets created, consideration for the supply of transport services and the subsequent evaluation of outcomes. All are essential for the provision of long term sustainable access and mobility for rural communities. Experience suggests that one of the greatest challenges is in the long term maintenance of assets as insufficient attention has been given to this part of the project cycle. Successful approaches to maintenance have tended to include a strong partnership between the community and public works departments where both have been involved throughout the project cycle. The community monitors road condition and ensures routine maintenance is undertaken and the public works department provides technical support and resources for heavier maintenance activities.

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