



# Rural Roads - Issues and Development: Overview

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## ABSTRACT

**Objective:** At the beginning of the 21st century the UN Millennium Development Goals drew the attention of the development community to social development projects, and infrastructure development was only given a new impetus with the World Trade Organization (WTO). Rural transport depends on appropriate infrastructure where consists mainly of rural roads, tracks, trails and footpaths. **Methodology:** As rural households, 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. World Bank study estimated that 15 % of the agricultural produce is lost between the farm gate and the consumer because of poor roads and inappropriate storage facilities alone, adversely influencing the income of farmers. International Fund for Agricultural Development observed that construction of rural roads almost inevitably leads to increase in agricultural production and productivity by bringing in new land into cultivation, intensifying existing land use to take advantage of expanded market opportunities. **Results:** Therefore, in this paper points to are some aspects of the character of rural roads for the development of rural economy. Namely, in order to avoid the problems associated with rural road development, it is advisable to prepare a rural road plan by building strong database, which consists of village level information and road inventory details. **Conclusion:** The Village and Road Information System (V&RIS) developed under GIS environment is very much useful for problem identification, planning, allocation of resources and location of various socio - economic facilities for an integral rural development.

## 1. Introduction

Approximately one billion people according to Hine et al (2014), citing on research World Bank (2007) indicates that or about 40 % of the rural population served by the International Development Association (IDA), the World Bank's fund for the world's poorest countries, lack reliable access to the road network. As a result, rural road investment is a significant component of government and aid agency budgets. The World Bank alone spends in the region of US\$ 1 billion per year on rural roads; this excludes expenditure on main and secondary roads (World Bank, 2007).

Jouanjean (2013), citing on research Bryceson et al. (2008) and World Bank (2008) & World Bank (2011) indicates that the issue of the importance of improving rural infrastructure, and in particular rural roads, is not new in the development community. This topic has long been at the centre of development policies, supported by the popular assumption among development theorists that remote areas' disadvantageous position vis-à-vis economic opportunity and social welfare could be remedied with road building. Investments in rural infrastructure were considered to have important positive effects on agricultural production and trade, and governments and donors invested heavily in the development of rural roads and transport corridors. Yet - perhaps because the importance of such infrastructure for development seemed so obvious - there has for some time been little formal evidence on how and under what conditions roads benefited rural households and agricultural development. By the end of the 20th century various studies nonetheless showed that the causality between road building and rural development should be more nuanced. The World Bank 1994 World development report on infrastructure for development highlighted that focusing solely on increasing the quantity of installations was not adequate: more should be done on the quality and efficiency of related services.

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At the beginning of the 21st century the UN Millennium Development Goals drew the attention of the development community to social development projects, and infrastructure development was only given a new impetus with the World Trade Organization (WTO) - led Aid for Trade initiative. Trade - related infrastructure is one of the four Aid for Trade categories of support - as defined by the Organization for Economic Co - operation and Development and the WTO - along with technical assistance for trade policy and regulations, productive capacity building (including trade development) and trade - related adjustment. For a long time discussions of developing countries' access to developed markets for agricultural and food products focused on efforts to reduce traditional barriers (Jouanjean, 2013). According to Hine et al. (2014), citing on research De Walle (2008) indicates that despite the importance of the topic, there is some dissatisfaction with the evidence to demonstrate the impact of rural road investment. Although there have been quite a number of studies of impact, giving varying results, much of it has been anecdotal and in 2008 one reviewer came to the conclusion that there were relatively few studies that had been carried out with proper controls and subject to rigorous analysis and statistical testing.

## 2. Materials and methods

The presented material was mainly based on the study of many international specialty papers (see references at the end of the paper), from the observation of rural roads, on the occasion of documentation, as well as in consultation with numerous articles and studies published on Internet. A number of official websites of institutions and central and local management bodies has been taken from: OECD (1986), International Fund for Agricultural Development (1995), World Bank (1997), World Bank (2007), NSW Roadside Environment Committee (2014) and others.

## 3. Discussion and results

### 3.1 Analysis and Discussion

Rural transport depends on appropriate infrastructure according to Lombard and Coetzer (2007) 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, 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. 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.

A pattern diagram of a road network in a rural area is shown in Figure 1. Most of the rural roads and rural access roads in developing countries are unpaved, graveled or even just earth roads. During the rainy seasons, they are in such a poor condition that people struggle to pass along them by tractor, bike or even non - motorized traffic (NMT), such as bicycles or animal - drawn carts. Due to the difficulty of reaching markets to sell their agricultural produce and other goods in the rainy seasons, rural people are locked into subsistence farming. Buyers also cannot reach the village; thus, the cash crops cannot be exchanged for money and the crops rot. Better market incentives for farmers are blunted because of the physical barriers and economic costs of transporting goods to and from local markets. The impassability of the rural access roads also hampers the provision of basic social services, such as health, education and information.

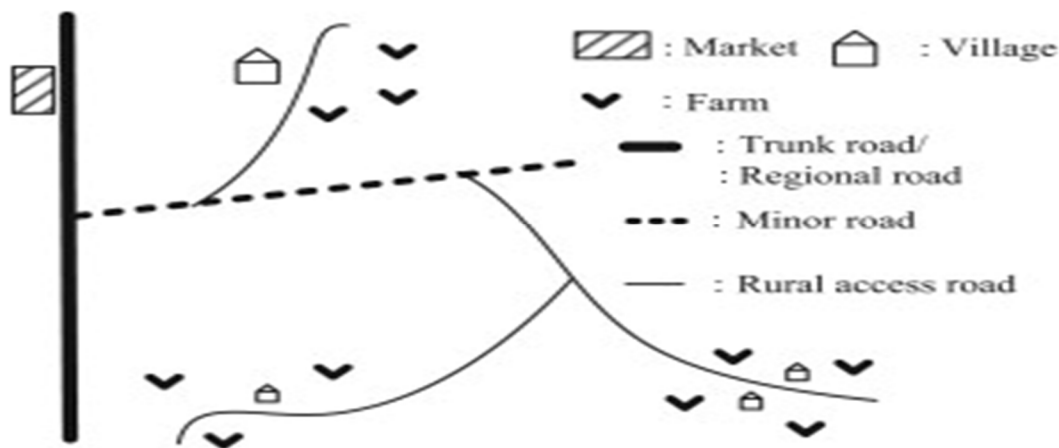


Figure 1. Pattern diagram of road network in rural area.

Rural access roads are the lifeline for people living along the roads, and they provide intra - and near - village transport connecting the houses and farms in various communities, as shown in Figure 1. Rural access roads are generally earth roads less than 20 km in length. Transport activities on rural access

roads are performed to a certain extent on foot, sometimes by intermediate means of transport, such as bicycles and animal - drawn carts, and occasionally by motorized transport. The average daily motorized four - wheeled traffic on most rural access roads is below 50 vehicles per day (VPD), whereas the NMT can be a multiple of this number.

According to Escobal and Ponce (2006) authors like Jalan and Ravallion (2002) have highlighted the importance of both the existence of rural infrastructure facilities as well as the complementarities among them, as an essential requirement for rural income growth and poverty reduction. These authors find that in order to overcome poverty traps it is crucial to assure not only the access to some particular key public facilities, like roads or electricity, but also the conformation of a critical mass of complementary key public infrastructure facilities. Escobal and Ponce (2006) further states research as Gannon and Liu (1997) which emphasize that, the microeconomic mechanisms by which road infrastructure investment generates positive impacts on economic growth and poverty reduction have been recognized by specialized literature. According to these authors, rural infrastructure investment allows, on the one hand, the reduction in production costs and transaction costs, fostering trade and making possible division of labor and specialization, key elements for sustainable economic growth. Furthering that kind of argument according to Escobal and Ponce (2006), Blocka and Webb (2001) find that higher road density promotes specialization, enabling farmers to develop a more intensive agriculture based on modern inputs. On the other hand according to Escobal and Ponce (2006) another mechanism pointed out by Gannon and Liu (1997) is related to how rural infrastructure improvement fosters increases on the profitability of public and private assets belonging to households that have access to such infrastructure.

The management of minor roads is problematic according to Spooner (2015) where legislation requires councils to address a number of competing values, and manage roads accordingly (Table 1). For example, efforts to conserve biodiversity in road reserves must be balanced with road safety and fuel reduction priorities. This is no easy task, where efforts to maintain roadsides vary enormously from one council jurisdiction area to the next. Unfortunately, many rural types of council cannot afford a dedicated environment officer, and so compliance to any roadside vegetation conservation plan is often lacking. Roadside vegetation plans need to be promulgated in local by - laws for compliance to take place. A further problem is that roadside environment conservation training for workers is often lacking or non - existent, and local contractors are often over - looked in the training process. Ongoing training and monitoring is critical to ensure that workers know exactly where high quality/ conservation value sections are, so as to avoid damage by heavy roadwork's machinery. To this end, simple marking (signage) of roadsides (using color - coded markers on existing road reflector posts) has been successfully implemented in many council areas to warn road workers of sensitive vegetation areas.

**Table 1. Overview of competing values and management considerations of minor rural roads**

Roadside value	Description and management considerations
Connectivity	Prime function of road for humans Wildlife collisions (links to road safety) Dispersal conduit for species
Cultural heritage	Historic bridges, aqueducts, cuttings, Location for scar trees, monuments, memorials, and other built objects of historic significance, Historic road, stock routes, drove roads, drift way, sunken roads.
Ecotourism values	Route to explore sites, localities or landscape Interpretation signage and other infrastructure
Environmental	Refuge for threatened species and ecosystems Seed source for re vegetation activities Weed and pest management Fire and timber management Provision of ecosystem services e.g. pollination
Infrastructure corridor	Corridor for water supply, electricity, gas and telecommunications Vegetation clearance for utilities
Recreational	Sight - seeing, horse riding, hiking, bike riding educational values
Resources	Source of firewood/ rocks/ gravel and sand Stock grazing for fodder during drought Stockpiling of materials for road management
Roadside amenity	Aesthetic values of roadside Litter management Transport parking areas
Transport and road safety	Legal requirements/ insurance, Road upgrade, construction and maintenance requirements, Soil stability management/ landslides, Water runoff, run - on control, flooding, snow and ice.

\*Source: Spooner (2015) according to NSW Roadside Environment Committee (2014).

It is critical for state and federal environmental agencies to provide necessary resources to local government road managers to conserve roadsides. Given that conservation outcomes derived from roadsides can greatly contribute to catchment or state based conservation targets, these assets cannot be ignored. Also in terms of future climate change scenarios, a green network is already in place to assist native species to disperse across the landscape. In this context, it is vital that roadside vegetation networks are maintained and even improved with further restoration programs. Ongoing monitoring of roadsides is also vital, as vegetation conditions can both improve and deteriorate, depending on prevailing disturbances (i.e. stock grazing, fire, flood, or soil disturbances from road maintenance activities) (Spooner, 2015).

To assist in maintenance planning, it is important to define a "core network" of roads to be maintained in good condition, with procedures for condition monitoring and maintenance programming. Routine and periodic maintenance should therefore be identified as a specific component of rural road spending priorities, with defined tasks and budgets, and routine reporting of measures of achievement. It is important that routine maintenance funds be tied to specific outputs, and not simply allocated to staff and equipment costs. The second priority for rural roads spending should be to selectively add roads to the maintainable core network through rehabilitation and upgrading, including through spot improvements to drainage and badly damaged road sections. Since maintenance of the core network takes highest priority for road funding, additional roads should only be added to this network through upgrading or rehabilitation when the capability and resources have been established for their maintenance.

Selection criteria should take account of traffic flows and functional importance. If budgets are limited, it may be necessary to exclude some roads, even in good or fair condition, from the core network. This implies a "disinvestment" in these routes, typically due to low traffic flows or low functional importance. Separate provision should be made for emergency maintenance works required to keep lower - quality roads open and serviceable. Some funding is essential for such works, recognizing that they often provide only short - term benefits until more extensive rehabilitation works are undertaken. However it is most important to ensure that routine maintenance resources are protected and not diverted to these activities, if necessary by reducing spending on upgrading and rehabilitation.

Responsibility for "non - core " roads would then revert to communities and local residents, possibly supported by small grants and technical assistance. If community roads are short (not more than 5 - 10 km), do not cross major obstacles (e.g. rivers or swamps), and lead to good quality roads, then local efforts should lead to substantial improvements in accessibility to transport services. For such roads, improvement works should be primarily labour - based. Because improvements require local initiative, the likelihood of sustained maintenance is high.

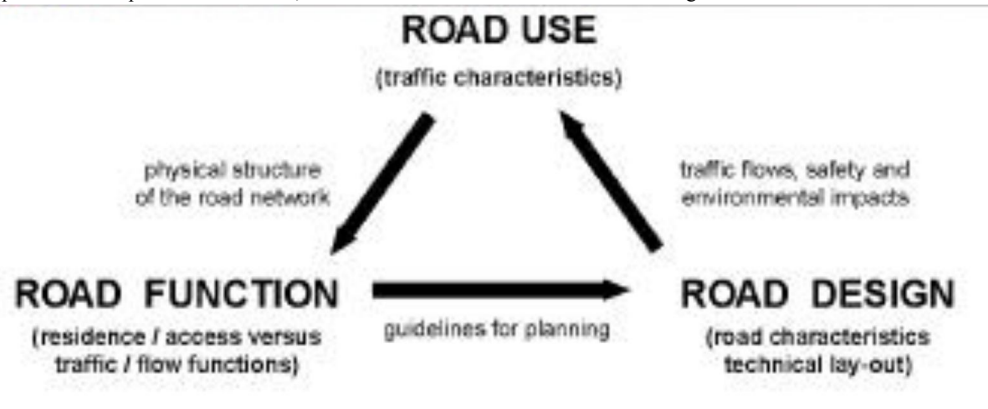


Figure 2. Relationship between road function, design (technical layout) and traffic use (Jaarsma, 2000).

Traffic problems on minor rural roads should according to Jaarsama (1991) be solved on a regional scale. Moreover, Jaarsama (1991) citing on research OECD (1986) indicates that the relationships between minor roads (local collector and access roads) and major roads (rural highways and motorways) in the regional network should be considered. "To get a safe and efficient traffic system, first a functional classification of the network should be made. The assignment of functions to the regional road links should be based on an inventory of the present situation (function; traffic volumes and speeds; traffic accidents; acceptable road capacity; geometric features), regional transportation plans, (possible changes in) land uses and traffic volumes. A proper distinction between minor roads with (mainly) a residence (access) function and minor roads with (mainly) a traffic (flow) function should result from this functional classification. Next step in the planning is a mutual harmony between (1) desired function, (2) technical layout and (3) traffic characteristics, for every road link in the regional network in question. This is schematized in the Figure in 2" (Jaarsma, 2000).

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 (Ellis and Menendez, 2014).

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.

\*Source: Ellis and Menendez (2014).

Key dimensions according to Ellis and Menendez (2014), 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?

In order to avoid the problems associated with rural road development, it is advisable to prepare a rural road plan by building strong database, which consists of village level information and road inventory details. GIS supports multiple views of data and yet provide integration that would minimize redundancy and maintain data integrity and security. It allows concurrent access to multiple users and processing of user transactions in an efficient manner (Rao et al., 2003).

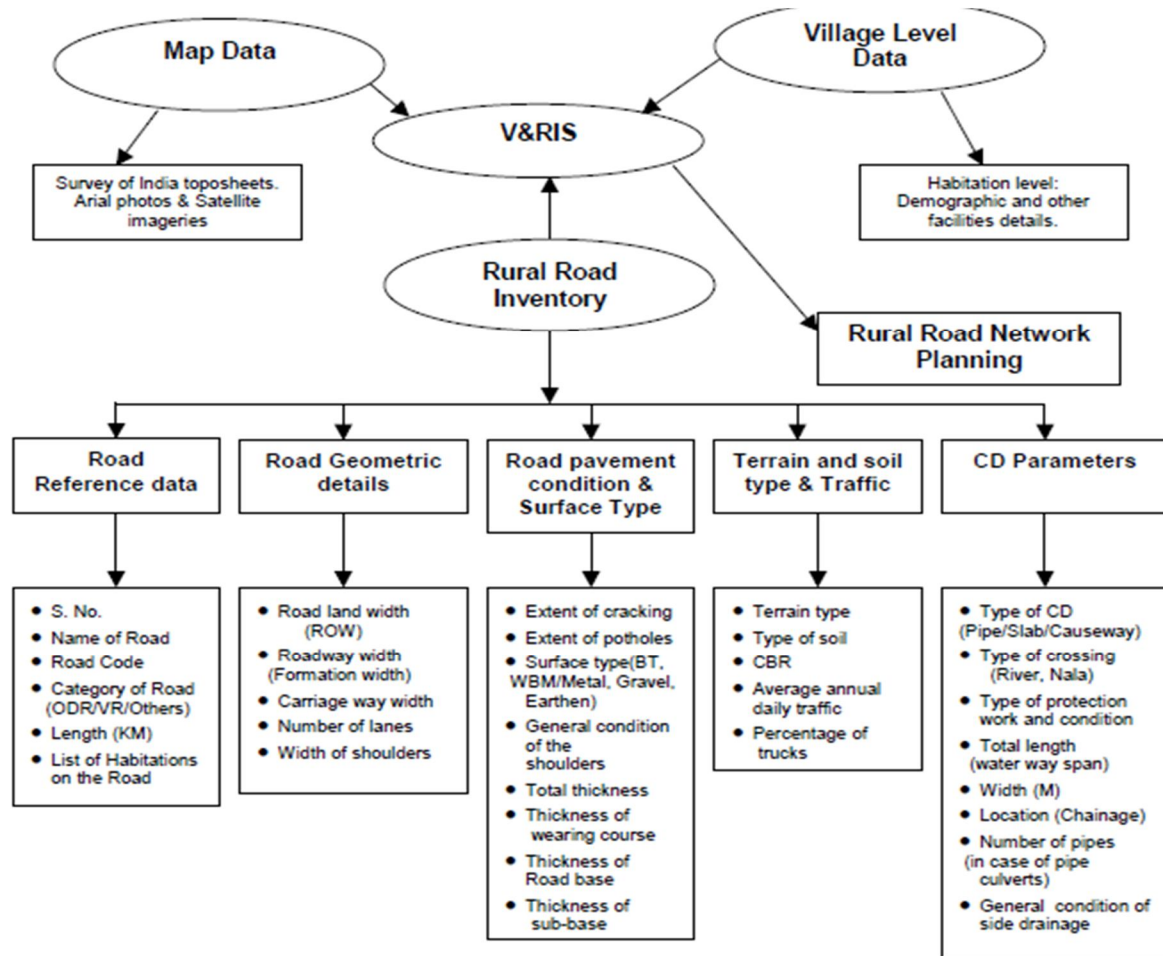


Figure 3. Flow Chart for Village and Road Information System (Rao et al., 2003).

The most advanced computer based information technology tool for spatial planning is the Geographic Information System, which would become indispensable in planning and management of database. GIS can be used as an effective tool for village and road information system, which will help the planners and administrators to identify the problems associated with rural road development activities, location and provision of appropriate facilities, monitoring and maintenance management of the assets created in rural areas. In these cases the information generated from the villages as well as the decision taken at the official level will flow faster to the official involved in development activities. Therefore, there is an urgent need to develop a simple method for collection and collation of data of village and roads, which will help in planning and provision of various facilities (Rao et al., 2003).

Highlights the various data requirements of Village and Road Information System (V&RIS) (Figure 3). The Village and Road Information System (V&RIS) developed under GIS environment is very much useful for problem identification, planning, allocation of resources and location of various socio-economic facilities for an integral rural development. It is also useful for creation, maintenance and accessing the GIS database. V&RIS can serve as an efficient tool for decision making with respect to any rural development programmed. Further using the information available at the road network layer, it will be easy to estimate the construction cost of selected links. Based on overall information, the budget required for providing all-weather road access to all villages and its priority can also be calculated for phase wise development. Road Maintenance Management System can also be developed using the database, which will sustain the road for a longer time with minimal efforts (Rao et al., 2003).

#### 4. Conclusion

In an age of uncertainty one thing is certain: the poor of the world are getting poorer while the rich are getting richer. It is now seen that in the last 25 years of national and international effort the pattern of development has often resulted in growing disparities between the living standards of countries and also in many developing countries between classes in the same country. In an age that has seen massive economic growth for the world as a whole there are still about 40 developing countries where the annual income per head is less than \$200. Thirty per cent of the world's population, 1200 million people, lives in these countries. Even in those countries of the Third World which are above this poverty line it is often the case that the benefit of over half the national income goes to less than one quarter of the population. The poor countries are those that rely almost entirely on agricultural production and where 80 - 90 percent of the population lives in rural areas by subsistence or near subsistence farming. It is these facts that have led to new thinking nationally



and internationally about directions for development and new policies of aid to developing countries. Indeed “a widespread current view among analysts of the development process is that, unless specific action is taken to assist the poorest groups directly, relative poverty will increase and any reduction in the numbers of people living in a state of absolute poverty will be painfully slow.

Construction and modernization of rural roads in function development rural economy is certainly a priority. Namely, rural roads according to Lindsay and Kongolo (2014) citing on research Barret et al. (2001) and Donngos et al. (2007) indicates that play a role in the provision of physical access. Physical access further plays an important role in reaching a number of the Millennium Development Goals. The benefits of improved access can be short lived if the rural roads are not managed and maintained. In most instances rural roads are defined as those roads with less than 50 vehicles a day, ranging from engineered roads and bridge that link to towns and villages, to motor able tracks, trails and paths. In general these roads serve dispersed households and populations, often with an agricultural or natural resource based land use structure. Rural road networks also tend to be large and complex; they are often 2 to 3 times the size of the main and regional networks, but carry only 10 % of the traffic in vehicle kilometers. Lindsay and Kongolo (2014) concluded using the study Buys et al. (2006), to understand issues with rural road management it is necessary to understand the decentralization context in the various countries. Also, to assist decision making on improved management arrangements for rural roads it is necessary to get to know the extent and condition of the rural road network. Furthermore, it will be important that transport policies take into account rural transport issues in general, and that the legal context for the management and financing of rural roads is clearly defined in the country’s road legislation or Roads Act. Rural roads and transport are essential for sustaining agricultural development.

Rural road increases the diffusion of agricultural technology by improving access to markets, enhances more efficient allocation of resources, reduces the transaction costs as well as helps the farmers to realize better input and output prices. Improved road infrastructure also increases the transport facility through which the rural farm households are able to get better health care, education and credit facility. Rural - urban linkages are developed through road development, which also helps strengthening the backward and forward linkages in agricultural sector. Better road connectivity opens up employment avenues outside the village that improves the living conditions of the poor, reduces the marginal costs of agricultural production through lower transaction costs that has the potential to increase both producer and consumer surpluses which eventually have a positive impact in reducing rural poverty.

World Bank study (1997) estimated that 15 % of the agricultural produce is lost between the farm gate and the consumer because of poor roads and inappropriate storage facilities alone, adversely influencing the income of farmers. Poor rural road infrastructure limits the ability of the traders to travel to and communicate with remote farming areas, limiting market access from these areas and eliminating competition for their produce. Easier access to market allows expansion of perishable and transport - cost intensive products. International Fund for Agricultural Development (1995) observed that construction of rural roads almost inevitably leads to increase in agricultural production and productivity by bringing in new land into cultivation, intensifying existing land use to take advantage of expanded market opportunities. Better roads also lowered the transaction costs of credit services, resulting in increased lending to farmers, higher demand for agricultural.

In order to avoid the problems associated with rural road development, it is advisable to prepare a rural road plan by building strong database, which consists of village level information and road inventory details. GIS can be used as an effective tool for village and road information system, which will help the planners and administrators to identify the problems associated with rural road development activities, location and provision of appropriate facilities, monitoring and maintenance management of the assets created in rural areas. The Village and Road Information System (V&RIS) developed under GIS environment is very much useful for problem identification, planning, allocation of resources and location of various socio - economic facilities for an integral rural development. Road Maintenance Management System can also be developed using the database, which will sustain the road for a longer time with minimal efforts (Rao et al., 2003).

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