



सत्यमेव जयते



Ministry of Rural Development
Government of India

New Delhi, May 2007



“ My Government proposes to undertake a major plan for rebuilding rural India called **Bharat Nirman**. This will be a time-bound business plan for building rural infrastructure in the areas of irrigation, roads, housing, water supply, electrification and telecommunication connectivity. The programme has been conceptualized as a platform on which the Government would construct its new deal for rural India. ”

Address of Hon'ble President of India to Parliament
On 25th February, 2005



“ Roads become a lifeline to new markets, new businesses, new incomes, and, above all, to new opportunities. Even a narrow road can be a Highway to prosperity. Bharat Nirman would ensure that every village in India has access to markets, to services, to opportunities, indeed, to prosperity. ”

Dr. Manmohan Singh, Prime Minister of India
On 16th December, 2005



“ Urban amenities should be available to people living in villages. If villages are provided with the facility of well-built good roads, nobody can stop India from moving towards top-ranking nations of the world. ”

Dr. Raghuvansh Prasad Singh
Minister of Rural Development, Govt. of India



RURAL ROAD DEVELOPMENT PLAN: VISION 2025

New Delhi

May, 2007



**National Rural Roads Development Agency
Ministry of Rural Development
Government of India**

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Foreword

India lives in its villages. The development of rural areas is unthinkable without the provision of All-Weather Road access to all our villages and habitations. Realizing that there are still vast areas with low levels of connectivity, the Government of India decided to undertake the massive programme of rural connectivity under the Pradhan Mantri Gram Sadak Yojana (PMGSY). The intention is to provide not simply rural tracks/ paths but a well laid-out network of well engineered and durable roads though out the country.

I take this opportunity to congratulate the officers of my Ministry and the NRRDA, who took several bold steps including laying down of proper standards, quality control, standard bidding documents, standard data book for rate analysis, dedicated specifications for rural roads. The support of the Indian Roads Congress (IRC) in this endeavor is also appreciated. My Ministry also laid down firm guidelines and procedures for preparation of District Level Rural Road Plans, so that today we have a complete Core Network identified for phasewise development of the PMGSY Programme. Such plans have been prepared with the full involvement of the elected representatives of the Panchayats and the State Governments. The Core Network includes links to the market centers, social and economic services. I am glad that the State Governments have also geared themselves to effective implementation of the programme.

Our Hon'ble President in his address to the Parliament in 2005 spoke of "**Bharat Nirman**" as a business plan for rebuilding rural India including all weather road connectivity to all habitations with population above 1000 (500 in case of hills, deserts and tribal areas) by 2009. Adequate financial resources have been mobilized to achieve the goals of Bharat Nirman within the stipulated time frame. I am confident we shall achieve the targets with the active support of the State Governments.

It is to be recognized that even after the habitations eligible under PMGSY are fully covered we would still be left with a large number (about 1.68 lakhs) unconnected habitations of lower size population. We must serve the last person and the remotest village. We, therefore, decided to formulate a 20 Year Vision Covering various aspects related to rural areas and its dovetailing with the higher categories of roads and the urban landscape. The preparation of the Draft was entrusted to the Indian Roads Congress. I would like to complement the IRC in coming out with a comprehensive draft of such a Vision.

I understand that the document has been subjected to several rounds of intensive discussion among the members of the IRC council and thereafter in the Steering Committee set up by my Ministry which included Secretaries in Charge of Rural Roads in the States and eminent domain experts/ specialists.

I would like to place on record my deep sense of appreciation for the painstaking efforts made by the officers of my Ministry and the NRRDA and specially Shri. S. Vijay Kumar, former JS (RC), Shri. J.K. Mohapatra, JS (RC) and Shri Subas Pani, Secretary (RD) in finalizing the Vision Document.

The Vision lays down clear milestones and implementation strategies covering financial, institutional, managerial and technical aspects with emphasis on preservation of assets being created with huge costs to the economy. These will require attention of both the Central and State Governments.

I would like to dedicate the Rural Roads Vision: 2025 to the nation and I am confident this would help in serving as a blueprint for a resurgent rural India.

May, 2007
New Delhi


(Raghuvansh Prasad Singh)

Preface

The Government of India launched in December 2000, the programme of village connectivity known as Pradhan Mantri Gram Sadak Yojana (PMGSY) with the objective of connecting all unconnected habitations having a population of 500 and above with all-weather roads. The population threshold is relaxed to 250 in case of hill, tribal and desert areas.

In departure from the earlier programmes of rural road development, the PMGSY is a hundred percent funded programme of the central government. The Ministry of Rural Development (MoRD) has been entrusted with the task of implementing this programme. The National Rural Development Agency (NRRDA) – an arm of the Ministry provides management and technical support to this programme. The Ministry of Rural Development has already brought out dedicated specifications for rural roads and Standard Data Book with the support of the Indian Roads Congress. This has helped in setting national standards and specifications for rural roads at national level for uniform implementation at local level duly taking into account different terrain, soil and traffic conditions in the country.

The Hon'ble Union Minister for Rural Development, Dr. Raghuvansh Prasad Singh rightly perceived that there is need for preparing a vision for development of rural roads that should go much beyond the current PMGSY and it should cover a 20-year time horizon. Accordingly, the Ministry of rural Development entrusted the task to the Indian Roads Congress since this professional body of highway engineers had earlier been engaged in preparing long-term plans for roads for the country.

I would like to acknowledge the support of the IRC and particularly its Group of Experts comprising Sarvashri D. P. Gupta, L. R. Kadiyali and P. K. Lauria, who have brought to bear their profound experience in preparation of the draft vision. The draft was reviewed by the Steering

Group of IRC headed by its President and discussed in the Council. The draft document received from the IRC was further deliberated upon by the Steering Committee of the MoRD, which was chaired by Shri J. K. Mohapatra, Joint Secretary (Rural Connectivity) and DG, NRRDA, and included Secretaries to the state governments dealing with rural roads.

A number of useful suggestions and comments were received both from the IRC Council and the Secretaries to the state governments. The document was thereafter reviewed and revised by the officers of the NRRDA and the Ministry of Rural Development in consultation with the Indian Roads Congress.

The major areas covered in the Rural Road Development Plan: Vision 2025 relate to preparation of district rural roads plans, targets of connectivity to all unconnected habitations of the country going beyond the PMGSY norms, preservation of rural roads assets, emphasis on engineered roads and quality construction with judicious blend of labour and light machinery so that roads being constructed are durable on the one hand and use of local materials and local skills is maximized on the other hand. Reference has also been made to some promising international practices for suitable adaptation in our context. The document also brings out implementation strategies with priority being accorded to the flagship programme of the government relating to Bharat Nirman, which includes rural roads as one of its key components.

The leadership and guidance provided by the Hon'ble Minister has brought the Vision Document to its present shape. I sincerely believe that this document would guide the Centre and the States in their efforts to formulate and implement the long term plans for the development of rural roads.

May, 2007
New Delhi



Secretary, Rural Development
Government of India

Executive Summary

1. As India launched the era of planned development in 1951, she had a reasonably good railway system, a few ports and around 400,000 km of serviceable road network. Accessibility to villages was poor as only about 20 percent of them had all-weather road links. The Government laid down a framework for accelerated growth through investments in irrigation, power, heavy industry and transport. Side by side, stress was laid on provision of social infrastructure (education and health) and integrated rural development including agriculture.
2. Emphasis is continuing in social development sectors so as to improve the quality of life and alleviate poverty. The Central Government have set up a National Committee on Rural Infrastructure under the Chairmanship of the Prime Minister with the objective of improving rural infrastructure in a time bound manner for overall rural development. An initiative known as Bharat Nirman has been announced. This covers drinking water, housing, assured irrigation, telephone communications, electricity besides connectivity to villages by all-weather roads. Recently, another national level initiative by way of Rural Employment Guarantee Programme has been launched with the twin objective of employment assurance and poverty reduction. The country hopes to attain the status of a developed country by the year 2020 with substantial achievements of UN Millennium Development Goals, laying foundation for elimination of extreme poverty by the year 2025.
3. For development of roads, the long-term 20-year plans viz Nagpur Plan (1943-61), Bombay Plan (1961-81), Lucknow Plan (1981-2001), Road Development Plan Vision :2021 formulated by Chief Engineers in-charge of roads under the aegis of the Indian Roads Congress has served as sound reference framework for the central and state governments to formulate their successive Five Year Plans. As a result, the road network now stands at 3.3 million km. Of this, rural roads comprise around 2.7 million km, i.e. about 85 percent. Overall village accessibility stood at 54 percent in the year 2000, although position in respect of accessibility to large size habitations has been much better.

4. There is enough empirical evidence that rural roads serve as an entry point for poverty alleviation. A study by the International Food Policy Research Institute has revealed that an investment of Rs.10 million in roads lifts 1650 poor persons above the poverty line. It also contributes to growth in total factor productivity in agriculture which in turn helps in keeping consumer prices of food grains reasonable. Rural roads act as facilitators to promote and sustain agricultural growth, improve basic health, provide access to schools and economic opportunities and thus hold the key to accelerated poverty reduction, achievements of Millennium Development Goals, socio-economic transformation, national integration and breaking the isolation of village communities and holistic rural development.

5. The development of rural roads cannot be viewed in isolation from the needs of higher categories of roads and even changes affecting the urban landscape. National Highways (and Expressways) comprise the primary system serving the mobility function. State Highways and Major District Roads comprise the secondary roads combining both mobility and access function. Rural roads basically serve the access function. There is need for balanced development of all categories of roads as well as all regions of the country, priority for rural roads being given to new construction in areas of low connectivity and to improvements in areas of higher connectivity. For assessment of success in the development programmes of roads, a few transport indicators such as road density, village connectivity, traffic pattern, public transport services, safety, revenue, socio-economic benefits have been identified for data collection and analysis by various organisations concerned with rural development. On the one hand, we need to accelerate the process of providing new road links to habitations in low connectivity states, on the other hand, we need also to upgrade the existing road in the comparatively better off states to squarely meet the development needs both economic and social.

6. A major thrust to the development of rural roads was given at the beginning of the Fifth Five Year Plan in 1974 when it was made a part of the Minimum Needs Programme. In 1996, this was merged with the Basic Minimum Services (BMS) programmes. The works of village tracks were also taken up under several employment creation and poverty alleviation programmes of the Central and State Governments.

7. However, in order to give a boost to rural connectivity, a Rural Roads Programme known as the Pradhan Mantri Gram Sadak Yojana (PMGSY) was launched in December 2000. As a departure from the earlier programmes, the PMGSY is being implemented as a 100 percent centrally funded scheme. As per the current guidelines, the PMGSY covers all habitations above 500 population to be provided with all-weather rural roads. In case of hills, deserts and tribal areas, the threshold is relaxed and covers all habitations above 250 population. It is estimated that about 1.79 lakh unconnected habitations need to be taken up under the PMGSY programme. This would involve new construction in a length of about 375,000 km at an estimated cost of Rs. 78,000 crore and improvements of 372,000 km at an estimated cost of Rs. 59,000 crore. Upto the end of December, 2006, a total of about 83,000 habitations have been covered and rural road works for an amount of Rs.38,387 crore have been sanctioned.

8. Besides the balance work of PMGSY which in itself is an ambitious task, there is need to tackle the requirement of connectivity to habitations with lower population in the interest of social justice and

removing sense of isolation of remote villages and bring them into main stream of national life. The objective has to be to provide full connectivity to all habitations including provision of bridges and culverts. Accordingly, the following vision for new connectivity has been recommended.

<ul style="list-style-type: none"> ● Habitations with population above 1000 (500 in case of hill, NE states, deserts and tribal areas) 	Year 2009-10*
<ul style="list-style-type: none"> ● Habitations with population above 500 (250 in case of hill, NE states, deserts and tribal areas) 	Year 2014-15
<ul style="list-style-type: none"> ● Habitations with population above 250 	Year 2021-22

* These are the targets as per the Bharat Nirman Programme

9. The state governments have proceeded systematically in the preparation of rural roads master plans at the district level (developing from the block level) as per the guidelines of the Ministry of Rural Development in due consultation with the rural administration (Panchayats) and elected members of the State Legislature and the Parliament. As a refinement of the current guidelines, the states could consider tools such as IRAP (Integrated Rural Accessibility Planning) developed by ILO and experimented in states of Orissa and Rajasthan.

10. The Central Government has also introduced the concept of a Core Network, which is defined as the network that is essential to provide one basic access to each habitation. Basic access means one all-weather road access from each habitation to the nearby market centre or rural business hub and essential social and economic services. The Core Network comprises of through routes and link routes. Through routes are those, which collect traffic from several link roads or a long chain of habitations and lead it to a market centre or a higher category road. Link routes connect single habitation or a group of habitations to through routes or district roads leading to market centres. Through routes have the potential of getting upgraded as Major District Roads in future. As such, the route alignment, design and construction standards for such roads be decided accordingly.

11. The state governments may use the District Rural Roads Plan and the Core Network developed as part of the PMGSY programme for a holistic planning and implementation of their state level programmes as well.

12. Rural roads do require proper engineering and design with special attention on drainage and protection works. The design standards, however, should be in harmony with the requirement of rural roads serving the 'access' function. It is preferable to optimize costs by stage construction in tune with traffic growth. For this, it is necessary to ensure proper budgeting for subsequent upgradation and given higher priority than new construction. Subject to consideration of rainfall and traffic intensity, black-topping of rural roads may be restricted to through routes and such link routes that link bigger villages say with population above 1000. In other cases, gravel roads may be provided. A comprehensive manual on gravel roads should be prepared synthesizing the practices in India and abroad.

13. In order to manage the land availability process equitably and in a manner that reflects local concerns, the local community including the Panchayati Raj Institutions need to be fully involved in making land available for the road. Effort should be to encourage local community participation in voluntary land donation efforts. In occasional cases, land acquisition by payment of compensation may have to be considered. However, there is need to avoid excessive reliance on compensation based acquisition. The states need also to record the possession and ownership of all roads after following the due process. There is also need for integration of road network with GIS based land use data.

14. The formulation of specifications for rural roads and Standard Data Book by the NRRDA will facilitate adoption of uniform construction practices throughout the country. These documents should be periodically reviewed and updated based on implementation feedback from the ground. Construction technology should be intermediate with judicious blend of machinery and labour. The Indian Roads Congress with the support of CRRRI and MORD may draw up a matrix of various work items involved in construction and maintenance of rural roads and the appropriate work methods that can maximize use of local skills and local materials with light machinery.

15. Although there is increasing awareness regarding the need for maximized use of locally available materials, adoption of soil stabilization technologies and relevance of unsealed gravel roads for low volume rural roads have not yet found favour in many states.

16. There is scope for introducing light equipment (low end and low cost) that can perform equally well as the heavy road construction equipment. Their use should be encouraged as this will facilitate growth of small contractors for low volume of works locally. The Equipment industry also needs to focus on production of low-end technology machines. Pedestrian road rollers, chip sealing machines, simple equipment for spraying emulsions, cold-mix plants of small capacity, pot-hole repairing kit are some of the promising items of equipment that need to be developed.

17. Since large investments are being made in the rural roads now, it is desirable that good quality roads are constructed and durable assets are created. Quality assurance safeguards should be in-built at every stage of the project cycle viz surveys, investigations, design, bidding documents, construction and subsequent maintenance. A comprehensive total quality management system should be evolved and implemented. The three-tier system of quality management established for the PMGSY programme has been well received and the States will do well by adopting such features universally for all rural road programmes irrespective of the source of funding and the agency responsible for construction.

18. The states may also consider to institute a system of technical audit with a view to proposing corrective measures for future projects. The NRRDA may lay down the audit procedures (including outsourcing procedures) and develop the necessary guidelines for the technical audit.

19. Road safety should receive increasing attention in planning, design and implementation of engineering measures on rural roads. The engineering measures should preferably be identified with the help of traffic and safety specialist. It is also necessary to sensitize the communities and users of rural roads to road safety concerns and the role they can play in reducing the accident burden.

20. Generally rural roads follow the existing tracks in use for a long-time and environmental impact due to provision of all-weather connectivity is likely to be minimal. However, it is essential that the basic issues are not lost sight of. The road agencies must recognise the potential environment concerns and know how to plan and implement mitigation measures and comply with the provisions of the Environment (Protection) Act and the Environment (Conservation) Act and rules made there under. The MORD has recently finalised 'Environmental Code of Practices' for adoption on the rural road works financed by the World Bank. The NRRDA needs to evolve an all-India code of practice accounting for state level variations.

21. A broad assessment of the physical and financial requirements for rural roads has been carried out. It shows that investments in construction, upgrading and maintenance would need to increase from a level of Rs. 11,000 crore per year currently to Rs. 29,000 crore per year in the 14th Five Year Plan (2022-27). It may be noted that the proposed current investment is a mere 0.3 percent of the GDP and should, therefore, be considered modest and realistic.

22. Each state may work out its own district-wise requirements keeping in view the accessibility levels achieved in each district and the targets laid down for the PMGSY including Bharat Nirman and the need for connecting the low size habitations not covered under the PMGSY.

23. In view of the huge size of programme and constraints on mobilisation of resources, stress needs to be laid on cost cutting strategies such as:

- Promote use of locally available materials and waste materials from industrial plants in lower layers, by treating them with lime, cement or mechanical stabilisation. Continue R&D efforts in evolving cost-effective and innovative materials for road construction.
- Encourage intermediate technology for construction (labour based methods with light equipment) and enhance use of local skills.
- Review the current pavement design charts for flexible pavements in the light of performance studies by CRRI and international practices.
- Evolve low cost bituminous surfacings to provide water proofing layer on top.
- For access to small size habitations in areas with low to moderate rainfall, provide gravel roads with 3.0 m carriageway to start with. Stabilize the top layer with cement or other additives to reduce dust.
- Lay stress on provision of low cost water crossings

24. The major source of fund for development of rural roads is now the Central Road Fund. As per the CRF Act, 2000 half of the cess on diesel is earmarked for rural roads. It is a sound strategy that funds for this purpose are being generated at the national level and these are distributed on nationally agreed norms so that states with poor connectivity are brought on par with comparatively better off states.

25. Considering huge requirements for both development and maintenance, all possible sources of financing would need to be tapped. There is need to augment the current CRF. Also, states should create state level funds specially to take care of maintenance and rehabilitation needs. Already a few states have taken such initiatives by way of additional sales tax on petrol/diesel and levy of market fee on agricultural produce, etc. The strategy of borrowing funds from NABARD and multilateral financing agencies like the World Bank and the Asian Development Bank may continue for some time. This will help in accelerating the pace of accessibility to villages and improving quality of project implementation and institutional systems.

26. Timely and regular maintenance of existing rural roads is absolutely essential and does not admit of any laxity. The 12th Finance Commission in their Report has observed that it is far more important to ensure that assets already created are maintained and yield services as originally envisaged than to go on undertaking commitments for creating more assets. The Commission has recommended additional grants for maintenance of roads and bridges. An amount of Rs. 15000 crore has been provided over the period 2006-10. This amount is in addition to the normal expenditure which the states would be incurring on maintenance and is meant for non-salary components of maintenance.

27. The NRRDA may take the lead in introducing a Rural Road Management Act which, *inter alia*, clearly:

- defines the powers, functions and obligations of the road authority
- requires a register of all public roads in each block being kept with the Zilla Panchayat
- governs regulations of rural roads and requires instituting an asset management system.

The NRRDA also needs to bring out a detailed Maintenance Manual prescribing technical, management and accounting standards, and evolve efficient maintenance service procurement procedures.

28. A more detailed study of funds required for maintenance of rural roads on realistic basis should be undertaken by individual states. They should spell out minimum essential requirements. They may also set up a simplified maintenance planning and management system and carry out inventory and visual condition surveys at regular intervals.

29. In the first instance, the non-core roads may be devolved to the Panchayati Raj Institutions where partial subsidy could be given by the state government. Over time, maintenance of even core network should be undertaken by them.

30. The existing system of road gangs is inefficient. Some countries have successfully converted such road gangs into micro-enterprises who now undertake not only maintenance works but also earth works for road construction. There is need for finding a feasible solution for our country after study of problem in a few states.

31. The PMGSY programme seeks to integrate 'development' objective with 'employment' objective as it not only creates gainful employment opportunities to local people but also contributes to the creation of durable infrastructure. The current employment potential is estimated to be around 460 million man-days per year and would rise to over 950 million man-days by the 13th Five Year Plan (2017-22). Majority of the jobs would be in the informal sector. This would call for attention to aspects like occupational health, safety of workers, social protection and security and timely payment of wages. Being a member country of the United Nations, the guidelines and Acts on labour related aspects by the Ministry of Labour and Employment incorporate various objectives of the ILO viz promotion of rights at work, employment, social protection and social dialogue. The Standard Bidding Document on PMGSY works stipulate strict adherence to such requirements by the contractors. There is need to sensitize them and increase awareness for proper implementation. The Industrial Training Centres, Construction Industry Development Council and the National Academy of Construction could also help in this process.

32. The Panchayati Raj Institutions have to evolve themselves in a healthy manner over the coming years and emerge as the pivotal organisations at the district level in planning, construction and maintenance of rural roads besides their other functional responsibilities listed in the Eleventh Schedule. They should seek support and assistance from the PWD and other technical departments in the delivery of infrastructure development and provision of basic services. They need to work in close association with the voluntary agencies comprising of individual experts, NGOs, CBOs and SHGs.

33. The following main functions for various levels of panchayats are proposed.

(i) District Panchayat

- Ownership and construction of all roads
- Planning maintenance of all roads
- Maintenance of through roads under rural road category
- Coordination with District Planning Committee

(ii) Block Panchayat

- Network planning at block level
- Maintenance of link roads under rural road category
- Road safety and environment preservation of all rural roads

(iii) Gram Panchayat

- Selection of alignment
- Redressal of grievances
- Maintenance of non-core roads and roads within villages

34. The Government should fund capacity building of District Panchayats to enable them to take over functions like construction management, maintenance management and road safety. The future Finance Commissions may be approached by the states to recommend separate earmarked allocation of funds for maintenance of rural roads to the PRIs.

35. Since rural roads have been recognised as a major thrust area, the need for concerted Research and Development efforts aimed at evolving the most suitable and economical designs and developing appropriate technologies for construction and maintenance of low volume rural roads cannot be over emphasized. Some of the important thrust areas are:

- Critical appraisal of design and construction practices being adopted for low volume roads around the world.
- Review of the existing geometric design standards pertaining to low volume rural roads.
- Evolving low cost drainage and erosion control measures for low volume roads and preparing an exhaustive manual
- Identification of sources of locally available materials for road construction at district level and determining the strength and other characteristics of such materials.
- Developing stabilisation techniques for improving performance of locally available softer materials.
- Evolving appropriate technologies for the construction and maintenance of low volume rural roads, both sealed and unsealed pavements.
- Evolving suitable and economical 'Performance-Based' pavement designs for low volume rural roads, for both sealed and unsealed pavements.
- Evolving suitable and economical designs for low cost Cross-Drainage structures.
- Encouraging the use of cold mix technology and emulsions.
- Socio-economic impact assessment of rural road projects

36. Funds should not be allowed to be a constraint in pursuing the R&D work. An appropriate percentage of the amount of investment in rural roads may be set apart for this purpose. The CRRI and academic institutions in the country will have to carry the major burden of the R&D work. The CRRI needs to reorganize themselves to respond to this important call in view of their contribution to the cause of rural roads in the past. The Indian Roads Congress would also need to augment its efforts to support this essential and major component of the road infrastructure. The states should also utilize the results of R&D efforts to achieve economies in construction and maintenance of rural roads.

37. The implementation of PMGSY has helped in building up good absorption capacity of the states in terms of management structures and implementation procedures. It is clear, however, that further increase in absorption capacity will only come through institutional enhancements. There is need for a single specialized nodal agency in each state which should be responsible for overall policy, planning and management of all rural roads in the state. They should have uniform works accounting system

and move forward in becoming repository of computerized database covering road inventory, condition survey of roads and bridges, achievements in connectivity, traffic data and utilizing GIS and other IT-enabled facilities.

38. The Public Works Departments (PWDs) in the states are very old institutions and have evolved management and accounting procedures over time which now need to be adapted to the modern day requirements. Furthermore, substantial engineering works including rural roads would be required in the next twenty years requiring Rural Engineering Organisations. Irrespective of whether rural roads are currently with the PWD or the REO, it is necessary to create specialized rural road divisions so as to ensure necessary technical expertise and management quality. Such rural road divisions should be under a separate Rural Roads Wing in the PWD/RDD and be headed by a full time Chief Engineer. It would also be preferable to have a single cadre of Civil Engineers exclusively for road sector and in cases where rural roads are with the RD Department or with the PRIs, the Engineers should be taken on deputation from this single cadre of Road Engineers.

39. For sustained improvement in implementation of projects, development of contractors particularly small size in local areas is imperative. The adoption of intermediate technology would be of help in this direction. Some contractors specialize in different activities such as earthworks, bituminous works, culverts and bridges. They could be encouraged to serve as subcontractors. Mobilisation advance against machinery could be provided to contractors to assist them in owning equipment. The concept of equipment bank can also be encouraged as this would be of help particularly to small contractors. There is also need for capacity building of small contractors through training that can be organised through ITIs and polytechnics.

40. The role of consultants is also acquiring an important dimension in all stages of project cycle in the road sector and rural roads cannot be an exception to this. However, the works being small, scattered and spread over remote areas, there is need for district level consultants growth in addition to state and national level consultancy firms already available. The academic institutions have been playing a supplemental role although in some cases they also require exposure to ground realities.

41. Training policy for the rural roads sector is another issue requiring the serious attention of the government. The requirements are so huge that every state should set up a training centre for roads including rural roads. Concerted efforts are needed to identify the capacity building and training needs at various levels in road agencies, construction contractors and local (district level) consultants. Sufficient funds must be budgeted to the departments for conducting the training and creating the necessary training facilities. At the national level, the National Institute for Training of Highway Engineers is expected to perform the lead role and strengthen its activities with the support of the MORD. At the state level, the initiative of the State Government of Andhra Pradesh to create a National Academy of Construction is an example worthy of adoption by States. The training institutions in the country should also collaborate with international agencies like the ILO, TRB and IFG who are active in the rural road engineering field.

42. The Government also needs to develop independent think-tanks and academicians on various aspects of rural roads like engineering, safety, environmental issues, socio-economic impact, etc. They may fund positions in institutions like NCAER, IIPA, IIMs, IITs and NITs. Eminent persons with transportation, agriculture, economics, poverty and rural road engineering related disciplines need to get institutional support in this endeavour. The Ministry of Rural Development may provide lead role in this direction.

43. Action should be taken by each state to formulate a 5-year Action Plan in the light of recommendations of the Vision document. The Ministry of Rural Development and the states should monitor the implementation of the plan on a regular basis, review and update the plan every five years in the light of actual achievements, the demand of the economy and other developments taking place.

44. The Rural Roads: Vision 2025 is a declaration of the intent and recommends the directions and certain measures that should be taken in providing the road infrastructure to our people living in rural areas. This Vision is expected to serve the Central and the State Governments as a guide in providing rural road assets to quality standards for our people.

Abbreviations

ADB	:	Asian Development Bank
AASHTO	:	American Association of State Highway & Transportation Officials
ABC	:	Attitude, Behaviour and Culture of Drivers & Users of the Road
AIDS	:	Acquired Immune Deficiency Syndrome
ASCE	:	American Society of Civil Engineers
BMS	:	Basic Minimum Services
CIDC	:	Construction Industry Development Council
CRF	:	Central Road Fund
CRRRI	:	Central Road Research Institute
CVPD	:	Commercial Vehicles Per Day
DPR	:	Detailed Project Report
DRRP	:	District Rural Roads Plan
EAS	:	Employment Assurance Scheme
GDP	:	Gross Domestic Product
GERI	:	Gujarat Engineering Research Institute
GIS	:	Global Information System
GSB	:	Granular Sub-Base
HIV	:	Human Immune Virus
HRB	:	Highway Research Board
HRS	:	Highway Research Station
IFG	:	International Focus Group on Rural Road Engineering

IIM	:	Indian Institute of Management
IIPA	:	Indian Institute of Public Administration
IIT	:	Indian Institute of Technology
ILO	:	International Labour Organization
IRAP	:	Integrated Rural Accessibility Planning
IRC	:	Indian Roads Congress
IRD P	:	Integrated Rural Development Programme
IT	:	Information Technology
ITI	:	Industrial Training Institute
JBIC	:	Japan Bank of International Cooperation
JGSY	:	Jawahar Gram Samrudhi Yojana
JRY	:	Jawahar Rozgar Yojana
MDGs	:	Millennium Development Goals
MDRs	:	Major District Roads
MERI	:	Maharashtra Engineering Research Institute
MNP	:	Minimum Needs Programme
MORD	:	Ministry of Rural Development
MOSRTH	:	Ministry of Shipping, Road Transport & Highways
NABARD	:	National Bank for Agricultural and Rural Development
NCAER	:	National Council of Applied Economic Research
NE	:	North Eastern
NGO	:	Non Governmental Organisation
NHDP	:	National Highways Development Project
NICMAR	:	National Institute of Construction Management & Research
NITHE	:	National Institute for Training of Highway Engineers
NQM	:	National Quality Monitor
NREGP	:	National Rural Employment Guarantee Programme
NREP	:	National Rural Employment Programme
NRRDA	:	National Rural Roads Development Agency
OMMAS	:	Online Management Monitoring and Accounting System
PIU	:	Project Implementation Unit
PMGSY	:	Pradhan Mantri Gram Sadak Yojana
PRI	:	Panchayati Raj Institution
PTA	:	Principal Technical Agency

PWD	:	Public Works Department
R&D	:	Research & Development
RBH	:	Rural Business Hub
RD	:	Rural Development
REG	:	Rural Employment Guarantee
REGP	:	Rural Employment Generation Programme
REO	:	Rural Engineering Organisation
RES	:	Rural Engineering Service
RIDF	:	Rural Infrastructure Development Fund
RLEGP	:	Rural Landless Employment Generation Programme
RMI	:	Road Maintenance Initiative
SC	:	Scheduled Caste
SGRY	:	Sampoorna Grameen Rozgar Yojana
SGSY	:	Swarnajayanti Gram Swarozgar Yojana
SHG	:	Self Help Group
SQM	:	State Quality Monitor
SRRDA	:	State Rural Roads Development Agency
STA	:	State Technical Agency
ST	:	Scheduled Tribe
STU	:	State Transport Undertaking
TFP	:	Total Factor Productivity
TQM	:	Total Quality Management
TRB	:	Transportation Research Board (of USA)
UMI	:	Upper Middle Income
UN	:	United Nations
UNESCO	:	United Nations Educational Scientific & Cultural Organization
US	:	United States
USA	:	United States of America
WBM	:	Water Bound Macadam

UNITS

Rs	:	Rupees
US\$:	United States Dollar (1 US\$ = Rs 44 approx in 2006)
km	:	kilometre = 1000 metres
sq	:	Square
kg	:	kilogram = 1000 gram
t	:	tonne = 1000 kg
m	:	metre (unit of length)
cum	:	Cubic metre
1 million	=	10 lakh
10 million	=	1 crore
1 billion	=	1000 million
mile	=	unit of length in foot-pound-second system (= 1.6 km approximate)
litre	=	unit of volume

Socio-Economic Context

1.1 Past Development

As India launched the era of planned development in 1951, she had many assets: a democratic form of government, world-class leaders, an active entrepreneurial class, a modest degree of industrialisation and a sound administrative framework. A reasonably good railway network (54,000 km route length), five major ports, a poor yet serviceable road network (400,000 km) formed the transport system. The accessibility to villages was poor as only about 20 percent villages had road links. Average distance of a village from a blacktop road was 10 km and from gravel road 6 km. It had a large number of un-bridged crossings. Despite availability of several natural resources like minerals and river systems, poverty was appalling and literacy levels were low. The government laid out a framework for accelerated growth through investments in irrigation, power, heavy industry and transport. Side-by-side stress was laid on provision of social infrastructure like education, health and integrated rural development including agriculture.

The country moved slowly, with planned development, at an average Gross Domestic Product (GDP) growth rate of 3.6 percent up to 1980 and 5.4 percent during 1980-90. The Government introduced a series of economic reforms and structural changes in 1991, which had a salutary effect on the growth of the economy. The economy grew at around 6.2 percent during 1999-2000 and in the year 2003-04, the growth touched a high of 8.5 percent.

India's population rise overtook the growth in agricultural production during the early years of planning. In the early sixties, the country witnessed a spectre of hunger, and had to depend upon the munificence of donors. The government turned this challenge into an opportunity by importing several tonnes of High Yield Variety of wheat seeds. The agricultural technology was soon modernized with inputs like better seeds, fertilizers, pesticides and farm machinery. The "green revolution" was first ushered in

the States of Punjab and Haryana, but soon spread to other states. This development gave rise to other needs, like large grain markets, storage facilities, assured irrigation, power for tube wells, better roads for transportation, rural banking and credit facilities. Punjab, followed by Haryana, launched programmes for building rural roads to connect all villages. A similar success story unfolded in Gujarat in milk production, which was soon replicated all over the country. The “white revolution”, as it is called, also had several financial spin-offs like augmentation of rural infrastructure and transportation and storage facilities.

1.2 Recent Scene

Economic liberalization measures since 1991 have dramatically changed the outlook. The country has a very comfortable foreign exchange reserve, the rate of inflation is a modest 4 per cent, investments are picking up, exports are showing a healthy growth, and the Gross Domestic Capital formation as a proportion of GDP is 26.3 per cent. There is a good buffer-stock of 65 million tonnes of food grains, which can withstand any serious shortfall in food production on account of vagaries of monsoon.

There are many areas of concern that need attention in the coming years. One is the slow rate of growth of agriculture (around 2 per cent). For achieving a sustained rate of growth of 7-8 per cent, public sector investments in infrastructure like transport, irrigation, electricity, agricultural research, markets and communications in the rural areas will have to be stepped up, as these measures alone can halt the current trend in declining rate of growth in agriculture.

The second area of concern is the increasing population, a substantial proportion of which is poor. In 2004, India’s population was 1.07 billion. The average annual growth rate of population is 1.6 per cent. The number is expected to reach 1.33 billion by 2020 and about 1.44 billion by 2025. About 26 percent of our population is still below the national poverty line. Removal of poverty has been an integral part of the government development strategy. The benchmark for poverty removal in case of Upper Middle Income (UMI) countries is 13 per cent of population below poverty line. The reduction of poverty to this level or even below is a major challenge for India. We have, thus, a long way to go. The UN Millennium Development Goals (MDG), as approved by all the member countries, targets to reduce the world’s extreme poverty to half by 2015 and thus lay the foundation for eliminating extreme poverty by 2025.

The various goals set by MDG and India’s status are indicated in Table 1.1.

Table 1.1: Million Development Goals and India's Status

MDG Goals	India's status (latest data available)
1. Reduce poverty by half by 2015	<p>Below 1\$ a day</p> <p>1977-78 51.3 per cent</p> <p>1999-2000 26.1 per cent</p> <p>2007(targeted) 19.3 per cent</p>
2. Ensure universal primary education by 2015	<p>2002-03 95.39 per cent enrolment</p> <p>An education cess has been levied on all central taxes to create a fund for education.</p>
3. Promote Gender Equality and empower women	<p>Primary Education 2002-03</p> <p>Boys 97.5 per cent</p> <p>Girls 93.1 per cent</p> <p>Sarva Shiksha Abhiyan and Mahila Samakhya are being implemented. National Policy on Empowerment of Women adopted in 2001.</p>
4. Reduce Child Mortality	<p>Mortality Rate per 1000 live births</p> <p>1991 80</p> <p>2002 63</p>
5. Improve Maternal Health	<p>Maternal Mortality Rate per 100,000 live births</p> <p>1993 437</p> <p>1998 407</p>
6. Combat HIV/AIDS	<p>Prevalence rate among adults</p> <p>2003 0.9 per cent</p> <p>Number of cases (million)</p> <p>1981 2.7</p> <p>2004 0.91</p>
7. Ensure Environmental Sustainability <ul style="list-style-type: none"> ● Integrate principles of sustainable development into country policies and programmes; reverse loss of environmental resources. ● Reduce by half the proportion of people without access to safe drinking water. ● Achieve significant improvement in lives of at least 100 million slum dwellers. 	<p>Environmental protection is given high priority in all sectors of development.</p> <p>Various schemes for safe drinking water in urban and rural areas are under implementation.</p> <p>Percentage of people living in slums</p> <p>1981 28 million (17.5% of urban population)</p> <p>1991 45.7 million (21.5%)</p> <p>2001 40.6 million (22.8%)</p>
8. Develop a global partnership for development <ul style="list-style-type: none"> ● Open trading and financial system ● Ensure tariff and quota-free access for exports ● Deal comprehensively with debt problems of developing countries ● Develop decent and productive work for youth <ul style="list-style-type: none"> ● Ensure access to affordable drugs ● Make available benefits of new technologies, especially information and communication technologies 	<p>India is pursuing this goal</p> <p>India is pursuing this goal</p> <p>India is pursuing this goal</p> <p>India has recently enacted a National Rural Employment Guarantee Act, which gives a minimum of 100 days of work to at least one adult member of a household in a year.</p> <p>India is pursuing this goal</p> <p>India is increasingly harnessing the use of information and communication technologies in all fields.</p>

Though literacy level has improved, still 35 percent of the population is illiterate. With the World Declaration on Education for all adopted in 1990, India has initiated several measures to achieve the goal of universal elementary education. The provision of rural roads is likely to improve accessibility to schools.

Over the past five decades, India has made significant gains in ensuring health for all. Life expectancy has increased from 37 to 65 years. A vast health infrastructure and manpower has been built at primary, secondary and tertiary health care. Further penetration of health facilities into the rural areas can be facilitated by building rural roads.

Sectors such as software services and IT enabled services have emerged as new sources of strength, creating confidence about India's potential to be competitive in the world economy.

According to the 2001 census, 72.2 per cent of the population resided in rural areas. In the year 2025, the share of rural population is estimated to be around 60 percent. Rural areas will continue to offer healthier environment and less expensive spaces for agro-based industries and work stations. The provision of planned amenities in villages will contain the drift of population to the urban areas, while at the same time opportunities for employment and upgrading local skills would be available to rural population.

India's labour force was 375 million in 2002, and is expected to reach 600 million by the year 2025. Nearly 200 million additional jobs would have to be created over the next 20 years. This calls for a multi-pronged action particularly to expand opportunities in non-farm employment. The construction and maintenance of rural roads, using low-end technologies will not only create direct employment opportunities, but will also have a multiplier effect, opening up further avenues for employment in sectors like education, health care, trade, communication, forestry, agriculture, horticulture, handicrafts, dairy and livestock development.

A good percentage of the population belongs to the vulnerable groups like scheduled castes, scheduled tribes, other backward classes, etc. They will need special attention to bring them to the national mainstream. Rural accessibility is one of the means to uplift these vulnerable groups.

1.3 Rural Development: Key to Propoor Growth

Social sectors development

Emphasis is continuing in social development sectors so as to improve the quality of life and alleviate poverty. The social services like education, health, empowerment of women, shelter and safe drinking water will receive much higher focus in the coming years. It may be recalled that in the seventies, the Government of India launched the Minimum Needs Programme (MNP) with the objective of bringing the rural population into the mainstream of national development. This programme covered various activities like electricity, rural roads, health care, primary schools and rural housing. The MNP was later merged with the Basic Minimum Services (BMS) programme formulated in 1996, which had similar

objectives. Employment generation programmes like National Rural Employment Programme (NREP), the Rural Landless Employment Generation Programme (RLEGP), and the Integrated Rural Development Programme (IRDP) were taken up. The Swarnajayanti Gram Swarozgar Yojana (SGSY) was instituted in 1999, merging several allied programmes. This programme is conceived as a holistic programme of micro enterprise development in rural areas with emphasis on organizing the rural poor into self-help groups, capacity building, planning of activity clusters, infrastructure support and market linkages. The programme specially takes care of the less privileged and weaker groups like women, Scheduled Caste (SC) and Scheduled Tribe (ST) and the disabled. The NREP and RLEGP were merged in 1989 under the Jawahar Rozgar Yojana (JRY), which was specially meant to generate meaningful employment for the unemployed and the under-employed. The JRY was revamped in 1999 as the Jawahar Gram Samrudhi Yojana (JGSY), becoming a programme for the creation of rural economic infrastructure, with employment generation as a secondary objective. Funds from the Rural Infrastructure Development Fund (RIDF) were channelised into several small rural infrastructure projects through the help of the NABARD. The JGSY, the Employment Assurance Programme (EAS), and the Food for Work Programme, all of which aimed at the creation of employment opportunities in the rural areas, were revamped and merged under the new Sampoorna Gramin Rozgar Yojana (SGRY) in 2001. Rural infrastructure creation, including rural roads, received encouragement under all the above programmes. Recently, the Government of India, with the twin objective of employment assurance and poverty reduction, has launched another scheme of National Rural Employment Guarantee Programme.

National Committee on Rural Infrastructure

Continuing the momentum gathered, the Government set up a National Committee on Rural Infrastructure in 2004, under the chairmanship of the Prime Minister, with Ministers of Agriculture, Shipping and Road Transport, Power, Rural Development, Water Resources, Panchayati Raj, Communications & IT, Non-Conventional Energy Sources and Deputy Chairman and four Members of the Planning Commission as Members, with the objective of improving rural infrastructure in a time-bound manner through initiating policies, effecting internal prioritization and developing innovative financing arrangements. This is a very welcome step and demonstrates the high-level of commitment to ensuring overall rural development of the country.

Bharat Nirman Initiative

The seriousness with which the government viewed rural development as crucial to Indian's overall growth is evidenced in the President's address to the Parliament in 2005, when he spoke of "Bharat Nirman" as a business plan for rebuilding rural India. The Finance Minister in his budget speech further elaborated this theme in 2005. The six components of Bharat Nirman and the goals set under the programme are given in Box 1.1.

Box 1.1: Goals under Bharat Nirman Programme (to be achieved by 2009)

- Drinking water: 74,000 habitations
- Additional houses to poor: 6,000,000 houses
- Assured irrigation: 10 million hectares
- Connectivity by road to all habitations with population above 1000 (500 in case of hills and tribal areas)
- Telephones: 66,822 villages
- Electricity: 125,000 villages

1.4 Perspectives

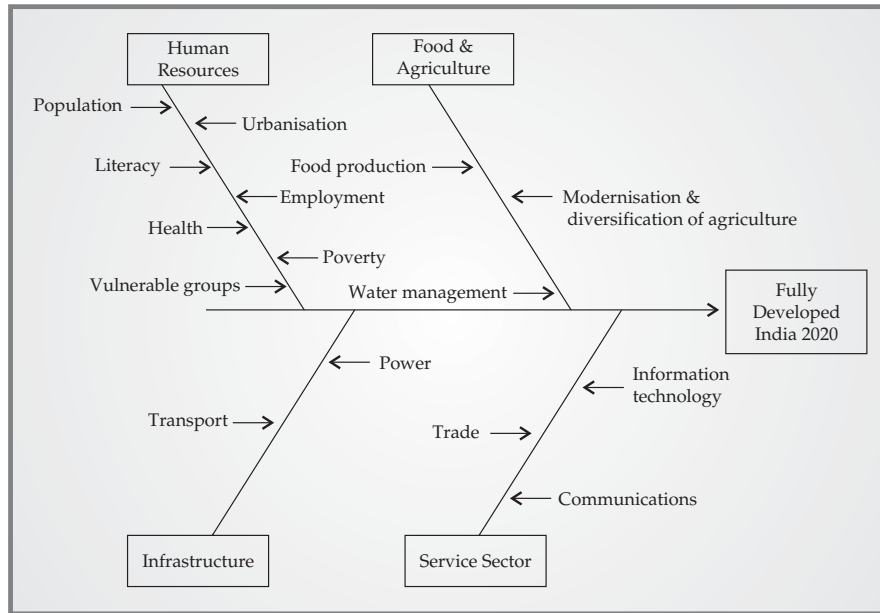
Glimpse

Box 1.2 gives the perspective of what India can become by the year 2020 according to a recent study by the Planning Commission.

Box 1.2: Glimpse of India in 2020

- Population 1.33 billion, better fed, more educated, healthier and better housed
- School enrolment 100 percent in age group 6-14.
- Major contagious diseases eradicated.
- Agriculture activities diversified to commercial crops, agro-based processing industries.
- A vast reservoir of scientific personnel with knowledge enhancement in IT, biotechnology, medical sciences, engineering innovations
- All habitations provided with road links, electricity and water supply.
- UN Millennium Development Goals substantially achieved, laying foundation for elimination of extreme poverty by the year 2025.

There are several factors that would enable attaining this status (Figure 1.1).

Fig 1.1: Enabling factors for attainment of fully developed country status in 2020

1.5 International Comparison

International comparison with some countries with similar profiles and aspirations will give a valuable insight into the country's forward path (Table 1.2). India's greatest asset is its human resource. If this can be tapped and its advantage in the pool of technical manpower and natural resources utilised, India can catch up fast and attain the status of a developed country by 2020. Several developing countries like China and Indonesia have adopted strategies to achieve a high rate of growth of the economy by laying stress on expanding the rural infrastructure, particularly roads. The emphasis has been to reach out to remote habitations by constructing roads, employing appropriate technology and opting for achievable and sustainable design standards.

Table 1.2: International Comparison of Selected Socio-Economic Indicators

Country	Population in million	Population Density (people per sq km)	GNP				GDP growth (%) 2001-02	Poverty (BPL) (1\$ a day %)	Infant Mortality (per 1000 live births)	Life Expectancy (years)		Road Length (km)	Percent Paved Roads	Road density km/ Sq. km	Cars per 1000 persons	Telephones per 1000 persons		Personal Computers per 1000 persons	
			US \$ billion	World Rank	PPP US \$ billion	GNP Per Capita US\$				World Rank in PPP Terms	Male					Female	Main Line		Cell Phones
USA	288	31	10,207	1	10,414	36,110	1	2.4	0	6.9	74.1	79.7	6,286,396	91	0.67	452	667	446	625
Japan	127	349	4,324	2	3,481	27,380	3	0.3	0	3.4	73.3	77.3	1,156,000	73	3.06	401	598	573	349
China	1,280	137	1,234	6	5,792	4,520	2	8.0	16.6	38.0	69.0	73.0	1,278,474	93	0.13	8	140	114	20
India	1,049	353	495	11	2,778	2,650	4	6.9*	26**	64.9	61.9	63.1	3,316,000 [®]	46	1.00	6	34	6	6
Brazil	174	21	495	12	1,300	7,450	8	1.5	8.2	38.0	58.5	67.6	1,658,677	9	0.19	119	234	276	63
Indonesia	212	117	150	28	650	3,070	14	3.7	7.5	42.0	65.0	69.0	341,467	56	0.18	12	38	25	11
Malaysia	24	74	86	40	207	8,500	19	4.1	Less than 2.0	7.9	70.3	75.2	66,437	76	1.20	14	199	300	126
Thailand	62	121	123	31	425	6,890	33	5.4	Less than 2.0	18.0	71.0	76.0	64,000	98	0.13	26	95	120	27

* Figure for 2004-05 ** Based on 1999 data. @Figure for 2005-06

PPP: Purchasing Power Parity

Rural Roads: Role and Importance

2.1 History of Road Development

Jayakar Committee (1929)

Roads were recognized as an essential public asset for administrative and strategic reasons historically in India. Under the colonial rule, the early British interest was only in maintaining roads of military and dire administrative requirements. The advent of the railways, owned and operated by British companies, led to a decline of the road system. The improvement of the roads was confined only to the feeder roads that led to and supported the railways. The motor vehicles came on Indian roads at the beginning of the twentieth century. This exposed the weakness of the roads and there was a clamour for better roads. The Government of India appointed the Jayakar Committee, whose report was a major landmark as it signified the first organised effort at road building at the national level. It was on the recommendation of this committee that the role of the Central Government in regard to development of road system was recognised. The Central Road Fund was created from an additional duty of 2 annas (12.5 paise) per gallon levied on petrol in 1929.

Indian Roads Congress

As a follow-up to a recommendation of the Jayakar Committee, in the year 1934 the Central Government, after consulting the State governments, convened the first meeting of highway engineers in New Delhi. This event marked the birth of the Indian Roads Congress (IRC). The IRC is a body of engineers from both the government and the private sectors as also academic and research institutions dealing with roads.

The principal objectives of the IRC are:

- To provide a national forum for projecting the collective opinion of its members on all matters relating to planning, design, construction and maintenance of roads.

- To prepare and promote the use of standards and specifications covering various aspects of road engineering.

Besides, the IRC also suggests improved methods of administration, planning operation and use of roads. It has been closely associated with long-term road planning and has formulated the Nagpur Plan (1943-61), Bombay Plan (1961-81), Lucknow Plan (1981-2001) and the recent Road Development Plan: Vision 2021. It has also contributed significantly to improvements in areas like planning, design, construction and maintenance of roads and has enjoyed the support of central and state governments, academic and research institutions as well as the private sector. It serves as a Think Tank for the professional engineers in the roads sector and is devoted to the cause of roads of all categories.

It has as its research arm, the Highway Research Board, which identifies areas of research and facilitates the adoption of research findings in the field.

Nagpur Plan (1943-61)

In 1943, chief engineers-in-charge of roads in the country met at Nagpur to consider requirements of the road system over a twenty-year period, which resulted in the famous Nagpur Plan. This Plan classified roads as national highways, state (or provincial) highways, district roads and village roads, and prescribed standards, norms and targets for road development of various categories. In agriculturally developed areas, the target set was that no village should be more than two miles away from a road or more than five miles from a main road, the average distance from a main road being less than two miles. In non-agricultural and less developed areas, accessibility was to be within five miles from a road and not more than twenty miles from a main road, the average distance being six to seven miles in most cases. A road density of 26 miles per 100 sq miles (16 km per 100 sq km) was the target for 1961.

Bombay Plan (1961-81)

In 1957, chief engineers-in-charge of road and bridge development of the central and state governments met to formulate a new road plan for 20 years, starting from 1961, popularly known as the Bombay Plan. It envisaged that no village should be more than one-and-a half miles from any road in developed agricultural areas, three miles from any road in semi-developed and five miles from any road in underdeveloped and uncultivable area. While working out specific proposals, considerations of the size of area, population, regional levels of development and future potential were taken into account. Transport requirements of administrative centres, places of pilgrimage, health resorts, tourist centres, big railway junctions, ports, and defence and strategic points also had to be considered in an integrated road system. The Bombay Plan framed a scheme of priorities which included among others, provision of missing bridges, improvement of road surface to at least one-lane black-topped specification for national and state highways, widening of main roads in the vicinity of large towns to two lanes or more and provision of two lane roads on major arterial routes. The Bombay Plan target was to achieve an overall density of 32 km of roads per 100 sq km of area; (44 km of roads for developed agricultural areas; 19 km for semi-developed areas, and 12 km for under-developed areas).

Lucknow Plan (1981-2001)

The highway professionals continued the system of long-term plans and when the Bombay Plan was about to end, another perspective road development plan for the next 20 years ending 2001 was formulated. This is known as the Lucknow Plan. In this plan, all relevant factors, such as (i) the urgent social need to connect rural, hilly, tribal and backward areas with administrative, market, health and educational centres, (ii) security requirements, (iii) traffic needs (iv) need for effecting fuel economy through provision of good roads, and (v) requirements for non-mechanised traffic, such as that of bicycles, cycle-rickshaws and bullock carts were given due weightage and competing claims judiciously balanced. This plan was not confined to only prescribing accessibility targets on a global basis for 'developed', 'semi-developed' and 'under-developed' categories in general; it also provided a direction how states could prepare their own perspective plans for road development keeping in view the differences in the land-use pattern, population, terrain, stage of and potential for economic development and social infrastructure needs to achieve a balanced road network. The Lucknow Plan laid down an overall target of 27 lakh km road network, a road density of 82 km per 100 sq km of area by the end of year 2001.

Road Development Plan Vision: 2021

The Road Development Plan Vision: 2021 was prepared with the full involvement of the highway profession both within the government and the private sector and represents an expression of the intent for highway development in the two decades from 2001. This Vision addressed concerns such as the need for mobilisation of financial resources including augmentation of road fund, toll financing, private sector participation, capacity augmentation of main highways, strengthening of pavement to cope with movement of heavy commercial vehicles, undertaking massive programme of construction of village roads and preservation of existing road assets. Aspects such as road safety, social and environment concerns and energy efficiency have also been highlighted. The vision document laid down targets for main roads but did not specify the length of the rural road network. Instead, stress was laid on preparation of proper district level master plans to optimize the network.

2.2 Transport Sector in the Post-Independence period

Before independence, the transport system consisting of mainly railways and roads, was developed primarily to provide communications with the major ports and larger cities. The focus changed after independence for rebuilding the transport network and making it respond to the development needs of the economy. Not only were the rail and road network expanded but efforts were made to develop other modes of transport such as shipping, ports, air, inland water transport, etc. A proportion of investment was set apart to promote transport in the remote and backward regions of the country with a view to opening them to the growth process.

The country's transport sector has witnessed a good growth in the last 60 years. Today, the Indian Railways are one of the largest systems in the world with a network of about 63,000 route-km. It is a principal mode of transport for long haul freight movement in bulk, long distance passenger traffic and for mass rapid transport in suburban areas. In the port sector, there is 29-fold increase in traffic from

19.38 million tonnes in 1951 to 573 million tonnes in 2006. The passenger traffic by air has witnessed an unprecedented growth in the past ten years. The inland water transport is also receiving attention where rivers are navigable. Pipeline is also emerging as a good option with growth in oil and gas sector.

For development of roads, the long term 20-year plans formulated by the chief engineers in-charge of roads under the aegis of the Indian Roads Congress have served as sound reference framework for the central and the state governments to formulate their successive Five Year Plans commencing from the First Five Year Plan in 1951. Box 2.1 gives a glimpse of plan-wise road investments.

Table 2.1 gives a broad profile of road network achieved as a result of investments in the road sector since 1951. The road network has increased eight fold from 4 lakh km in 1951 to 33 lakh km (including 10 lakh km of earth tracks constructed under various employment oriented programmes).

Box 2.1: Investment in Roads	
	<i>(Rs. crore)</i>
First Plan (1951-56)	135
Second Plan (1956-61)	224
Third Plan (1961-66)	440
Period 1966-69	309
Fourth Plan (1969-74)	862
Fifth Plan (1974-79)	1701
Sixth Plan (1980-85)	3807
Seventh Plan (1985-90)	6335
Period 1990-92	3779
Eighth Plan (1992-97)	13210
Ninth Plan (1997-2002)	39331
Tenth Plan (2002-07)	59490

Source: Planning Commission and IRC Road Development Plan Vision 2021

Table 2.1: Progress of Road Network

(‘000 km)

	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06
Total length	400	515	915	1485	2327	3176	3316
Of which surfaced length	156	234	398	684	1090	1600	1700
National highways	22	23	24	32	34	58	67
State highways	45	62	70	95	127	124	132
Major District Roads and Rural Roads	333	429	821	1358	2166	2994	3117
Percentage of villages with population above 1000 connected with all-weather roads	32%	36%	40%	46%	73%	90%	92%
Overall village accessibility	20%	22%	25%	28%	44%	54%	60%

Source: Basic Road Statistics, Planning Commission and Road Development Plan Vision: 2021

Nearly 50 per cent of the roads are surfaced, the balance being earthen, gravel or water-bound macadam. A major portion of the unsurfaced roads is in the category of Rural Roads.

2.3 Role of Rural Roads as Poverty Reducer and Infrastructure Multiplier

Effect of Deprivation

Due to lack of rural road access, millions of villagers are suffering tragic isolation and prolonged deprivation. They do not share the development opportunities. Some of the eloquent symptoms of such deprivation are enlisted in Box 2.2. These symptoms are merely illustrative and by no means exhaustive.

Box 2.2: Symptoms of Deprivation due to Lack of Access

- Daily several pregnant women die, as they cannot reach the healthcare centres in time from their villages.
- Lakhs of rural children cannot reach the schools during rainy season.
- Perishable agricultural produce cannot reach the markets in time leading to heavy losses to the farmers.
- A large number of cattle die in veterinary epidemics especially during rainy season because timely help cannot reach them.
- Water tankers cannot reach several thousand drought prone villages leading to migration of rural population in total despair.
- The public distribution system fails to penetrate to thousands of villages leading to malnutrition and infant mortality.
- Poor connectivity has a high correlation with high levels of illiteracy, unemployment, and poverty.
- Low levels of accessibility have deprived large number of villagers from equality of opportunity as compared to the urban population.

Source: Report of National Rural Road Development Committee, Government of India, September 2000

It must, however, be appreciated that the scenario is not equally bleak all over the country. While in some states, the level of connectivity is quite low, in some other states it is much better than average. Even in the same state, there are wide variations from district to district.

Entry Point for Poverty Alleviation

Rural roads are a key component of rural development since they provide access to economic and social goods and services thereby generating increased agricultural income and productive employment

opportunity in rural areas. Rural development has now become a matter of growing urgency for considerations of social justice, national integration and economic uplift. Rural roads are used as an entry point for poverty alleviation since lack of access is accepted universally as a fundamental factor in continuation of poverty. Over time perceptions of poverty have undergone a significant change. Poverty is not only related to low level of per capita income but also conditions such as mal-nutrition, ill health, literacy and lack of access to basic services. There is a growing body of empirical evidence that links transport investment to the improved well-being of the poor. Transport is highly relevant to the achievement of a number of targets defined under the Millennium Development Goals (MDGs). The linkages between transport improvement and MDGs are clearly elaborated in a recent study by Africa Union and UN Commission for Africa (2005). Improved infrastructure of roads and transport services would make trading in rural areas more efficient thereby reducing costs of inputs and contributing to increased agricultural output and rural development. In this process, income levels of villagers get raised thus improving their quality of life. Side by side, access to health, education and other services is improved providing the villagers with better opportunities for improving their standards of living. In yet another indirect way, roads influence the process of growth through changes in socio-economic attitudes of people by facilitating the dispersal of knowledge and reduction of inequalities leading to demand for more goods and services.

A study (Fan, Hazell and Thorat, 1999) carried out by the International Food Policy Research Institute on linkages between government expenditure and poverty in rural India has revealed that an investment of Rs. 10 million in roads lifts 1650 poor persons above the poverty line. Investment in roads also contributes importantly to growth in TFP (Total Factor Productivity) in agriculture thus generating economic surplus for expenditure in other sectors – helping in all round socio-economic development. The growth in TFP also helps in keeping the consumer prices of food grains reasonable benefiting the poor. It also increases non-agricultural employment opportunities because of the stimulus to non-farm commercial activities and leads to higher wages. Of the total productivity effect on poverty, 75% arises from direct impact of roads in increasing incomes while 15% from lower agricultural prices and 10% from increased wages. Given that agriculture will continue to play vital role in national development, rural roads would be required to support this effort.

Similar results are found in other developing countries. The study by the same Institute (Fan, Zhang and Zhang, 2000) in China revealed for example that for every 10,000 Yuan (about \$1,200) spent on rural roads, 11 persons are lifted above the poverty line. Living standards survey in Vietnam in 2002 showed that families living alongside the road (within 2 km of all-weather road) have lower poverty rate. A comparison of ten core states having low connectivity with roads and poverty ranking in India also reinforces similar assertions (Table 2.2). (Rajasthan being a sparsely populated desert State and Himachal Pradesh being a hill State fall in a separate category.)

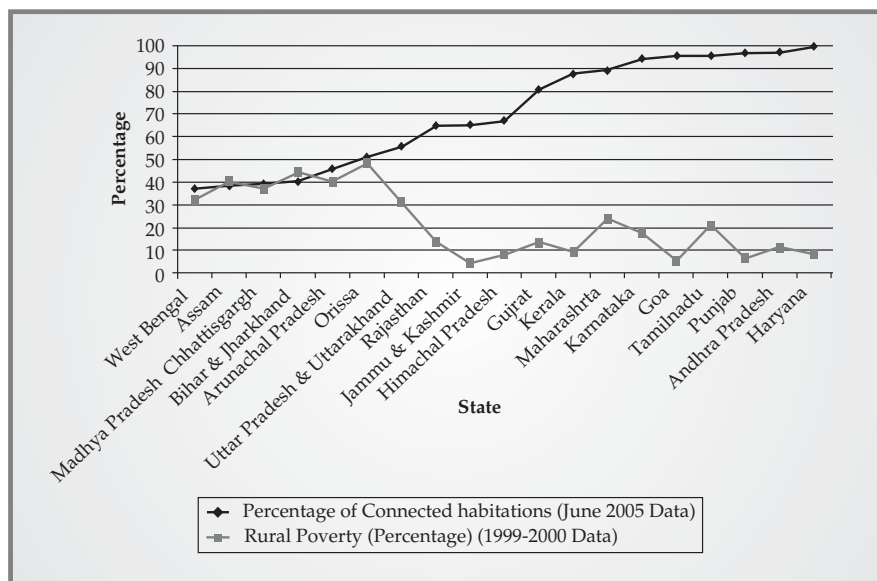
Table 2.2: Linkage between Poverty and Unconnectivity (Poorer/more unconnected ranks lower)

10 core states	Unconnectivity rank*	Rural poverty rank (1999-2000)**
Orissa	21 st	25 th – (48.01)
Bihar	23 rd	24 th – (44.30)
Jharkhand	28 th	Included in Bihar
Assam	25 th	17 th – (40.04)
Madhya Pradesh	26 th	15 th – (37.06)
Chhattisgarh	24 th	Included in MP
West Bengal	27 th	14 th – (31.85)
Uttar Pradesh	18 th	13 th – (31.22)
Rajasthan	15 th	9 th – (13.17)
Himachal Pradesh	12 th	4 th – (7.94)

* Source: PMGSY website. Ranked according to percentage of unconnected habitations (June 2005)

** Source: Planning Commission. Figures in brackets denote percentage of rural people below poverty line.

The relationship covering other states in India is also depicted graphically in Figure 2.1. The higher the accessibility, lower is the poverty.

Figure 2.1: Relationship between connectivity and rural poverty

Statistical evidence apart, the link between poverty and lack of accessibility is quite apparent. A few voices of the poor captured in an ADB study on assessing the impact of transport and energy infrastructure on poverty reduction is given in Box 2.3 to illustrate.

Box 2.3: Perceptions of the Poor about Access

A community without roads does not have a way out.

— A poor man Juncal, Equador

If we get the road, we would get everything else, community center, employment, post-office, telephone.

— A young woman, Little Bay, Jamaica

Many of the poor communities are isolated by distance, bad road conditions, lack of or broken bridges and inadequate transport. These conditions make it difficult for people to get their goods to market and themselves to place of work, to handle health emergencies, to send children to school and to obtain public services.

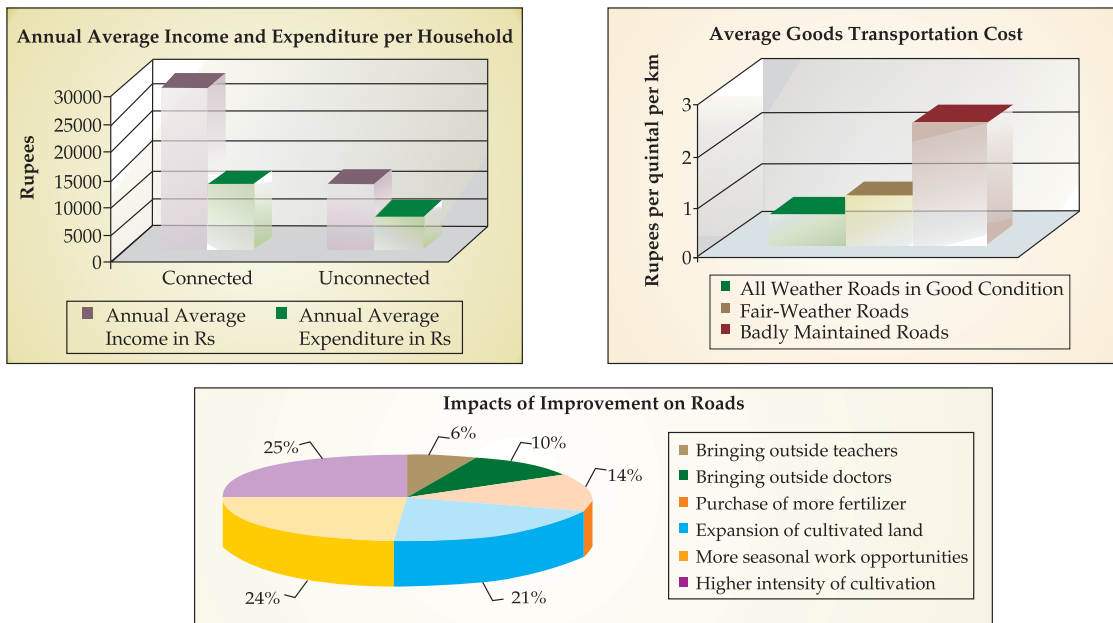
Source: Narayan, et al, Voices of the Poor. Crying out for Change. The World Bank, Oxford University Press, 2000.RETA 5947, ADB October 2003.

Socio-economic Impact

A household survey conducted in the state of Andhra Pradesh indicated that rural road improvements led to substantial reduction in freight charges, increase in household income, more employment opportunities and expansion of cultivated land (Figure 2.2).

Figure 2.2: Rural Transport Surveys (1997)

Andhra Pradesh Economic Restructuring Project



Source: World Bank Report (2002): Challenges for India's Transport Sector. Vol II Chapter 2 Rural Roads.

The NRRDA recently carried out a quick socio-economic impact assessment of the PMGSY. The study revealed positive impact of rural roads on agriculture, employment, health and educational services. Table 2.3 gives a glimpse of impact on different sectors in a few states.

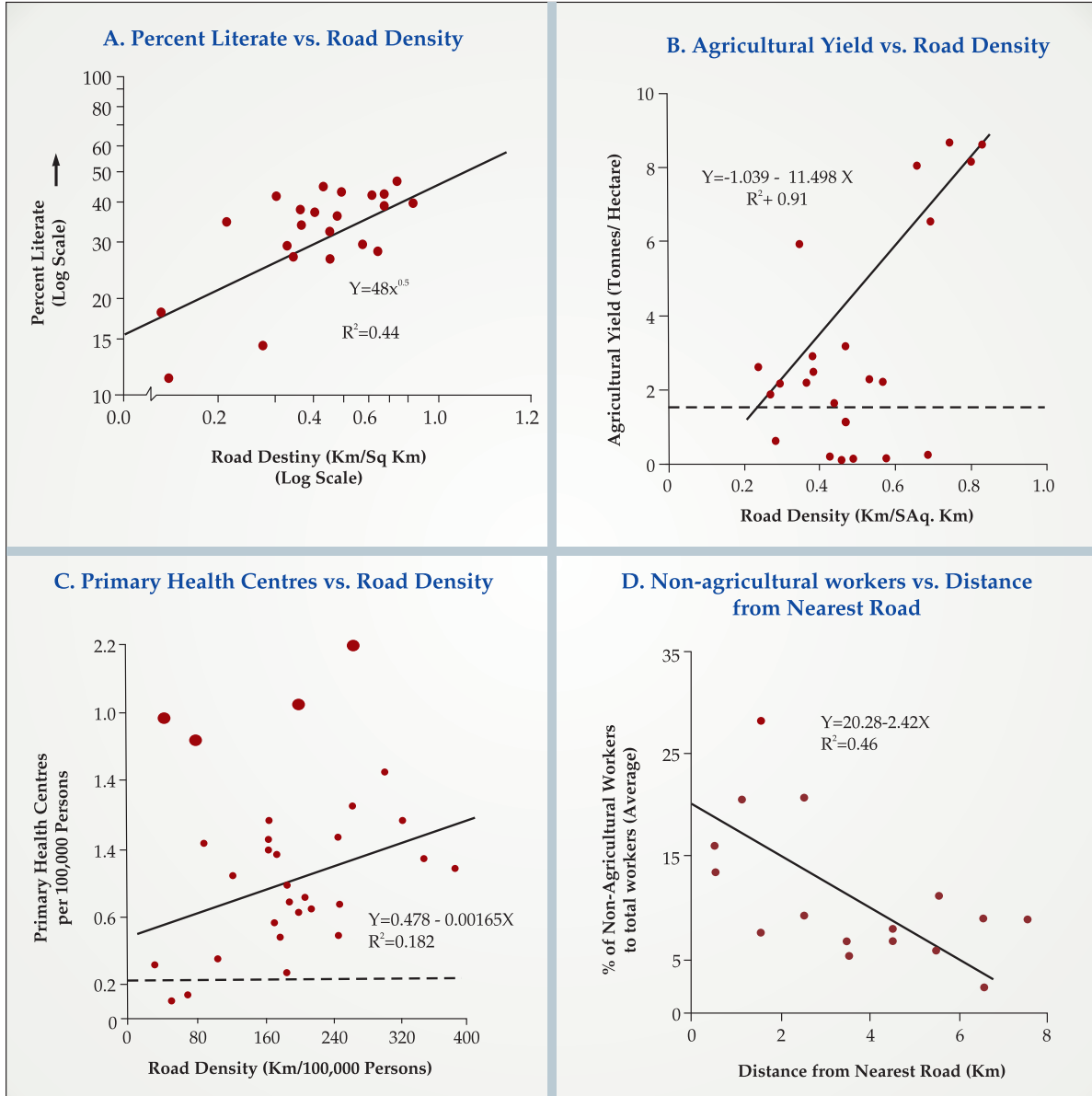
Table 2.3: Impact of Construction/Upgradation of Rural Roads on Different Sectors (Based on Perception of Respondents)

	Assam	Himachal Pradesh	Madhya Pradesh	Mizoram	Orissa	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal
AGRICULTURE & ALLIED									
Increased accessibility to markets for agricultural products									
Increase in motorised agricultural vehicles & equipment									
Change in cropping pattern from food grains to cash crops									
EMPLOYMENT									
Increase in on-farm employment opportunities due to increase in cropping intensity									
Increase in employment opportunities outside the village due to greater mobility and accessibility of nearby towns									
HEALTH									
Improved access to Public Health Centres, & district hospital									
Increase in number of visits of health workers									
Greater availability of vehicles or mode of transport to hospitals									
Decrease in infant mortality									
EDUCATION									
Increase in the number of boys going to middle and high schools									
Increase in the number of girls going to school for middle and high school education									
Increase in the availability and number of teachers in school									
SOCIAL ASPECTS									
Increased frequency of visits of Government functionaries									
Improved post & telegraph services and better accessibility to banks									
Improved police patrols around the village									
TRANSPORT									
Increased ownership of bicycles/scooters, etc. in the village									
Improvement in public transport service									
Increase in commercial vehicles or share jeeps									

Perceived benefit No change perceived Data not available

Some attempts were also made in the past to understand the interactive relationship between road accessibility and development. Results of socio-economic impact studies of rural roads undertaken in nine districts under the aegis of the Indian Roads Congress (in late 1970's and early 1980's) were synthesized by the CRRRI. Figure 2.3 brings out some of the relationships derived.

Figure 2.3: Socio-economic Impact Study in Nine Districts



Source: CRRRI: Rural Road Development in India, Vol I.

There is thus ample evidence – both national and international – that provision of rural road infrastructure holds the key to accelerated poverty reduction, achievements of Millennium Development Goals, socio-

economic transformation, national integration and breaking the isolation of village communities and holistic rural development. The government has accorded priority to rural connectivity by all-weather roads by making it part of the Bharat Nirman programme. This programme includes other sub-sectors, which are equally critical for integrated rural development.

The multiplier effect of provision of rural roads is well known. The provision of a good road network is a better option than indefinitely expanding the education or health services to reach all consumers at their doorstep as it becomes expensive and unsustainable in terms of stationing trained service providers like health workers and teachers. The beneficiaries can thus access a sustainable service network through the roads. Roads thus multiply the impact of provision of a service without the government having to invest in its unsustainable expansion.

To sum up, rural roads act as facilitators to:

- promote and sustain agricultural growth
- improve basic health and hygiene
- provide access to schools and other educational opportunities
- provide access to economic opportunities
- create employment opportunities
- enhance democratic processes and bring people into national mainstream
- enhance local skills
- reduce vulnerability and poverty
- act as infrastructure multiplier

2.4 Rural Transport Services

Even before the provision of rural roads, people staying in the habitations used to travel to the nearest market centre or facility centre on foot, pack animals or animal-drawn vehicles. In the hills, bridle paths are common, facilitated by simple footbridges across streams. In the plains, cart tracks exist at the fringe of land holdings. Animal drawn carts exist both with pneumatic tyres and iron-rimmed wooden wheels. The latter are now gradually on the decline as road surfaces improve. The tractor, often with a trolley, is becoming ubiquitous. Since it can travel on earth tracks, it is the most favoured transport mode for transporting agricultural produce. It transports people also, especially for marriages and melas (religious, social or recreational gatherings) and weekly market places (haats). Cycles are owned by many villagers.

BOX 2.4

The provision of good rural roads changes the characteristics of rural transport. People tend to travel more, the ownership of vehicles increases, and the cost of travel and transport comes down.

As all-weather roads get built, people become prosperous. The ownership of cycles increases, people purchase two-wheelers and some prosperous villagers acquire cars and jeeps. Private or government buses start operating. Cycle rickshaws are popular in some states. Children cycle to nearby schools and Light Commercial Vehicles start serving the villagers. The number of trips made increases. Travel to high schools, hospitals, post offices, shops, banks and market centres spurts up.

A notable feature of rural goods transport is that the post-harvest movement is always very high. The number of goods vehicles on the road can jump to 3-4 times the number in the lean season. The post-harvest season may be one or two in a year, depending upon the region. The spread of the post-harvest season can be upto 3 months.

The agricultural tractors, which are now basic to agricultural operations, are often used, in conjunction with trolleys, to carry agricultural produce to the market place and mills. Thus, the bulk of the sugarcane from the fields reaches the sugar mills in agricultural tractor-trolleys. This mode is also used for passenger movement during marriages, and festival gatherings. The agricultural tractor-trolley is not an efficient vehicle for transport. But since the farmer owns it, and the vehicle is used only for about 100 days in a year for agricultural activities, he finds it expedient to take it out for all and sundry purposes. The other advantage is that it can operate on rough tracks without much difficulty.

As the quality of road surface gets upgraded from earthen tracks to paved, the travel time decreases, and the cost of operation of vehicles comes down. More service providers like bus operators and goods transport operators are attracted to reach to the remote villages. With the transport costs coming down, the farmers enjoy a higher farmgate price, and are encouraged to produce more. Agricultural output increases, transport costs come down and the farmers enjoy a producer surplus, which is one of the tangible benefits of the provision of rural roads.

2.5 Integration of Rural Roads with Higher Categories of Roads

Rural transport is part of a transport chain with one end in the agricultural fields and the other on the local market. It is also the transport chain from the main highway network upto the local market. Development of rural roads cannot be viewed in isolation from the needs of higher categories of roads and even changes affecting the urban landscape. National highways serve the mobility function as they criss cross the whole country connecting capitals of the states, major ports, industrial and tourist centres. Rural roads serve the accessibility function. They feed traffic into and receive traffic from the secondary system, (State Highways and Major District Roads: SH and MDR), which in turn is supported by and supports the primary system (National Highways: NH). The secondary system contributes both to the rural economy and to the industrial development. They combine the mobility and access function.

The road transport system can function efficiently only if all the three groups of roads are developed harmoniously and are integrated into one another. No single class of road can function efficiently if its linkages with the other are deficient.

The government has launched an ambitious programme like the National Highway Development Project (NHDP), which takes care of the primary system. The Rural Road programme under the Pradhan Mantri Gram Sadak Yojana (PMGSY), a project funded by the central government takes care of the needs of the

tertiary system, to a good extent. The Road Development Plan Vision: 2021 prepared by the Indian Roads Congress for the Ministry of Shipping, Road Transport and Highways (2001) has laid down targets for development and expansion of national highways, state highways and major district roads. Table 2.4 gives the length of higher categories of roads recommended. As mentioned earlier, targets for rural roads were not mentioned in the Vision 2021. Stress was laid on preparing district level Master Plans and undertaking massive programme of roads to achieve full connectivity.

Table 2.4: Length of Main Roads by 2021

S.No	Category of road	Length recommended
1.	Expressways	10,000 km
2.	National Highways	80,000 km
3.	State Highways	160,000 km
4.	Major District Roads	320,000 km

Source: Road Development Plan Vision 2021 published by IRC, 2001.

There is need for balanced development of all categories of roads and balanced development of all regions in the country, priority for rural roads being given to construction in areas with low connectivity and improvement of existing roads in areas with higher connectivity. Side by side, stress is also required for maintenance of roads so as to preserve these assets being created at huge costs to the economy.

A few states have accelerated the programme of upgrading the state highways with external assistance from the World Bank and the Asian Development Bank. It may be mentioned that while a two-lane pavement is a minimum required for a State Highway, only about one-third of the length has such a width, the remaining being just single lane carriageway. Only a small length, about one percent has four-lane or more. As regards the riding quality and the pavement thickness, it can be said that the bulk of the state highway network has an inadequate pavement thickness and fair to poor riding quality. This results in inefficiency of transport movement. The condition of the Major District Roads is even worse. These roads are mostly single-lane and are in a state of disrepair. There is an urgent need to address the issue of maintenance and upgradation of this category of roads. Since the financial position of the states is poor, it is necessary to explore alternative sources of funding. NABARD funds are a good option, and it is recommended that the government may consider issuing a directive that NABARD funds should be used mainly for MDR and upgrading of existing rural roads.

Each component of the hierarchy of roads in the country has its own administrative and management system. While the National Highways are the responsibility of the central government, all other roads including rural roads are financed and administered by the state governments. With the launch of the PMGSY programme, the Central Government has taken the initiative of providing financial support to states in accelerating the programme of connectivity to villages. At the state level, these roads are being looked after by several agencies. The presence of several agencies responsible for rural roads has often resulted in the past in the lack of planning, setting of priorities and maintenance of assets. With the present emphasis on rural roads, a scientific and coordinated approach to network planning, construction and asset management is slowly evolving. During the past few years, these roads have emerged from

the shadow of neglect to a rightful place in the highway sector, not only in terms of funding, but also in respect of design, construction, maintenance, and management practices. The momentum needs to continue.

2.6 Transport Indicators

Any developmental programme requires the assessment of its success through measurements in terms of objectively assessed indicators, on physical achievements, performance levels and the impact of the programme, on the society. Such indicators and their periodical trend show whether or not the targets have been achieved as planned, whether the system is performing with desired level of service and whether the services extended to the society through the development have the anticipated impact. If the indicators are appropriately identified, compiled and analysed, they would help in both bench marking and performance comparison at intra and inter-sectoral level. Though, in the normal course, the physical achievements are generally compiled, the performance and outcome, particularly in the Rural Roads Sector have not been attempted so far. This requires a suitably identified system and calls for dedicated resources.

Transport Indicators in Rural Roads Sector are expected to cover a wide range of information, the indicative list of which is given in Table 2.5.

Table 2.5: Indicative List of Rural Transport Indicators

S.No.	Indicator	Measure of Performance
1.	Network	
1.1	Density of Rural Road Network	km per Sq km
1.2	Core Network	Percentage of Core Network to the total Rural Road Length
1.3	Paved and all-weather Roads	Percentage paved and all-weather to the total Rural Road length
1.4	Black-topped roads	Percentage black-topped to the total Rural Road Length
1.5	Village Connectivity	Percent of villages connected by an all-weather road
2.	Traffic	Average Daily Traffic, classified by vehicle type for each road
3.	Passenger travel pattern and freight movement	Frequency of trips, mode of travel, cost of travel, cost of freight movement
4.	Public Transport	Availability of public transport services (per cent of villages with public transport buses), fare structure, frequency of services
5.	Traffic Safety	Number of fatalities, injuries and damaged vehicles
6.	Revenue	Registration and other taxes on vehicles
7.	Financial	Unit costs and annual allocation for new construction, upgradation and maintenance
8.	Socio-Economic Benefits	Growth of income, producer surplus, farm-gate price, growth of agricultural production, increase in literacy, increase in students' school attendance, increase in teacher attendance in schools, decrease in child mortality, increase in life expectancy, changes in vehicle ownership and other consumer durables.

Further, in order to develop harmonization in the collection and collation of the indicator data, it is suggested that a strategy be put in place for this purpose. The details are given in Table 2.6. Such a strategy to be successful needs to be backed by an institutional arrangement, where responsibility and accountability are clearly defined consistent with objectives set forth.

Table 2.6: Transport Indicators for Rural Transport Sector

Sl. No.	Indicator	Content	Collaborators	Available/to be initiated	Strategy for Data Collection, Storage and Analysis
1.	Network	Physical length, length by type, length by ownership, surfaced, unsurfaced, condition, etc.	PWDs, REOs, Panchayati Raj Departments and others.	Mostly available except condition which needs to be assessed periodically.	All concerned road agencies can be asked to collect the data, store and consolidate. The departments may be required to carryout the inventory once in 2 years and update the database with changes in the status. Can be done immediately. The information is readily available, but only requires reconciliation and updation.
2.	Traffic	Growth, frequency, private, public, motorized vehicles, light commercial vehicles, heavy goods vehicles and non-motorised vehicles	Transport department, public sector transport operators	Not available except in aggregate terms.	The breakup of traffic plying on rural roads is not explicitly available. Such data is to be deduced based on traffic census on rural roads. Special care is to be taken in respect of non-motorised vehicles since, as of now, their registration is not compulsory. Methodology to be developed and needs orientation.
3.	Passenger travel and freight movement patterns	Frequency, purpose, cost, time, passenger km by mode, commodity tonne km by type	Public transport operators, public works department, freight operators	Not available	To be assessed by organizing origin-destination surveys. Requires design of formats, training of enumerators, working out logistics, etc. This can be done on sample basis once in five years as it requires elaborate arrangements for data collection and analysis.
4.	Public transport	Number of seat km provided, seat km used, fare structure, trip frequency	Public transport undertakings	Available but requires filtering out for rural transport	State Transport Undertakings (STUs) are to filter out the data for rural operations from their records. Can be readily obtained where STUs are operating. Otherwise requires special surveys.
5.	Accidents	Vehicle type, persons involved, fatality, grievous injury, minor injuries, property damage.	Traffic police	Mostly available but needs stream lining	At present data recording is not scientific. Requires better organized way of data collection and analysis. Numbers can be obtained with immediate effect since compilation is done regularly. However, detailed instructions for database management are required.
6.	Revenue indicators	Registration and other taxes	Transport, excise departments	Available	Needs filtering out data
7.	Financial indicators	Capital investment for new construction, upgradation, renewal, routine maintenance.	PWDs, REOs, Panchayati Raj departments and others.	Partly available	Each department can easily work out the details yearly. This facilitates planning and operationalization of the work programmes for each financial year.
8.	Coverage indicators	Habitations/ population connected, unconnected, access to schools, dispensaries and other services	District administration and Panchayati Raj Institutions	Partly available	This data can be readily compiled by PIUs of PMGSY programme in association with other organizations like Panchayats.

Sl. No.	Indicator	Content	Collaborators	Available/to be initiated	Strategy for Data Collection, Storage and Analysis
9.	Outcome indicators	Growth of income, employment, increased enrolment in schools in rural areas, reduction in child mortality, reduction in maternal mortality (in tune with MDGs) including productions and productivity	District administration	Partly available, but requires restructuring	Requires design of formats for data collection, storage and analysis. Many of the parameters can be at panchayat level to be consolidated at Block/District/State and National level. Indicators like income, employment can be at district/state level.Steps can be initiated by the SRRDAs in each state.

The information on Transport Indicators should serve as a databank, the analysis of which will lead to appropriate policy decisions at different levels of sectoral management. The Transport Indicators help in redefining and refining the programme objectives, its implementation and management. Therefore, all possible efforts must be made in data collection, validation, compilation, storage, analysis and retrieval for use at different levels and by various organizations/departments concerned with overall rural development.

Connectivity: Achievements and Vision

3.1 Village Connectivity Policies in the Past

Long-term Road Plans

The Nagpur Plan (1943-61) aimed at the following targets of connectivity by 1961:

All villages are brought reasonably close to a planned system of all-weather roads. No village should be more than 2 miles (3.2 km) from a road in a highly developed area, and 5 miles (8 km) from a road in non-agricultural area.

The Bombay Plan (1961-81) aimed at the following targets of connectivity:

All villages are brought reasonably close to a road network, such that no village is more than 2.5 km from any road in an agricultural area, 5 km from any road in semi-developed area, and 8 km in an underdeveloped and uncultivable area.

The Lucknow Plan (1981-2001) had envisaged that all villages with population above 500 should be brought closer to the road network (no more than 1.6 km from an all-weather road).

Minimum Needs Programme

A major thrust to the development of Rural Roads was given at the beginning of the Fifth Five Year Plan in 1974, when it was made a part of the Minimum Needs Programme (MNP), along with electricity, primary health centre, primary school and dwelling unit with a view to bringing the rural population into the mainstream of national development. Funds were provided by the States. The objective of the rural road programme under the MNP was to:

- (i) Link all villages with population more than 1500 by all-weather roads, and
- (ii) Link 50 per cent of villages with population between 1000 and 1500 by all-weather roads.

The norms were later reviewed and made more liberal (Table 3.1):

**Table 3.1: MNP Norms for connectivity of villages with Rural Roads
(Census Data of 1981)**

Type of Area	Population of villages for 100 per cent connectivity	Population of villages for 50 per cent connectivity
Plains	1500 and above	1000 – 1500
Desert, Coastal, Tribal	1000 and above	500 – 1000
Hills	500 and above	200 – 500

The programme was targeted for completion by 1990. However, several States lagged behind.

Basic Minimum Services

In 1996, the MNP was merged with the Basic Minimum Services (BMS) programme. Funds continued to be provided by the States. The BMS followed the 1991 census data. About 55 percent of villages achieved connectivity by March, 2000. Table 3.2 gives the connectivity achieved upto year 2000, under the Minimum Needs and Basic Minimum Services programmes.

Table 3.2: Connectivity of villages with roads achieved upto year 2000

Population category	Total No. of villages	No. of villages connected by 1980	No. of villages connected by 1985	No. of villages connected by 1990	No. of villages connected by 1995	No. of villages connected by 1995
1500 & above	71623	37950 (53%)	49495 (69%)	59722 (83%)	65704 (92%)	70000 (98%)
1000-1500	58229	21970 (38%)	28732 (49%)	35362 (61%)	44120 (76%)	50000 (86%)
Less than 1000	459465	107324 (23%)	142020 (31%)	166311 (36%)	173837 (38%)	200000 (43%)
Total	589317	167244 (28%)	220247 (37%)	261395 (44%)	283661 (48%)	320000 (54%)

Note: Figures within brackets give the percentage of villages in each population category to the total number of villages in that category. The basis for population is 1981 census.

Source: Planning Commission and MORTH Road Development Plan Vision 2021 (published by IRC in 2001).

It will be seen that about 270,000 villages out of a total of around 590,000 villages still remained to be connected by all-weather roads at that time.

Other Programmes

Apart from the Minimum Needs and Basic Minimum Services programme, the State governments have been providing funds out of their own budget and availing of loan assistance from NABARD under

RIDF window. The construction of rural roads has also been undertaken as part of several employment-creation and poverty-alleviation programmes of the central and state governments. Because of the employment focus, roads were mostly left as earth tracks or gravel roads and did not conform to technical standards in terms of compaction, drainage and geometrics. They were also not maintained. As a result, they may not be functional as means of connectivity.

3.2 Achievements under the Various Long-term Road Plans

The targets and achievements of various categories of roads including rural roads under the three 20-year Road Plans between 1943 and 2001 are given in Table 3.3.

Table 3.3: Targets and achievements under 20-year road plans

(Length in km)

Road category	Nagpur Plan (1943-61)		Bombay Plan (1961-81)		Lucknow Plan (1981-2001)	
	Target	Achievement	Target	Achievement	Target	Achievement
1. National Highways	33,395	22,636	51,500	31,737	66,000	57,700**
2. State Highways	86,825	62,052	112,650	95,491	145,000	124,300
3. Major District Roads	80,145	113,483	241,400	153,000	300,000	
4. Rural Roads (Other district roads and village roads)	332,335	500,802	651,780	912,684	2,189,000	2,994,000*
Total	532,700	698,973	1,057,330	1,192,912	2,700,000	3,176,000

** Currently the length of National Highway is 66,590 km

* includes 1,000,000 km of earth tracks, mostly under the employment generation programmes.

Note: Figures for targets and achievements relate to the end of the Plan period.

The targets in terms of length were fully achieved particularly in respect of rural roads. Emphasis in the past, particularly with reference to rural roads, was on achieving the length targets. Some states were not able to provide adequate funds for improvements, rehabilitation and maintenance of existing roads and even the required cross-drainage structures while constructing new link roads to villages. A network approach to rural road planning was absent, even though there was a mention of the need to prepare Master Plans for rural roads at the district level. In many states, more than one connection was provided for a village, resulting in a large network, which was difficult to maintain. Regional imbalances in connectivity were also seen.

It was only when the PMGSY was undertaken with central funding in 2001, the system of preparation of Master Plans and Core Network got institutionalised. Further, the requirements regarding maintenance and upgradation of existing roads were sought to be integrated while providing new connectivity to village/habitations, and high and uniform technical standards for pavement, drainage and protection works were put in place.

3.3 PMGSY and Bharat Nirman Initiative

In order to give a boost to rural connectivity, a Rural Roads programme known as the Pradhan Mantri Gram Sadak Yojana (PMGSY) was launched in December, 2000. This programme shifted the focus from the village to the habitation since it was realised that a village may consist of several clusters separated by considerable distance, often mirroring socio-economic stratification. The initial objective of the PMGSY was to provide all-weather road connectivity to:

- all habitations over 1000 population by the year 2003
- all habitations of 500–1000 population by the year 2007 (end of the Tenth Plan)
- all habitations of population above 250 (in case of hill states, desert and tribal areas) by the year 2007.

As a departure from the earlier programmes, the PMGSY is being implemented as a 100 per cent centrally funded scheme. When the PMGSY was launched in 2000, it was estimated that about 347,000 habitations out of a total of 825,000 habitations were without any all-weather access. Thus, 40 per cent of the habitations were cut off from the country's mainstream of development. According to latest figures made available by the state governments under a detailed survey undertaken to identify core networks about 1.79 lakh unconnected habitations need to be taken up under the PMGSY programme (Table 3.4).

Table 3.4 PMGSY Programme: New Connectivity

Habitation Population Group	Number of Rural Unconnected Habitations	Length Required (km)	Estimated cost (Rs billion)
1000+	60,030	138,888	784.18
500-999	79,208	160,754	
250-499 *	39,530	75,690	
Total	178,768	375,332	784.18

* Only in hill states, desert and tribal areas as per PMGSY eligibility.

A state-wise details of the requirements of the length and cost of new connectivity is given in Table 3.5.

Table 3.5: Length and Cost of Rural Roads required for New Connectivity under PMGSY

S. No.	Name the State	No. of Unconnected Habitations	Eligible Unconnected Habitations						Total length to be covered (km)	Cost for Connectivity under PMGSY in Rs. Million
			1000+		500-999		250-499			
			No	Length (km)	No	Length (km)	No	Length (km)		
1	Andhra Pradesh	2679	167	668	417	1668	396	990	3326	4520
2	Arunachal Pradesh	2741	49	318	127	1079	290	2119	3516	8390
3	Assam	17975	7323	7900	4862	6671	3161	4416	18987	51950
4	Bihar	11497	8187	28713	1847	4831	0	0	33544	66470
5	Chhattisgarh	24202	2604	12213	6313	14709	3644	10634	37556	76700
6	Goa	55	0	0	20	40	35	50	90	100
7	Gujarat	8127	472	1038	2288	4027	1493	2387	7452	10210
8	Haryana	23	0	0	2	26	0	0	26	60
9	Himachal Pradesh	11340	262	1734	853	3389	2379	7709	12832	34900
10	Jammu & Kashmir	3946	785	3454	942	2722	1065	2236	8412	27720
11	Jharkhand	21036	2622	5298	4178	8943	3896	7204	21445	36420
12	Karnataka	4608	156	103	118	397	602	1367	1867	2250
13	Kerala	475	121	116	333	323	19	21	460	950
14	Madhya Pradesh	34771	5804	25131	10645	31403	2043	3730	60264	121990
15	Maharashtra	6892	187	633	810	1961	516	1774	4368	7680
16	Manipur	1142	71	355	187	633	340	1143	2131	5170
17	Meghalaya	2752	9	31	150	553	597	2078	2662	6930
18	Mizoram	392	47	236	114	948	124	837	2021	5910
19	Nagaland	127	21	280	32	478	41	231	989	2490
20	Orissa	29023	3703	7946	6715	13652	7921	7776	29374	69620
21	Punjab	920	103	205	433	774	0	0	979	1610
22	Rajasthan	19945	2725	9961	6428	19875	1842	5871	35707	40630
23	Sikkim	410	16	78	138	541	164	488	1107	3280
24	Tamil Nadu	5318	577	1426	1825	3552	238	281	5259	7870
25	Tripura	4448	179	260	655	1205	1083	1516	2981	9610
26	Uttarakhand	8613	152	1299	690	4251	1689	4880	10430	22990
27	Uttar Pradesh	89246	10898	16300	17944	22300	0	0	38600	87560
28	West Bengal	33904	12790	13192	10142	9803	5952	5952	28947	70200
	Total	346607	60030	138888	79208	160754	39530	75690	375332	784180

In addition, upgradation of roads of the core network will be undertaken where required to provide connectivity to market centres and other social infrastructure. A length of 372,816 km for upgrading at an estimated cost of Rs.590.330 billion has been included out of a total length of 1,134,112 km, Table 3.6. gives state-wise picture.

Table 3.6: Length and Cost of Rural Roads required for Upgradation under PMGSY

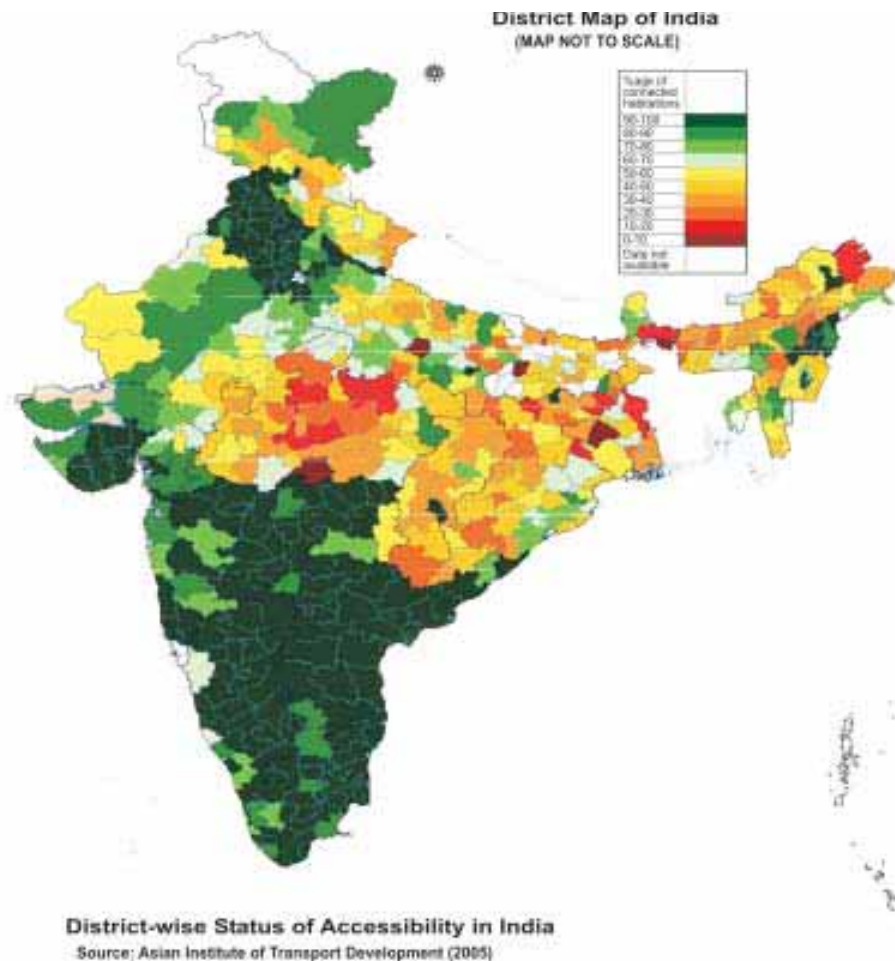
S. No	State	Length of Core Network (Rural Roads)			Length of upgradation to be covered (km)	Estimated cost (Rs million)
		Through roads (km)	Link roads (km)	Total (km)		
1	Andhra Pradesh	8576	57495	66071	17201	25820
2	Arunachal Pradesh	2750	9154	11904	4123	7260
3	Assam	10551	16632	27183	13046	33400
4	Bihar	12746	38898	51644	18581	27770
5	Chhattisgarh	12536	29040	41576	16892	27850
6	Goa	71	788	859	190	190
7	Gujarat	2982	40668	43650	9082	9720
8	Haryana	6567	6387	12954	7525	13150
9	Himachal Pradesh	5894	23577	29471	9431	16600
10	Jammu & Kashmir	3585	15238	18822	5870	11400
11	Jharkhand	7978	29677	37654	12429	17280
12	Karnataka	8141	58539	66679	16921	18720
13	Kerala	305	15734	16039	2665	4190
14	Madhya Pradesh	25330	79380	104710	37237	57420
15	Maharashtra	8905	72130	81035	19724	27650
16	Manipur	1343	7284	8627	2435	3750
17	Meghalaya	2312	7120	9432	3380	6020
18	Mizoram	1117	2396	3513	1476	2650
19	Nagaland	805	6003	6807	1705	2510
20	Orissa	19138	61257	80395	28327	43480
21	Punjab	7484	17751	25235	10147	12500
22	Rajasthan	14821	75304	90125	26117	27750
23	Sikkim	485	2408	2893	846	1150
24	Tamil Nadu	14317	52561	66878	22201	30190
25	Tripura	1637	4704	6341	2343	4760
26	Uttarakhand	4321	17124	21446	6890	12100
27	Uttar Pradesh	40363	111404	151767	57074	99720
28	West Bengal	13410	36991	50400	18958	45330
Total		238470	895642	1134112	372816	590330

Since states would be the major beneficiaries and normally such up-gradation should have been carried out by the states themselves, additional length out of the core network of rural roads where upgradation would be justified based on condition assessment may be taken up by the states out of their own resources. States would need to take up an inventory and condition survey of the entire core road network in a time bound and systematic manner as already emphasised by the NRRDA.

The Government of India have announced a Bharat Nirman programme, which includes Rural Roads as one of the components and has set a goal to provide connectivity to all villages with a population of 1000 (500 in the case of hill and NE states, desert and tribal areas) with all weather roads by the year 2009-10.

From the data available from the National Rural Roads Development Agency (NRRDA), which is providing technical and management support for PMGSY, value of works sanctioned is Rs. 383,874 million covering both new construction and upgrading upto the end of December, 2006. A total of 82,833 habitations have been covered already.

A Map of India showing the status of accessibility is given in Figure 3.1.



A broad analysis of the balance work under the PMGSY as on 1.4.2005 and 1.1.2007 is given in Table 3.7.

Table 3.7: Balance Programme of PMGSY

S.No.	Particulars	As on 1.4.2005	As on 1.1.2007
(i)	Number of rural habitations still to be covered	134,643	95,935
(ii)	New construction		
	(a) Length	295,824 km	242,017 km
	(b) Estimated cost	Rs. 661,770 million	Rs. 565,044 million
(iii)	Upgrading		
	(a) Length	337,122 km	307,435 km
	(b) Estimated cost	Rs. 558,190 million	Rs. 425,592 million
	Total cost	Rs. 1,219,960 million	Rs. 990,636 million

3.4. Connectivity Vision

3.4.1. Apart from the balance work of PMGSY, which in itself is an ambitious task, there is need to tackle the requirement of connectivity to habitations with lower population thresholds not presently covered under the PMGSY. Existing roads and tracks are also to be brought to a fully serviceable condition.

The objective has to be to provide full connectivity to all habitations including provision of bridges and culverts. Optimising investments in upgrading and maintaining the existing network while giving due regard to providing access to unconnected habitations of smaller size is the challenge. This has clearly to be met with state and even district specific strategies.

3.4.2. Strategy: Once it is clear that 'access' is the primary function of the rural road, it is possible to dovetail state and district specific connectivity requirements and develop cost-effective access solutions. These may include unsealed roads and in case of hill areas even foot-bridges to provide low-cost access to the road network. For smaller habitations, the definition of all-weather access may also be suitably modified and frequency and duration of interruption increased to acceptable levels.

3.4.3. The following vision for new connectivity is recommended:

- Habitations with population above 1000 (500 in case of hill, NE states, deserts and tribal areas)* Year 2009-10
- Habitations with population above 500 (250 in case of hill, NE states, deserts and tribal areas) Year 2014-15
- Habitations with population above 250 Year 2021-22

* This is part of Bharat Nirman

3.4.4. It must be recognized here that whether or not habitations of population size 250 and above all over the country are to be connected within a definite time frame, commencing the programme currently not eligible under the PMGSY, after completion of current PMGSY targets has immediate and direct implications on PMGSY, which is primarily funded out of a cess. Excessive leveraging of the cess, which may preclude providing connectivity to habitations with population below 500 (perhaps even below 1000) will have serious implications for the vision.

Rural Road Master Plans

4.1 Past Policy

The need for a Master Plan for the road network has been advocated whenever the country prepared long-term road development plans. In its report (May, 1980), the National Transport Policy Committee set up by the Planning Commission recommended, for instance, that the Road Development Plan for the period 1981-2001 should not only prescribe the accessibility targets for 'developed', 'semi-developed' and 'under-developed' areas but also provide a spatial dimension by breaking up segments, regions and statewise keeping in view the peculiar conditions in each region. For rural roads, the Committee recommended that the Rural Road Authorities should draw district plans indicating the alignment of rural roads and other road network. The Road Development Plan, Vision 2021 stresses that in the first instance, Master Plans for Rural Roads in each District be prepared building up from Block level. The alignments may be optimised to serve maximum population per unit length and utilisation of existing tracks. Needs of tribal areas, coastal regions, deserts and hill areas should receive special attention. However, except for a few states, the district level master plans were not being prepared.

4.2 Current Guidelines

When the PMGSY was launched in 2000, with full funding from the central government, an opportunity presented itself to the central government to frame certain guidelines for the development of rural roads at the national level but which can be implemented by the states at the local level.

Major activities covered in the guidelines of the PMGSY are:

- prepare a master plan at the district level (to be digitized and put on GIS)
- identify a Core Network
- prioritise the upgradation programme based on a quick condition survey
- allocate more resources to first achieve full connectivity for prescribed population-sizes habitations

- allocate funds for maintenance of assets already created
- adopt uniform design standards, specifications, rate analysis and standard bidding procedure
- enforce strict quality control measures
- adopt On-Line-Monitoring Systems and accounting practices
- put in place state level agencies for rural road planning and management

The Central Government laid down that District Rural Roads Plan (DRRP) should be prepared after consultation with the rural administration (Panchayat), elected representatives of the people and the State Government. The district plan is a compendium of the existing and proposed road network system in the district, which clearly identifies the proposed roads to link up with the market centres, social and economic services and the existing network in an economic and efficient manner. These plans are to be prepared at two levels – first the block level and then the district. Box 4.1 gives the process prescribed.

Box 4.1: Preparation of District Rural Roads Plan (DRRP)

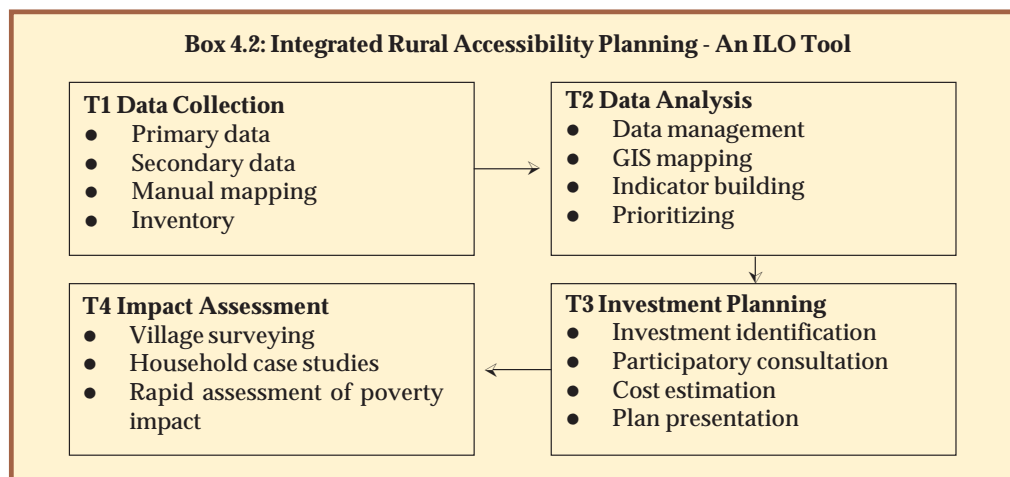
- Constitute the Team to work at block level.
- Tabulate data: Habitations, road inventory, roads of higher category, condition survey, pavement condition index
- Prepare Block Maps and arrange integration into District Map
- Prepare list of unconnected habitations and select optional road links
- Consideration and approval by the Block (Intermediate) Panchayat
- Submission of Block level rural roads plan to the District Planning Committee
- Scrutiny by the District Planning Committee
- Consultation with the District Panchayat and Elected Representatives and approval of DRRP.
- Forwarding the DRRP to the state level standing committee
- Vetting of the DRRP by the state level standing committee

Under the PMGSY, the preparation of the Master Plan and Core Network Plan is mandatory before any projects are sanctioned. Several data collection formats were prescribed and it is a commendable effort that the data on the status of connectivity has been compiled. The plans have the approval of the beneficiaries through a transparent consultative process. The preparation of the next twenty-year programme for Rural Roads has been greatly facilitated by this effort.

4.3 International Experience

The International Labour Organization (ILO) has developed an approach called “Integrated Rural Accessibility Planning” (IRAP), which looks simultaneously at the rural roads network and the

distribution of socio-economic facilities and services. Box 4.2 gives the process in brief. It has been successfully adopted in several countries in Africa and Asia, notably Philippines, Laos, Kenya, Indonesia. Recently, the ILO has completed first stage work of IRAP in two states in India, Rajasthan and Orissa. The IRAP does not seek to replace existing planning process or procedures but aims at supporting these by encouraging due attention for accessibility issues.



The notable feature of the IRAP process is its dual strategy of bringing people more easily to the services and destinations they need to reach (i.e. improving the mobility of people); and bringing services and supplies closer to the people (i.e. reducing the need for transport itself.).

The States could consider such tools for possible adoption as a refinement in the current guidelines.

4.4 Core Network

Realising that the first priority should be to provide a basic access (single all-weather road connectivity) to each unconnected habitation, the concept of a core network has been introduced. The Core Network is defined as the network that is essential to provide one basic access to each habitation. Basic access is defined as one all-weather road access from each village/habitation to the nearby Market Centre or Rural Business Hub (RBH) and essential social and economic services.

Market centers or RBH are centers of activities for marketing of agricultural produce and inputs, servicing of agricultural implements, health, higher education, postal, banking services, etc. They are generally growth centers located on higher category of roads or at the confluence of roads emanating from a number of habitations. Maximum distance between a village and RBH would normally be 15-20 km. An RBH may not be fully developed at present but a big village may have such potential. Planning should take this into account.

The core network is extracted out of the District Rural Roads Plan (DRRP), which shows the existing roads as well as the roads required to be constructed to connect the unconnected habitations.

The concept of Core Network has become the cornerstone of planning road network after 2001. This is the development, which is bound to have effect on future expansion and consolidation of the network. After having established a good and sound base for rural road network planning, it is necessary to continue the observance of this concept over the years to come. Once the entire Core Network is constructed, and upgraded to acceptable standards, time may then be appropriate to consider additional links to already connected villages, based on transport demand between pairs of villages and the need to reduce the travel distance to major service centres like schools, colleges, markets and warehouses. Thus, the Core Network is to be viewed as a major step to achieve full connectivity to all habitations and removal of regional imbalances.

The Core Network comprises of Through Routes and Link Routes. Through Routes are the ones, which collect traffic from several link roads or a long chain of habitations and lead it to a market center or a higher category road. Link Routes are the roads connecting a single habitation or a group of habitations to Through Routes or District Roads leading to market centres. The classification of Through Routes and Link Routes needs to be systematically used as a planning tool. Many Through Routes have the potential to become Major District Roads (MDR) over the next 20 years. Route alignment, design and construction standards must keep this point in view in order to reduce the need for avoidable investments when such roads become MDR on the basis of traffic volumes etc.

4.5 State-level Planning

The state governments may use the DRRP and the Core Network developed as part of the PMGSY programme for a holistic planning and implementation of even state level programmes including those that fall into RIDF (NABARD), World Bank, ADB State plans, and local areas development schemes by the Members of the State Assemblies and the Parliament.

Design Standards

5.1 Rural Roads as Well-Engineered Structures

There is a misconception that Rural Roads being the lowest category of roads need no elaborate design and engineering. It was on this presumption that several thousand kilometers of such roads were constructed in the past, under various plans and programmes including employment generation and famine relief schemes. As a result, rural roads had poor geometrics, inadequate compaction of embankment and inadequate drainage. Consequently, these did not last long. Rural Roads do require proper design, and the same attention is needed as for any other class of highway. Given the fact that rural roads serve an 'access' function rather than a 'mobility' function the scope for engineering intervention to ensure a cost-effective solution is all the greater.

5.2 Principles Governing Rural Road Design Standards

The following principles should govern in design of rural roads.

- Rural Roads are low volume facilities basically serving as an access function. The design speed and level of service expected are low. The design standards should be in harmony with such expectations.
- Geometric standards, particularly gradients, are difficult to change later, and hence should be selected carefully with the future requirements in view.
- The initial cost is an important consideration. Many roads particularly through routes will in due course carry fairly substantial traffic but it is preferable to optimize costs by stage construction in tune with traffic growth.
- A design period of 10 years is considered adequate, with rehabilitation being planned based on road condition.

- Durable and permanent assets need to be aimed at through adequate provision for drainage and protection works.
- The maintenance of assets must receive careful attention as a policy and should not be capitalized into richer than required standards.

5.3 Geometric Design Standards

The geometric design standards for all categories of roads have been laid down in the Indian Roads Congress Codes. While these are widely accepted in the country; from a long-term perspective, planners and engineers need to give due attention to the following issues:

Carriageway and Roadway Widths

In the Rural Road projects recently being implemented, a roadway width of 7.5 m and a carriageway width of 3.75 m are being routinely adopted in plain and rolling terrain. The IRC Rural Roads Manual mentions that these may be reduced to 6.0 m and 3.0 m respectively where the traffic intensity is less than 100 motorised vehicles per day. The reduced widths may be adopted where applicable based on traffic, especially on link roads.

Radii of Horizontal Curves and Sight Distances

The radii of horizontal curves and sight distance are related to the design speed. In view of the difficulties being faced in availability of land for rural roads, it may be desirable to review the current IRC standards regarding design speed.

5.4 Pavement Design

The IRC Rural Roads Manual gives pavement thickness based on:

- (i) 4-day soaked CBR value of soil
- (ii) Traffic in terms of commercial vehicles per day (CVPD)

As regards the type of surfacing, all rural roads except those (i) in an arid region with annual rainfall less than 500 mm and traffic upto 150 motorised vehicles per day and (ii) in a region with an annual rainfall less than 1000 mm and traffic upto 50 motorised vehicles per day (except two-wheelers) were required to be provided with a bituminous treatment. Unsealed gravel roads did not receive adequate treatment, and thus, practically all rural roads being constructed in the country now are black-topped.

The definition of commercial vehicles is not given, and practising engineers often include agricultural tractors in this category. Though the curves are the standard UK Road Research Laboratory curves, these curves are applicable for commercial vehicles of laden weight more than 3 tonnes.

Considerable amount of work has been done on pavement design of low volume roads internationally. Of these, the following may be mentioned:

- (i) AASHTO design curves for low volume roads
- (ii) Australian pavement design curves for low volume roads
- (iii) Chinese pavement design curves for unsurfaced low volume roads.

AASHTO design curves have been evolved after extensive observation of performance of roads under various climatic conditions and traffic load repetitions. The USA experience shows that upto 100,000 repetitions of standard axles, gravel roads can be considered, and for traffic less than 10,000 repetitions earth roads are suitable.

The Central Road Research Institute made a study of the performance of rural roads in several parts of the country. Based on this research, a simple design methodology has been developed by them. A comparison of the thickness obtained from the CRRI study and the international guidelines indicated above shows close agreement in pavement thickness.

The National Rural Roads Development Agency (NRRDA) has initiated a research project on Pavement Performance, covering the diverse climatic conditions prevailing in the country and the soil types available. The outcome of the research project will fill the current knowledge gap in pavement design of low volume roads. In the meantime, the IRC may like to review the current pavement design methodology for rural roads and give serious consideration to the approach evolved by the CRRI.

5.5 Gravel Roads and Use of Locally Available Materials

Though India did extensive work on soil stabilization and the use of locally available materials (for example Mehra's method popularised nearly five decades ago), the adoption of these techniques has not been popular. In this process, the country has lost a good opportunity to build on its own experiences and achieve economies in the road cost. The use of expensive stone aggregate based specification, such as water bound macadam, has been universal, even in locations where they are brought from long distances. Gravel roads, or soil-aggregate roads, so popular in other developing countries, have not been adopted. AASHTO has developed a design chart for aggregate surfaced roads considering allowable rutting. Stabilisation of local soil with lime, cement and chemical additives are well established technologies abroad, but hardly practiced in India. Apparently, there has been reluctance to bring such practices from Lab to Land (i.e. in the field). The state governments will do well to undertake research project of determining strength characteristics of locally available materials in each district, prepare district maps and then draw up strategies to utilise them in various layers with improvements through stabilisation. This is extremely important for achieving reduction in costs of construction and speeding up the programme of connectivity within the available financial resources. The project may be funded by the Ministry of Rural Development and implemented by regional/state research laboratories, academic institutions, etc. overseen by the CRRI.

For link roads, gravel pavements of designed thickness based on consideration of traffic over the full formation may be provided.

Since gravel roads are likely to be constructed on the future Rural Road network as a first stage in cases of connectivity to low size habitations, there is need to compile and disseminate knowledge on this subject. The NRRDA and IRC should prepare a comprehensive Manual on gravel roads, synthesising the practices in India and abroad.

5.6 Drainage and Protection Works

The provision of adequate drainage and protection works for rural roads needs more attention. Inadequate drainage can lead to premature failure of the pavement, embankment and cut slopes. In order to economise, earth for forming the embankment is borrowed from within the available land width, almost touching the embankment toe. Proper slopes are not provided longitudinally in these drains to lead the water to the nearest natural drain. It is common to see standing water in these drains leading to breeding of mosquitoes.

The control of erosion of the slopes of the road embankment is also a neglected activity now. Simple measures like turfing the embankment slopes will protect the embankment and the road, prevent deep rain cuts, which can endanger the pavement, and reduce maintenance costs. Drainage and erosion control measures should form part of the initial design.

On hill roads, drainage and protection works assume still greater importance. Slips and landslides are common, damaging the road. In the future rural roads to be built, the protection works should be made a part of the initial design itself.

5.7 Bituminous Surfacing

Bituminous surfacing is currently being provided on almost all rural roads, without any consideration of traffic and rainfall. This is a costly item, its cost being in the range of Rs 4-5 lakh per km. Blacktopping, therefore, has a bearing on investments needed for rural roads. Availability of bitumen at reasonable cost and in desired quantities might also pose a problem in foreseeable future. Moreover, this surfacing will involve extra cost in periodic maintenance subsequently. Subject to consideration of rainfall and traffic, blacktopping may be restricted to through routes and to link routes that link bigger villages say with population above 1000. For roads connecting villages with population less than 1000, gravel roads should do unless heavy rainfall conditions justify blacktopping. As already mentioned earlier, AASHTO designs recommended only a gravel road for traffic upto 100,000 repetitions of standard axles. Roughly, under present loading conditions observed in India, this implies that many of the link roads in low rainfall areas can be left without blacktopping in the first stage.

Several countries in the world, including USA, have a large percentage of unpaved roads. Table 5.1 gives the picture. It is thus apparent that un-paved gravel roads have an important role to play in India's future road programme.

Table 5.1: Unpaved Roads in Selected Countries

Sl. No.	Country	Road Length	Percentage of unpaved roads to total length
1.	Australia (1999 est.)	Total: 811,603 km Paved: 314,090 km Unpaved: 497,513 km	61.3
2.	Bangladesh (1999)	Total: 207,486 km Paved: 19,773 km Unpaved: 187,713 km	90.4
3.	Brazil (2000)	Total: 1,724,929 km Paved: 94,871 km Unpaved: 1,630,058 km	94.5
4.	Canada (2002)	Total: 1,408,800 km Paved: 497,306 km Unpaved: 911,494 km	64.7
5.	China (2002 est.)	Total: 1,765,222 km Paved: 395,410 km Unpaved: 1,369,812 km	77.6
6.	Japan(2001)	Total: 1,171,647 km Paved: 903,340 km Unpaved: 268,307 km	23.0
7.	Mexico (1999 est.)	Total: 329,532 km Paved: 108,087 km Unpaved: 221,445 km	67.0
8.	Russia (2001)	Total: 537,289 km Paved: 362,133 km Unpaved: 175,156 km	32.6
9.	South Africa (2002)	Total: 275,971 km Paved: 57,568 km Unpaved: 218,403 km	79.1
10.	United States of America (2003)	Total: 6,393,603 km Paved: 4,180,053 km Unpaved: 2,213,550 km	34.6
11.	India (1999)	Total: 2,525,989 km Paved: 1,448,655 km Unpaved: 1,077,334 km	42.6

(Source: CIA World Fact Book, 2005)

Furthermore, several low cost bituminous sealing techniques are available. These include surface dressing, which can be practiced with low cost equipment and labour-intensive techniques. Gravel roads and soil-cement roads can also be sealed by a light bituminous treatment.

5.8 Cement-based Specifications

Since bitumen may become scarce and costly in the years to come, options such as soil-cement, lime-flyash-aggregate mixes etc. may be tried particularly in areas of poor drainage conditions and in areas where stone aggregates are very costly.

5.9 Bridges on Rural Roads

5.9.1 Cross-drainage Structures for All-weather Connectivity

The ultimate objective of constructing rural roads is to provide all-weather connectivity. This implies that all streams and rivers crossing the alignment should be fully bridged. The cost of providing cross-drainage structures can be 30-40 per cent of the total cost of the road. Hence great care and attention should be given to this component. While over-design can be costly, underdesign can lead to premature failures that can cause long interruptions to traffic, defeating the very purpose of constructing all-weather roads.

5.9.2 Some Guiding Principles

Some guiding principles that should govern the selection of the type and design of cross-drainage structures shall be as under:-

- The provisions of cross-drainage structures should be made at the very first stage of construction, since the effective drainage of the road depends on them.
- Structures, once constructed, are difficult to remodel/ widen/ strengthen at a later stage. Hence, the initial design should be adequate to take care of the present and future traffic.
- The materials used and the specifications adopted should lead to a practically maintenance-free performance.
- In the case of Rural Roads, it is permissible to put up with minor interruptions to traffic. The road can be submerged upto 6 times a year, the period not exceeding 24 hours at a time.
- Use of local materials and skills and labour-intensive technology should be preferred.
- Construction of bridges shall be deemed to be an integral part of Rural Roads Network in order to ensure all-weather connectivity.

5.9.3 Fixation of Water-way

There is a wide variation in topography and climatic conditions across the country. The formulae for calculating the discharge and fixing the water-way of structures currently in use in the country were evolved several years ago and have not been updated based on actual observations. Since very large investments on cross-drainage structures for rural roads are envisaged, it is desirable that a study is undertaken about the rainfall pattern in the country and the discharge that should be

catered to in different parts of the country. Simple procedures and nomograms should be evolved to fix the discharge and waterway.

5.9.4 Bridging needs of People

In the hills and foothills, wide streams and rivers are encountered. On both the banks of these, the land is fertile and several habitations exist. In such situations, it may be judicious to propose all-weather motorable roads on both the banks, with motorable bridges only at selected locations where higher categories of roads like National Highways, State Highways and Major District Roads cross the streams and rivers. At intermediate locations, suitable suspension foot-bridges may be provided for use by pedestrians and pack animals. The Rural Road network should be evolved keeping in view the bridging needs of the people.

5.9.5 Choice of Materials

Stone masonry, brick masonry and concrete are the common materials. Bricks should be preferred in areas where stone materials are costly. Stone and brick masonry should be preferred to concrete since they generate employment. Steel for superstructure is another choice in remote areas. Timber bridges were popular for low volume roads in the past in states like Jammu & Kashmir, Himachal Pradesh and the NE region. However, many of these bridges now need replacement for enabling movement of heavy vehicles. Besides, the availability of timber for future bridging programme is uncertain because of the national priority to conserve forests. For future bridging programme, we would need to rely largely on masonry, concrete and steel structures.

5.9.6 Standardization of design

With a large bridging programme lined up for the next two decades, the use of standard designs will speed up project preparation as well as execution. Efforts should be made to evolve standard designs for various types of structures.

The standard designs should favour modular construction, manufacture of elements on a large scale at a central location and transporting and erecting them at site within a short time. This will save the time required for curing and strength gain, particularly of RCC elements. Appropriate technologies for bridge structures suitable for rural roads in different environment and regions should be evolved.

RCC pipes are the most cost-effective solutions for culverts and causeways. Galvanised Corrugated Pipe culverts (ARMCO Pipes) are cheaper, lighter and easily assembled. These are popular in countries abroad, particularly the U.S.A. Standard designs using them should be evolved and popularized. Indian manufactures will be more than happy to produce them as the demand will be large. RCC box culverts of vent size varying from 1m x 1m to 3m x 3m will find extensive application. In many cases, these will be cheaper than solid abutments and RCC slabs. Standard designs for these structures should be evolved on the lines of designs evolved for National Highways.

For structures involving solid abutments and slabs, standard sections and reinforcement details should be worked out that can be used for the loads that rural roads are expected to carry.

In hill states, the use of dry stone masonry scuppers is widely prevalent. These are very cost effective, use stone materials obtained by blasting, are labour-intensive and do not involve the use of cement. As such, the practice of provision of stone scuppers should be continued, and innovative type designs should be evolved.

Stone masonry and brick masonry arches have been adopted for centuries and this art should be allowed to continue, and standard designs should be developed. If suitable designs are evolved especially for rural road traffic, considerable economy can be brought about. Precast arch segments which replace the abutments and piers have been found to be quite cost-effective, and should be popularized.

For medium span bridges, type designs in RCC and prestressed concrete should be developed, laying stress on precasting on a large scale.

Design of steel bridges should be standardized for different spans. Steel bridges have several advantages, particularly for hill roads. Designs similar to bailey bridges being adopted by the Army and designs involving rolled steel joists for small spans should be evolved and their use popularized.

5.9.7 Standard Quantities

Side by side with the preparation of standard design, the standard quantities of work items should be evolved, and reproduced in the drawings. This will facilitate the preparation of estimates on a large scale, besides ensuring accuracy.

5.9.8 Document on cross-drainage structures

The Indian Roads Congress, with the support of NRRDA, may review the current design standards and methods of construction of cross drainage structures and bring out a comprehensive publication on provision of low cost cross-drainage structures on rural roads.

5.9.9 Maintenance of Bridges

The designs evolved should be generally maintenance forgiving. It needs to be appreciated that some maintenance is inevitable, such as painting of steel bridges, and clearing of vegetation and silt in the waterway. A comprehensive Maintenance Manual should be brought out for rural roads, which should include routine inspection and maintenance of bridges.

5.9.10 Training of Engineers in Design of Low-Cost Bridges

In view of the large investments involved and the lack of expertise among engineers, special courses for training Engineers in the design of low-cost bridges should be organized on a regular basis.

5.10 Stage Construction Strategy

Low volume rural roads offer the ideal conditions for following stage construction strategies so that the services offered are constantly and strictly adjusted to the needs. The UNESCO treatise on Low Cost Roads, gives the following definition of stage construction:

“Stage construction consists in constructing the road in successive stages phased in time in such a way that its geometric and structural characteristics evolve in parallel or slightly ahead of the growth of traffic and are at all times suitable to the level of traffic carried”.

This policy implies that the investments meet the demands at every stage. It may be mentioned that the road system in every country has been evolved in stages, the earliest being the roads fit for horse carriages, and these being gradually improved in stages by widening and surface improvements as the traffic changed in character and volume.

The following are the stages in the evolution of a rural road:

- (i) The earthen track, or unimproved road
- (ii) The earth road with a drained roadway and temporary or permanent engineering structures for crossing all the water courses
- (iii) A gravel road
- (iv) A surfaced (bitumen or cement concrete) road

To quote UNESCO’s treatise further,

“The concept of stage construction goes hand in hand with the idea that each investment must be able to be utilised in the subsequent stages in the development of the road. Such a strategy will involve:

- (i) avoiding any temporary structure
- (ii) carrying out the earthworks for the final roadway from the initial stages, and
- (iii) limiting progressive improvement to the different courses of the carriageway.

For practical purposes, the stages may be reduced to gravel and bituminous. The work done at the first stage would then become part of the second stage.

Stage construction strategy has been very well adopted particularly for construction of hill roads. The following stages are being adopted in many cases:

- (i) A bridle path, about 2 m wide formation
- (ii) Jeepable road, about 3 m wide formation
- (iii) Motorable road, 5 m wide formation

For rural roads, the strategy of stage construction described above may be considered by the states to accelerate the process of connectivity of even small size habitations. To start with, a gravel road with proper geometrics, drainage features and all cross-drainage structures shall be provided in areas of low rainfall (less than 1500 mm per year) and for linking habitations below 1000 population. As traffic grows, the gravel road may be sealed with a single coat of surface dressing. This strategy should be adequate for a period of about five years in most cases. When the number of motorized vehicles exceeds 100 per day, the gravel road may be overlaid with layers of stone aggregates and a bituminous surface provided.

However, a note of caution in stage construction philosophy is that such roads run the risk of being left unattended when they become due for next stage of upgradation. It is, therefore, necessary to keep a watch on the upgradation needs of roads where stage construction policy is adopted. To ensure this, the subsequent upgradation should be properly budgeted, generally in the tenth year after initial construction and in a higher priority than new construction.

Land Use Management

6.1 Current Practices

At present the rural habitations are reached through a network of village fair weather tracks, which have been in existence for long and have been the traditional routes of communication for the rural population. These existing pathways are shown in the revenue records as road land under the ownership/possession of the state government or Panchayats or as community owned lands. These paths meet the needs of slow moving traffic and the land width available varies from 5-8 metres. These paths include stretches with poor geometrics and even right-angle turns. The communities and villagers do not generally encroach on such paths and they become available for construction of roads. The land width reserved for such fair weather tracks, however, does not fulfill the requirements as per IRC standards and it becomes imperative to acquire additional private land to the extent of 3-4 m on either side. Land is also required when the construction is taken up on an altogether new alignment. The land adjacent to these corridors vests with the owners. Acquisition of additional land normally does not present much of a problem because in most cases, the villagers are voluntarily making land donation.

6.2 Land Acquisition

In occasional cases, land acquisition by payment of compensation may have to be considered. For rural roads the State Governments, keeping in view the overall context, will determine land availability policies. Uniform policies will need to be evolved to avoid competing demands and also in order not to discourage local community participation in voluntary land donation efforts.

6.3 Socio Economic Impact of Land Donation

Land donation efforts have several important social and economic impacts, which may need to be addressed, generally in a more planned way than if compensation is paid through an acquisition procedure. Impacts can include the following:-

- Loss of frontage for houses/shops on existing alignment
- Loss of agricultural land
- Loss of income
- Landlessness in rare cases
- Fragmentation of holding (in rare cases, where improvement in geometrics require realignment)

Though, in almost all cases the provision of an all-weather transport access has benefits far outweighing the losses, wherever feasible, local community needs to be mobilized to help minimize the impact of these losses, particularly for those below the poverty line or belonging to disadvantage sections of Society, including SC/ST, woman-headed household etc.

6.4 Environmental Impact

Since the road will follow the existing track, incremental adverse environmental impact due to provision of all weather connectivity is likely to be minimal and land acquisition/availability process needs to factor likely impact of alteration before assessing the final additional land requirement.

6.5 Community involvement in Land management

In order to manage the land acquisition/availability process equitably and in a manner that reflects local concerns and requirements, the local community including Panchayati Raj Institutions need to be fully involved in making land available for the road. Equally, they need to be involved in subsequent land use planning so that restrictive ribbon development does not take place along the road. Formalised mechanism need to be designed and operationalised to manage both stages of the process.

6.6 Land Records

Most of the rural roads and village tracks are in public use for a long time, in many cases since time immemorial. However, they are not always recorded as such in the Revenue Records. As rural roads are to be designed as proper engineering structures, the legal basis for the engineering needs to be well defined. States, therefore, need to launch a drive in order to record possession, and where possible, ownership of all roads of the DRRP in the State Government/local authority after following due process, based either on legal title or easmentary rights. All future acquisition/donation should not only be documented but should be given effect in the revenue record before work commences.

6.7 Integration of road network with GIS based land use data

GIS applications are developing around land use, with outputs related to agricultural, soil-erosion, general rural development planning, etc. It is important that the road network layer is properly integrated into exogenous GIS applications and per-contra, GIS based planning for road connectivity is adequately integrated with other spatial data sets. Not only must the revenue record properly show the road per se, but data coordination mechanism at State and District Level need to be put in place to ensure that the network character is adequately reflected.

Construction Technology

7.1 Current Practices

The current practices for the construction and maintenance of rural roads continue to be traditional inasmuch as the use of hard stone metal is being insisted upon, in the form of WBM layers and a bituminous surface treatment is being preferred even on low volume link roads. Although there is an increasing awareness regarding the need for maximized use of locally available materials, adoption of soil stabilization techniques and relevance of unsealed gravel roads for the low volume traffic conditions, such cost-effective practices have not yet found favour in many states.

The deployment of equipment/plant, both for construction and maintenance/ rehabilitation is, by and large, the same as is being adopted for higher category roads like Major District Roads and State Highways. For example, bituminous hot mix plants for the production of premixed materials and asphalt pavers for laying thin carpets are commonly used. For excavating earth from borrow areas, the use of excavators in combination with dumpers is also quite common.

The prevailing technology for construction and maintenance of rural roads needs a review.

The formulation of Specifications for Rural Road works and a Standard Data Book by the MORD/ NRRDA is a very welcome step. This will facilitate the adoption of uniform practices throughout the country. These documents should be periodically reviewed and updated based on the feedback from the field Engineers, Contractors and Consultants. In updating these, it should be ensured that the construction technology is “Intermediate” and not “equipment-intensive”.

7.2 Relevance of Tractor-bound Technology for the Use of Local Materials

One of the reasons being put forward for not being able to maximise the use of locally available materials

and for not adopting the highly cost-effective soil stabilisation techniques is the non-availability of proper construction equipment required for the implementation of these techniques. It is important to adopt such construction technologies, which do not rely on unnecessarily sophisticated and expensive machinery. This approach will also allow local contractors to compete effectively for such works and utilise locally available knowledge and skills with some training.

In the rural areas, all over the country, there are increasing number of agricultural tractors, which are used for about 100 days in a year for agricultural purposes and for the rest of the time, they can be utilized for rural road development works. In some countries abroad, notably in China, a number of implements, towed by an agricultural tractor, have been designed for performing a variety of tasks, both for the construction and maintenance of unsealed roads as also sealed roads with bituminous surface treatment. Some of the typical tractor-towed equipment are :

- Tractor-towed disc-harrow for pulverisation of clay clods
- Tractor-towed rotavator for mixing soil with stabiliser
- Tractor-towed water sprinkler
- Tractor-towed bituminous emulsion sprayer
- Tractor-towed blade grader
- Tractor-towed trolley for conveying soil and other road building materials
- A small excavator attached to an agricultural tractor
- Tractor-towed bituminous road maintenance mobile unit

Thus, most works of rural road construction and maintenance can be accomplished with tractor-based implements.

The use of tractor-based implements does not necessarily mean higher cost or dispensing with labour. In rural road construction, lower cost and higher employment can be achieved. Studies by CRRI in India have shown that:

- (i) savings of the order of 15-25 per cent can be effected in items of earthwork, mechanically stabilized and lime stabilized construction layers.
- (ii) the labour component of items of work such as earthwork and mechanically stabilized courses using semi-mechanized methods is in the range of 30-40 per cent of the total cost; on the other hand, if fully mechanized construction techniques are employed for these items of work, the labour component is as low as 5-10 per cent.

The mechanical stabilisation technique is commonly adopted all over the world for the unsealed gravel road construction and maintenance. It may be pointed out here that a good percentage of the rural road network connecting habitations with population less than 500 belongs to the category of low volume

rural roads for which gravel base with gravel surfacing can be suitable and economical. Adopting simple equipment like tractor-towed rotavators can significantly bring down the cost of Grave/Soil-Aggregate roads. Also, such tractor-towed equipment can be deployed for the Granular Sub-base (GSB) in lieu of WBM Grade I, bringing economy in construction.

Apart from tractor bound technology of construction, there are several low-end and low cost technology machines that perform equally well as the heavy road construction equipment and as such their use can be encouraged in the construction of the rural roads.

7.3 Use of Mobile Maintenance unit

Rural Road maintenance is currently being carried out by the gang labour system. The gang labour can be reorganized and its efficiency improved by the use of low cost, small capacity, mobile unit towed by tractor or other prime mover. Mobile Maintenance Unit may include the following items of equipment:

Item of Equipment	Number Required in one Unit
Prime Mover	1
Trailer	1
Blader Attachment	1
Cold Mix Plant 3-5 tonne/hr	1
Cold Emulsion Sprayer (200 litre)	1
Air Compressor (125 cfm)	1
Pavement Breaker	1
Plate Compactor (180 kg)	1

One mobile unit may cost around Rs 2 million. It can look after the maintenance of 200 km of roads. An area wide approach can be adopted depending upon the density of rural roads.

If contract maintenance is found feasible, Mobile Maintenance Units can be of great use, and the contractors should be encouraged to switch over to such practices.

7.4 Adoption of Labour-Based Technology

As the rural population grows in the coming years, off-farm employment opportunities need to be created to contain migration of rural population to towns and cities. Road construction and maintenance using labour-based technology promises to be a good avenue for creating employment potential while building productive assets. Many of the operations involved in a rural road, like excavation, embankment construction, cross-drainage works, soil-stabilisation, gravel roads, light-surface dressing, maintenance operations like trimming of berms and cutting grass and weeds, are easily amenable to be undertaken by manual means with support of light equipment. Provision of better tools to enhance the productivity

of labour and training of the work-force will help in the process. International experience from China and several African countries suggests that most of the operations involved in the construction and maintenance of Rural Roads can be efficiently performed by labour, aided by simple implements to increase its productivity.

7.5 Use of Cold emulsion Technology

In remote rural areas of the country, it is difficult to observe requirements of heating of bitumen and aggregates to the specified temperature, and ensuring that the mix is produced, transported and laid at the correct temperature. This is especially true of maintenance requirements like pothole filling and patch repairs. As a result, the quality of work is often sub-standard. The adoption of cold emulsion technology for operations like surface dressing, preparation of premix patch repair materials and preparation of premix materials for thin carpet can ensure that the works are done to the correct specifications and the final product is as per the requirements. Surface dressing using emulsions should gradually replace premix carpet using hot bitumen, say in a span of the 5 years. Suitable low-cost equipment like sprayers and mixing plants should be developed for the use of cold emulsion technology.

7.6 Further Work Needed towards Evolving Appropriate Technology

With the sudden increase in road construction activities in the road sector, particularly on National Highways and State Highways, the use of equipment like excavators, graders, vibratory rollers, wet-mix-macadam plants, pavers, hot-mix plants and mechanical bitumen sprayers has become commonplace. Many contractors have procured them, and there may be a surplus of such machinery, which is currently being used for Rural Road works. While this cannot be stopped or avoided, from the long-term perspective of large-scale Rural Roads programme, there is a need to evolve appropriate technologies, which should essentially be in between purely manual methods and highly mechanised methods. A number of work activities can be identified, which can be carried out equally effectively using labour based work methods. For this, specifications should clearly spell out how and when such methods can be applied, ensuring at the same time that the quality is not compromised.

The International Labour Organisation with the cooperation of the Ministry of Labour and the Ministry of Surface Transport (Roads Wing) had undertaken extensive studies in late 1970's in Madhya Pradesh for labour based construction technologies and the experience gained utilised by them in substituting machinery with labour and promoting labour based technologies with use of light equipment in provision of rural infrastructure in a few countries in Africa. Another international group, IFG on rural road engineering is promoting several good practices in rural road construction.

The Indian Roads Congress with the support of CRRI and the Ministry of Rural Development may draw up a matrix of various work items involved in construction and maintenance of rural roads and the appropriate work methods that can maximise use of local skills and local materials with light machinery, and restricting the heavy machinery to such items, which are necessary to ensure high

quality. The IRC can network with the ILO and IFG, etc. in accessing the techniques found successful in construction of rural roads in other countries and then identify promising techniques for our country.

7.7 Low-end Technology

The equipment industry also needs to focus on production of low-end technology machines, which can be used cost-effectively by the local contractors in construction and maintenance of rural roads. Pedestrian road rollers, chip-sealing machines, simple equipment for spraying emulsions, cold-mix plants of small capacity, pot-hole repairing kit are some of the promising items of equipment that need to be developed. For this, demand needs to be generated in the first instance and this can be done through mandating appropriate work methods. Demonstration of best practices using equipment like agricultural tractor towed blade graders, rippers, rotavators, water sprinklers, disc harrows and rollers in operations like clearing and grubbing, borrow area excavation, embankment construction, cement/lime-soil stabilisation, gravel road construction and maintenance of embankment shoulders will lead to building confidence among engineers and contractors.

When the equipment manufacturing industry comes out with suitable models, the financial burden of contractors in procuring them may be eased by firms leasing the equipment. A healthy equipment leasing industry may come up in the private sector.

Equipment, even though of low end technology, needs to be handled with care and expertise. For this, a whole army of operators, foremen and mechanics need to be trained. Some suggestions are given in Chapter 18.

Quality Systems

8.1 Importance of Quality in Rural Roads

Quality is a relative term and can be defined as “conformance to requirements” when compared to other similar products. Requirements and acceptance criteria for materials used and workmanship expected are detailed in contract documents. Normally these are based on the experience on similar works to ensure that the end products remain serviceable during its expected life. However, the requirements must be clearly stated so that they cannot be misunderstood. Measurements are then taken regularly to determine conformance to these requirements. The non-conformance detected is the absence of quality and may result in premature failures.

Quality control refers to the practice of checking the quality of a product by testing samples. Normally a laboratory is set up at the construction site and results of most of the acceptance tests are made available during the execution of the activity so that any non conformance can be rectified/ corrected before proceeding to the succeeding activity.

Since large investments are being made in the rural roads now, it is desirable that good quality roads are constructed meeting the laid-down specifications and durable assets are created. The roads should be able to perform well for the designed life. The present concept that ensuring quality is limited to performing quality control tests is too restrictive and should be broadened to include all aspects of quality assurance. Quality assurance safeguards should be in-built at every stage of the project cycle:

- surveys, investigations, designs and preparation of Detailed Project Report, whether through consultants or in-house
- preparation of bidding documents including specifications, bill of quantities, drawings
- construction by Contractor

- supervision by department with or without support of consultant
- maintenance

A Quality Assurance system should be developed covering all the above aspects of Rural Roads. Over a period of time, the sector should move towards Total Quality Management (TQM) as practiced universally.

Total Quality Management covers evolving and putting in place a quality assurance system, enunciating management policy, designating management responsibility and putting in place an organizational structure, exercising internal and external control, carrying out quality control tests, setting acceptance/rejection criteria, taking corrective action at all levels, and documentation of procedures, results and corrective action.

8.2 Quality Management System

Each state construction department such as PWD or RES must develop a quality management system, which shall include establishment of acceptance standards, tolerance levels and quality parameters. These should be based on qualitative assessment with simple compliance criteria and reasonable compliance process. These may need a yearly review on the basis of field data and also keeping in the cost factors in view. A well-trained quality appreciation unit should be set up within the construction departments to undertake quality checks at specified interval from planning and investigation stage to completion and subsequent maintenance. Such unit shall be responsible for the following functions:

- Quality engineering
- Data analysis and status reporting
- Corrective action
- Qualification approval of products, processes and procedures
- Technical Audit
- Quality education
- Safety

The cell responsible for monitoring the quality management system should be staffed by professionally trained quality personnel and report directly to the head or deputy head of the department. The system should be transparent and developed by interaction with all stakeholders such as contractors, inspecting officials, local community etc. The results of the tests should be prominently displayed at the construction sites, panchayats, office of construction agencies etc and generally made known to all

The Ministry of Rural Development has given a push to quality culture in rural roads construction by establishment of a three-tier system of quality control for the PMGSY roads as under:

- (i) First Tier : At the local level, involving the contractor and the supervisory staff. (Project Implementation Unit: PIU)
- (ii) Second Tier : An independent check of the quality through periodic checks by State Quality Monitors (SQM), officers and agencies engaged by the State Government, independent of the PIU.
- (iii) Third Tier : Independent inspection of works by National Quality Monitors (NQM), appointed by the Central Government out of experienced retired Engineers from the states.

Side by side, the following steps have been taken:

- (i) Introduction of a Quality Control Handbook. Quality of materials and workmanship is checked at each stage of work execution and registers showing the test results are to be maintained by the contractors. The frequency of testing for each activity has also been laid down in the said handbook.
- (ii) Insistence on the Contractor to maintain the road for five years after construction so that the need for good quality is recognised and ensured by him during the construction phase itself.
- (iii) Encouragement to the local stakeholders to lodge complaints about quality and other aspects, and a time-bound procedure for dealing with such complaints.
- (iv) Provision of financial support to the states in setting up material and workmanship testing laboratories at district level.

There has been, by and large, a very good feedback on the experience of quality in construction of PMGSY roads. The contractors are also taking pride in delivery of quality work. The states will do well by adopting such features universally on all rural road works irrespective of the source of funding and the agency responsible for rural roads. However it must be emphasized that while the responsibility of ensuring the stated quality fully rests on the contractor, the supervisory staff responsible for final acceptance has the duty of ensuring that the contractor discharges his responsibility faithfully. Quality comes at a price, but is a price worth paying only if the system ensures that the quality is delivered.

8.3 Quality in Surveys and Investigations

In order to get a rural road of good quality, it is also necessary to plan for quality right from the stage of surveys, investigations, design and preparation of Detailed Project Report (DPR). The engagement of the right personnel who are trained for the job and the use of the right survey and investigation equipment is a pre-requisite for obtaining a good quality DPR. This activity is not receiving adequate attention. The quality of surveys, investigations, design and preparation of DPR needs to be improved. An appropriate percentage of the cost of the project should be made in the estimate for surveys, investigations, design and preparation of DPR. Training should be given to the staff on these aspects to improve the output.

8.4 Financial Provision for Quality Measures

The implementation of quality systems requires earmarked funds. Some percentage of the cost of the project should be set apart for this purpose. This should also include funds required for training of the personnel.

8.5 Establishment of Laboratories for Testing

For checking the quality of works, the tender documents must clearly specify that the contractor establishes field laboratories, with the specified minimum testing equipment and facilities. District Level Laboratories should be established throughout the country to carry out more intricate tests. These laboratories should be provided with the necessary equipment.

8.6 Training

Total Quality Management can succeed only if the engineers (at various levels), contractor's staff, consultant's experts and laboratory technicians are trained at appropriate level to look for quality. The training should be a continuous process, with skills getting updated as new processes and materials are involved in Rural Roads. Training of contractors and engineers is not yet perceived as being the most crucial element in delivering consistently high quality. Training efforts directed at contractors staff must be an essential part of the contract and states must develop the necessary capacity to impart field level training at the time of commencement of each appropriate stage of works till such time as the contracting industry in the state has developed the requisite critical mass of trained workmen/engineers so as to become self-sustaining.

8.7 Skill Development

As rural road construction activity increases, requirement of personnel with various skills whether as road roller driver, operators of hot mix plant and other equipment increases. There is, however, no institutionalized mechanism for imparting skills and no certification system to ensure that only those with adequate skills are employed. States need to coordinate with ITI (urban and rural) to ensure the development of such skills. The Central Government would need to provide funds for equipment for such training centers and development of training modules and certification procedures.

8.8 Work Culture

A good and healthy work culture needs to be developed and nurtured through continuous training of the staff involved. In this process of quality systems, we have to train young engineers, supervisory staff, workmen and other persons directly connected with the preparation of estimates and execution of rural road works. Duties have to be specified at various levels including areas of responsibilities and delegation of powers. It is necessary to plan not only the cash flow but also resources of material, personnel and machinery, all of which translate into the quality of the work.

8.9 Third Party Assurance Mechanisms

The PMGSY has demonstrated that external experts from the Universities/Engineering Colleges and retired senior level engineers from the highway engineering profession can be inducted into the quality system. This will provide an independent external check on the work. To be successful, the experts need to be reoriented to the art and practice of rural road engineering. The limitation of the available resources in terms of sheer physical availability in requisite numbers is now evident. A conscious effort will be needed to develop capability within the existing third party systems and to further increase the base from which such third parties can be drawn by training and orientation as well as resource development.

8.10 Technical Audit

It is the normal practice for the PWDs to have an accounting audit carried out by the Comptroller and Auditor General. This system has served to ensure that due diligence is exercised by the executing agency in spending public funds. This audit does not cover technical aspects of the work, as the audit staff is not technically qualified to carry out this work. To overcome this deficiency, the Rural Road Development Agency of every state should conduct a technical audit on selected stretches of completed works. It is desirable that the audit is funded by the agency funding the works. The audit will highlight the deficiencies noticed in the project and will propose corrective measures for future projects. The NRRDA at national level may lay down the audit procedures (including outsourcing procedures) and develop the necessary guidelines for the technical audit.

Safety Aspects

9.1 Social Cause

Increased economic activity has resulted in increased vehicle ownership and mobility. The rate of growth is expected to increase further with the expansion of road network, increase in the surplus disposable income of the households and easier financial loans for autos. There has been a distinct improvement in the riding quality of Indian roads resulting in higher average speeds on the roads. Unfortunately this is also resulting in increase of accidents on the roads causing considerable casualties and injuries to the affected persons. These accidents also result in direct and indirect economic loss besides causing trauma to all involved. It is, therefore, essential that much greater emphasis be accorded to the safety aspects in planning, design, construction, maintenance and operation of road facilities.

Road safety is a multi- disciplinary activity. This involves joint and complementary inputs by the road agencies, transport, police, health, insurance, educational institutes, mass media, NGOs, etc. Road safety offers an opportunity to a wide range of stakeholders to actively engage in addressing the problem. The ABC of road safety is Attitude, Behaviour and Culture of our drivers and other users on the road. This demands all-round improvement. The government has taken a number of steps in this direction but it will need support from users. Safety consciousness has to be cherished as a social value and be viewed as a yardstick to measure the quality of life.

9.2 Engineering Measures

Rural roads are generally single lane with low design speeds and with low volumes of traffic both motorised and non-motorised. Road safety should receive increasing attention in planning, design and implementation of engineering measures on rural roads. The engineering measures may be identified with the help of traffic and safety specialists and interaction with users.

Intersections and junctions of rural roads with the main highways are more susceptible to accidents. The design of these intersections calls for ensuring adequate sight distance and removal of encroachments at junctions to improve safety. Provision of rumble strips on rural roads, close to intersections with main roads would also help.

Accidents sometimes occur, as the shoulders (road berms) remain cluttered with construction waste and/or other maintenance material. It is important that the berms are kept clear and formation of the road widened to provide platform for repair materials.

Road signs and pavement markings should be integral part of road construction and upgradation works. These signs and markings will also require regular maintenance to serve the intended purpose.

Wherever existing geometrics are poor, efforts should be made to undertake spot improvements through identifying such spots by traffic specialists. In the meantime, appropriate cautionary and speed limits signs may be posted in such locations.

Speed management measures on roads passing through habitations should be identified and steps taken to provide such measures.

A few other suggestions are:

- Provision of bus-bays at suitable locations close to villages en-route.
- Provision of adequate space for turning of vehicles at destination.
- Provision of suitable ramps where required for access to and from the agricultural fields.
- Where a small informal market has developed, the engineers should examine the possibility of constructing a lay-by. The market should be restricted from developing on both sides of the road.
- Some intersections may need to be lit up to provide proper visibility for converging traffic

9.3 Awareness Campaigns

It is also necessary to sensitize the communities and users of rural roads to road safety concerns and the role they can play in reducing the accident burden. Help of NGOs may be sought for awareness campaigns for road safety. They are already doing very useful work on main roads but attention is required on rural roads also. Suitable educational materials should be developed and aimed at risk groups identified by specialists. School children, school bus drivers, two wheel riders, agricultural tractor drivers are some of the groups needing special attention. School children may be made aware of simple precautions to be taken while moving on or crossing the roads.

9.4 Safety Councils, Committees

The state governments have set up safety councils at state level under the Motor Vehicles Act. District level Rural Road Safety Committees are being set up in several states. The head of the Project

Implementation Units of Rural Roads may be included in the district level committees. Similarly, State Level Quality Coordinator of the SRRDA may be nominated to the State Level Safety Council.

9.5 Safety Audit and Accident reporting system

There would be need to carry out safety audit of the road network in the district, with the help of local PRI officials, to identify the expected points of conflict and take effective corrective measures. All accidents involving serious injuries and loss of life need to be recorded, cause of accident analysed and the safety audit report updated on the basis of such analysis. Information signs should indicate about the location of nearest trauma centres or hospitals so that help can become available at time of emergencies.

9.6 Policing and Enforcement

Policing of rural roads is virtually non-existent now. With the rapid expansion of rural road network and general prosperity that will take place in the rural areas in the coming years, enforcement of motor vehicle rules should receive attention. Panchayati Institutions can play effective role in supplementing the police efforts in increasing the awareness for observance of traffic rules.

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Environment Concerns and Afforestation Strategy

10.1 Introduction

Road projects generally improve economic and social welfare of people, reduce travel time, lower cost of vehicle operation and cost of transport, and increase access to markets, jobs, education and health services. However, people in the direct path of road alignments are affected due to loss of productivity of arable soil, disruption of livelihood, and loss of community assets. Other adverse impacts could be soil erosion, changes in streams/under ground water, interference with animal and/or plant life and affecting life style of indigenous people. Roads are agents of change and can be responsible for both benefits and disturbance to existing balance between people, animals, plants and their environments. However detailed Environmental Management Plans may not be required in case of rural roads except for routes aligned through sensitive areas such as forests, national parks, areas protected under Wild Life Acts etc. However, it would still be essential to carry out social and environment assessment to ensure that the individuals affected adversely get suitably compensated for their loss.

10.2 Sustainable Development

There is a good deal of confusion about what constitutes sustainable construction, and many sweeping claims for buildings, products, and materials purporting to be 'sustainable'. In reality such things are neither sustainable nor unsustainable in themselves. However used in an appropriate way they can contribute to a sustainable community, society, or the way of life. Sustainable construction be considered as a subset of this broader sustainable development in which economic growth and social progress for all is coupled with protection of the environment and prudent use of resources.

What is sustainable construction?

Construction has been identified as being particularly important because of the significant environmental and social impacts, which the built-in environment has on everyone's quality of life.

Some might argue that construction of any form is an artificial intervention and therefore harmful, but most would recognize the need for roads, buildings, bridges, and other structures- and recognize that we would be a poorer society without such structures. The challenge is therefore to consider these broad questions at a detailed level against generally accepted measures of societal impact, financial cost benefit, resource use (during construction and in service), the effects on global warming and climate change, pollution, and the legacy-what remains good or bad) at the end of life.

The main issues for construction when considering sustainability are what to build, where to build, and what materials to use. And these relate to planning (what, where and whether to build) design (ensuring that these structures make a positive contribution to the society and others, and that their consumption of resources, particularly in service, is as low as possible) construction (ensuring the material consumption, particularly of critical resources, is minimized, and that disturbance during the construction process itself is minimized-how to build).

Inevitably there are often conflicts with specific actions providing benefits when measured against certain indicators but having a detrimental impact when measured against others. It is therefore essential to consider a holistic approach and to take account of long term implications using the life cycle assessment.

The decision on 'what to build' relates more to social and economic considerations than engineering, but the engineer should nevertheless be aware of and sensitive to these issues. We do need to keep in mind that there is need to provide the basic minimum facilities for all citizens of the country.

10.3 Impacts

Generally rural roads follow existing tracks in use for a long time, the environment impact in most cases is incremental and such impact due to provision of all weather roads is likely to be minimal. However, it is essential that the basic issues are not lost sight of while undertaking rural roads development projects. It may mean establishing procedures for avoiding and mitigating the adverse impacts. Some of the impacts that need consideration at the time of finalising the detailed project reports are as under:

- Biophysical environments
- Soil
- Water
- Air Quality
- Flora and Fauna
- Socio-economic environment
- Community life and economic activity
- Land uptake and resettlement

- Indigenous population
- Aesthetics and landscape
- Noise (generally not a major problem on rural roads)
- Human health and safety.

10.4 Biophysical Environment

The word “environment” refers to our natural surroundings of land, air and water in which people, animals and plant live. The various components are inextricably linked - no component exists in total isolation, and nothing can be changed without affecting something else. This concept is crucial in understanding the role, which humans play in affecting their environment. The Environment (Protection) Act lays down the legal obligations. Even if these are not strictly attracted, it is essential that the road authorities be able to recognise the potential environment concerns and know how to plan and implement mitigation measures. It is necessary to lay down practices to study and control the impacts that may be caused by the construction of rural roads. Some of the elements, which need consideration, are as under;

10.4.1 Land

Land being a scarce and non-replaceable resource, consideration needs to be given when planning and designing rural roads to avoid the alignment through areas under intensive irrigation to the extent possible even if it may result in a slightly longer route. The most immediate and obvious effect of road development is the elimination of its productive capacity. Unfortunately, the best sites for roads (flat and stable) also tend to be ideal for agriculture. The narrow, linear character of the roads makes the impact of lost land seem minimal, but when the width of right-of-way is multiplied by its length, the total area of the land removed from agricultural production becomes significant.

10.4.2 Soil

Everyone, not just farmers, needs to be concerned with reducing human- accelerated soil erosion, loss of productive soil, erosion, destabilization of slopes, side tipping of spoil material, water flow diversion and contamination of soil. It is important to conserve the topsoil and reuse it on top layers of shoulders and for protection of embankment slopes. The erosion of soil cover on steep slopes can be by providing suitable remedial measures such as planting grasses and/or other engineering measures such as check dams, silt fencing etc. These should be treated as integral components of design and included in DPR.

10.4.3 Water

The hydrosphere – the envelope of water that covers about 71% of the earth’s surface is what most clearly distinguishes the earth from other planets. This precious film of water, about 97% salt water and the remainder fresh water help maintain the earth’s climate and dilute the environmental pollutants.

Essential to all life, water constitutes from 50% to 97% of the weight of all the plants and animals and about 70% of our body. Water is essential to agriculture, manufacturing, transportation, and countless other human activities. Water is the only substance that exists in all the three physical forms under climatic conditions of earth's surface. It needs to be ensured that the development of any road do not result in either contamination of existing water bodies or cause hindrance in the natural flow of streams. The design of vent ways of drainage structures should not result in excessive velocity on the streams as it may cause erosion on the downstream. Further it needs to be ensured that any heading of water, due to inadequate vent way, may not flood the upstream fields.

The development of rural roads may affect the movement of water in the following ways:

- Surface/ Ground water flow modification
- Water quality degradation
- Drainage modification
- Water Table modification
- Silting of waterways

We must assess possibility of such impacts due to construction of rural roads and plan for remedial measures at the time of project preparation. The estimates for construction should provide for transportation of water in cases where the project is located in water scarce areas such as in Rajasthan or in hilly areas. Drainage both under- ground and above ground should receive special attention.

10.4.4 Air

To stay alive we inhale about 20000 litre of air each day. Although with the nitrogen and oxygen gases that make up 99% of the atmosphere, each breath also contains small amounts of other gases, minute droplets of various liquids, and tiny particles of variety of solids. Some of these chemicals come from natural sources, but most come from cars, trucks, power plants, cigarettes, and other sources related to human activities. Repeated exposure to even trace amounts of many of these chemicals, known as air pollution, can damage lung tissues, plants, buildings, metals, and other materials. It needs to be ensured that construction equipment does not release large quantities of pollutants in the atmosphere.

The main source of pollutants is the exhaust from the vehicles during operation of the road facility. It has been observed that a poorly maintained road with rough surface results in higher fuel consumption and release of higher amount of pollutants. It is therefore essential that the surface roughness be kept within limits at the time of initial completion and the riding quality not allowed to fall down much below these limits during its operation. The Motor Vehicles Act also lays down norms of emission for various types of motorised vehicles. All inspecting authorities should insist compliance of these norms.

10.4.5 Flora and Fauna

The increase in population and the need for increase in cropped areas to meet the growing need of the population has resulted in transfer of large tracts of land for agricultural purposes. There has also been transfer of virgin and even forest lands for roads, industries, mining and other projects. Till recently the main fuel used for domestic and even industry had been obtained by felling trees. Unfortunately replantation and regeneration has not kept pace resulting in deforestation and degradation of forest thus disturbing the natural balance. The importance of making up this loss has been felt by all concerned. The central government has enacted “Forest (Conservation) Act 1980” to remedy the situation and to stop further degradation of forest cover. Rural roads are expected to cover very large length. The strip of land between the road bed and agriculture fields should be utilised for propagation of fruit trees or other varieties of bio-mass, which can be utilised as domestic fuel by rural households. The planting of trees should be made integral part of all rural roads. The responsibility for plantation and maintenance can be left to the PRIs or under any of the employment generation programme. A small provision should be made in the estimates to subsidise the cost of plantation and maintenance. Such lands can also be made available for social forestry.

Animal life may get affected during the construction and operation of rural roads in all areas, more so where animal husbandry is main occupation of the villagers. The embankment of roads acts as barriers against free movement for the livestock. Their need must be analysed and suitable mitigation measures, such as cattle crossings, included in the DPR. The drainage structures should be located at close intervals to provide unhindered passage for small wild and other domestic animals. Some other issues for endangered species are covered in the Wild Life Protection Act.

10.4.6 Waste Management

The waste material generated during construction needs careful disposal. As far as possible cutting should be balanced with filling. In case the excess debris can not be used, it may be disposed of properly by widening the shoulders for providing passing places. In no case these should be allowed to be dumped in nearby streams as this may cause impediment to the natural flow of water and may also cause sedimentation of water reservoirs located on such waterways. This should receive special attention in hilly areas.

10.5 Compliance to legal requirements

In 1976, the 42nd Constitutional Amendment created Article 48a and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment. As a result, a number of laws relating to environment conservation were passed to strengthen existing legislation. Environment (Protection) Act, 1986 is the landmark legislation as it provides for protection of environment and aims at plugging the loopholes of other related Acts. In addition, each project may require clearance from designated authorities depending upon the location of the project. See Box 10.1 for major legal requirements.

Box 10.1: Major legal requirements

- Forest (Conservation) Act, 1980; For protecting and conserving the biodiversity and for commitment to Environment conservation and sustainable development
- Forest (Conservation) Act, 1980 and Forest (Conservation) Rules, 1980; For alignment through sensitive areas
- Wild Life Protection Act, 1972; To protect wildlife through certain National Parks, Sanctuaries, National Habitats, Reserve forests, Notified wetlands, Fisheries and Aquatic Habitat etc.
- Mines and Minerals (Development & Regulation) Act, 1957; To make good the mining areas after excavation.
- Water (Prevention and control of pollution) Act, 1974; To control water pollution by controlling discharge of pollutants as per prescribed standards
- Environment Protection Act, 1986; For regulating diversion of forest land
- Environment Protection Rules, 1986; To control noise and dust during construction and setting up of hot mix plants etc.
- Motor Vehicles Act, 1988; To control emission norms
- Indian Explosives Act, 1884; For safety in movement of hazardous goods

10.6 Project Reports

The following environmental aspects need consideration at the time of planning, design, construction and maintenance of rural roads. Their likely impact and the mitigation measures proposed should be spelt out in the project report

- (i) Major climatic phenomenon
 - Rainfall
 - Temperature
 - Humidity
- (ii) Utilisation of alternate material
 - Characteristics and availability of alternative material
 - Possibility of use in project

- Method of testing, specifications, recommended usage
 - Mechanism of procuring and transporting to site of work
 - Separate BOQ for alternate material
- (iii) Design modification, if any, for minimising material requirement by reducing the formation width and height. Use of fly ash/reuse of construction waste / use of mines waste
- (iv) Source of water for construction in water scarce areas
- (v) Location of silt fencing in areas subject to loss of ground cover due to cutting.
- (vi) Rehabilitation of water bodies. If storage is lost, the water body has to be deepened to regain the lost volume.
- (vii) There may be requirement of slope stabilisation in certain areas depending upon the geological features.
- (viii) Measures for erosion control
- (ix) Conservation of topsoil
- Area needed for topsoil conservation
 - Extent of loss of topsoil
 - Inclusion of use of topsoil on slopes and shoulders in bid documents
- (x) Impact on cultural properties/common property resources
- (xi) Location of natural habitats
- (xii) Estimation of water requirement and identification of potential sources of water
- (xiii) Location of area for waste disposal
- (xiv) Design of Out-falls for longitudinal drains
- (xv) Provision for tree plantation

The environmental considerations have to be incorporated suitably in the DPR and the bid documents to ensure implementation during execution.

10.7 Tree Plantation along Rural Roads

The state governments have stressed on plantation of trees (particularly fruit bearing, herbal or other income yielding varieties). This will help in generation of further employment opportunities. Box 10.2 gives a brief synopsis of the scheme of Vriksha Rozgar Yojana recommended by the National Rural Roads Development Committee of the Government of India set up in the year 2000.

Box 10.2: Vriksha Rozgar Yojana

Vriksha Rozgar Yojana would be formulated to plant the trees on both sides of the road. For this local youth would be engaged and they will be provided proper tools and small cycle/rickshaw mounted water tankers. One youth would be given the responsibility of 4 km of road length. In every kilometer of road, 500 trees would be planted on each side. After 1 year, the tree density will be reduced and only 250 trees will be maintained on each side of the road. The type of trees to be planted would be decided by local conditions. The final cutting of trees would be done only after their full growth. The revenue generated by felling of trees will be distributed equally between the local Gram Panchayat and the youth who has been given the responsibility of that particular stretch.

Source: Report of National Rural Road Development Committee, Government of India, September 2000.

The state governments may consider the outline suggested above for implementation of the scheme. Under the National Rural Employment Guarantee Act of the Ministry of Rural Development, in certain areas nurseries are being developed with the support of State Forest Departments. Some seedlings from such nurseries could be considered for planting along rural roads.

10.8 Environmental Code of Practice

The MORD has recently finalised “Environmental Codes of Practice” for adoption on the rural road works financed by World Bank assistance taken up, under PMGSY, in the four states. Similar action has also been taken up under schemes financed by Asian Development Bank. The NRRDA needs to evolve an all India Code of Practice accounting for state level variations based on local conditions.

Development and Maintenance Needs

11.1 Development Needs of Core Road Network

It needs to be borne in mind that the Core Road Network for each district includes all categories of roads viz. national highways, state highways, major district roads and rural roads. The strategies and needs for development of national highways, state highways and major district roads and broad targets have been brought out and discussed in Road Development Plan Vision: 2021 prepared by the Ministry of Road Transport and Highways and published by the Indian Roads Congress in 2001.

While requirements of national highways are being taken care of by the Government of India, development and maintenance of other categories of roads basically rest with the state governments. Of particular concern is the situation in respect of secondary system comprising state highways and major district roads. By acting as linkages between the rural and urban areas, these roads contribute significantly to the rural economy as also to the industrial development of the country by enabling movement of industrial raw materials and products from and to the interiors of the country. The past experience shows that the states found it difficult to allocate the needed funds for the secondary roads. Further, due to expansion of the rural roads, traffic on the secondary network continued to rise. The deficiencies on these roads are also thus a matter of concern so as to reap the full benefit of investments in the rural roads infrastructure.

Additional excise duty at the rate of 30 percent on petrol and 15 percent of the additional excise duty on diesel is earmarked for secondary roads out of the Central Road Fund. Initially this was amounting to Rs. 10,000 million a year. Currently this would be around Rs. 20,000 million a year. Some of the states are also supplementing their budget with loan assistance from the World Bank and the Asian Development Bank. Their assistance is currently around Rs. 20,000 million a year. Additional funding has also been mobilized by throwing open the high traffic density state highways to the private investors.

NABARD is providing some funds out of the RIDF window for road infrastructure in rural areas. The states may consider earmarking an appropriate percentage of such funds specifically for major district roads on a need-based approach. It should be possible to tap an amount of Rs. 40,000 to Rs. 50,000 million a year out of this window.

The basic strategy in respect of secondary roads should be on consolidation of the network by way of capacity augmentation and upgradation rather than expansion so as to remove basic deficiencies on these roads and improve efficiency in movement of goods and people.

11.2 Magnitude of PMGSY Programme

At the time of launch of the PMGSY in December, 2000 there were around 347,000 habitations in the country, which were not connected with all-weather roads. The PMGSY envisages covering 178,768 habitations eligible (population 500+ in plains and population 250+ in hills, tribal areas and deserts) for providing connectivity with all-weather roads. As per the District Rural Roads Plans prepared by the states and other data available, it is seen that for connecting these habitations, a length of 375,332 km of all-weather roads estimated to cost Rs.784,180 million is required (new connectivity involving new construction).

In addition, upgradation of roads of the core network will be undertaken where required. As per data available, a length of 372,816 km for upgrading at an estimated cost of Rs. 590,330 million has been identified.

Upto the end of December 2006, value of works sanctioned is Rs. 383,874 million covering both new construction and upgrading. A total of 82,833 habitations have been covered already. The balance work as on 1.1.2007 is as shown in Table 11.1.

Table 11.1: Balance Programme of PMGSY as on 1.1.2007

(i)	Number of rural habitations still to be covered	95935
(ii)	New construction	
	(a) Length	242,017 km
	(b) Estimated cost	Rs.565,044 million
(iii)	Upgrading	
	(a) Length	307,435 km
	(b) Estimated cost	Rs.425,592 million
	Total cost	Rs.990,636 million

Source: NRRDA, Ministry of Rural Development

11.3 Bharat Nirman

The President of India in his address to the Joint Sitting of Parliament in February 2005 announced a major plan for rebuilding rural India and called it Bharat Nirman. Rural roads connectivity has been identified as one of the six components of this programme.

As advised by the Planning Commission, the entire balance work of PMGSY is divided into two phases. Phase I work to be completed upto the end of the 11th Five Year Plan period and Phase II cover the remaining work beyond 11th Plan. Phase I is further divided into Phase IA and Phase IB. Bharat Nirman goals will comprise Phase-IA, involving an investment of Rs. 480,000 million during the period 1.4.2005 to 31.3.2010 with Phase IB covering the balance upto the end of 11th Plan.

11.4 Beyond PMGSY: Connectivity to low size habitations

Apart from PMGSY programme, it is necessary to provide connectivity to those unconnected habitations, which are having population lower than the PMGSY norms. It is proposed that all habitations with population above 250 may be connected with all-weather roads ultimately. Habitations below population of 250 may be taken care of by the PRIs themselves or simple tracks may do.

11.5 Cost Cutting Strategies

Considering the huge size of programme ahead and constraints on mobilisation of resources, stress needs to be laid on reducing the cost of construction. Box 11.1 lists the strategies that need to be adopted by the Ministry of Rural Development and the state governments.

Box 11.1: Cost cutting strategies in rural roads

1. Promote use of locally available materials and waste materials from industrial plants in lower layers, by treating them with lime, cement or mechanical stabilisation.
2. Review the current pavement design charts for flexible pavements in the light of performance studies by CRRI and international practices.
3. Evolve low cost bituminous surfacing to provide water proofing layer on top.
4. For access to small size habitations in areas with low to moderate rainfall, provide gravel roads with 3.0 m carriageway to start with. Stabilize the top layer with cement or other additives to reduce dust.
5. Lay stress on provision of low cost water crossings
6. Encourage intermediate technology for construction (labour based methods with light equipment) and enhance use of local skills.
7. Consider reducing the currently stipulated formation width of 7.5 m to 6.0 m on roads with traffic less than 100 motorised vehicles per day.
8. Review the core network alignments shown in the district level Master Plans for any possible reduction of the overall length.
9. Take steps for growth and capacity building of small-scale local contractors without compromise on quality control.
10. Continue R&D efforts in evolving cost-effective and innovative materials for road construction.

11.6 Assessment of Funds Required for both Development and Maintenance

A broad assessment of the physical and financial requirements for rural roads is given in **Appendix-1**. The annual investments required for construction, upgrading and maintenance during the period 2007-2025 would be as shown in Table 11.2.

Table 11.2: Phasing of Investments for Development and Maintenance of Rural Roads
Average Annual Investment (Rs. million)

Period	Construction + Upgradation	Maintenance	Total
2007-12	75000	40500	115500
2012-17	120000	54000	174000
2017-22	152000	84500	236500
2022-25	182000	106000	288000

It may be noted that the proposed investment of Rs.115500 million during the 11th Five Year Plan would be a mere 0.3 percent of the GDP and should, therefore, be considered modest and realistic.

11.7 Action Plan for States

- (i) Each state may work out its own district-wise requirements keeping in view the accessibility levels achieved in each district (see Chapter 3) and the targets laid down for the PMGSY including Bharat Nirman and the need for connecting the habitations with low size populations not covered under the PMGSY. Inputs from the Zilla Parishads and picture emerging from District Rural Roads Plans would be of immense help in this direction.
- (ii) It is imperative that the states adopt the proposed cost cutting strategies to reduce their financial burden.
- (iii) While the states with low levels of accessibility would need to give high priority for roads required to link the unconnected habitations, those with better levels of accessibility may provide for consolidation of the network through suitable upgradation and proper maintenance.
- (iv) A very good feedback has been provided by the states on several issues such as land acquisition, construction technology, design standards, planning of access to social infrastructure, role of Panchayati Raj Institutions, utilisation of academic institutions and consultancy sector, creation of database on road inventory and condition survey, maintenance interventions, capacity building of local contractors and road agencies. The Ministry of Rural Development should arrange periodic seminars and workshops on exchange of views and sharing of experiences among states on adoption of promising and good practices in construction and maintenance of rural roads. Support of IRC, NITHE and CRRRI may be obtained for this purpose.

Financing Rural Roads

12.1 Financing Gap

There is a wide gap between the funds currently made available for rural roads and those required to meet the demand for social and economic growth of our country. It will, therefore, be necessary to tap additional sources of financing to meet the requirements. It may be pointed out that not all the funds obtained from taxation of road transport is ploughed back on roads. Table 12.1 gives some statistics, which show that only about 40 percent of the road taxes collected is being spent on roads. Position is, of course, better in case of rural roads. According to a recent assessment by the World Bank, about 83 percent of revenue is spent on district roads and rural roads.

Table 12.1: Transport Revenue and Road Expenditure

Year	Transport revenue (Rs. million)	Road expenditure (Rs. million)	Expenditure as percentage of revenue
1950-51	470	260	55%
1990-91	76,310	33,000	43%
2002-03	500,000	211,000	42%

Source: Road Development Plan Vision 2021 and Financing Indian Highways (World Bank) 2005

12.2 Existing Sources of Financing of Rural Roads

The existing sources of financing are:

- Government budget
- Central Road Fund
- Market Committee Fees, etc.
- Loan assistance from NABARD
- Loan assistance from the World Bank and the Asian Development Bank
- Investment during scarcity conditions in form of labour

Funds for rural roads development are provided through the state government budget. The poverty reduction impact of rural connectivity and the need to reduce regional imbalances in road connectivity have been major factors for the intervention of the Government of India in their recent decision (Year 2000) to provide 100 percent grant to states for rural roads under the PMGSY programme. It was decided by the Central Government to levy an additional excise duty of Re. 1.00 per litre on petrol since 2nd September 1998 and Re. 1.00 per litre on high speed diesel since 1st March 1999 and earmark the proceeds for development of the road sector. The old Central Road Fund was revamped in late 2000 and the provisions are governed by the Central Fund Act, 2000. The major source of fund for development of rural roads is now the Central Road Fund. As per this Act, 50 percent of the cess on diesel is earmarked for development of rural roads. An amount of about Rs. 2500 crore per annum for rural roads has been available from CRF. The current additional excise duty is Rs. 2.00 per litre. The funds for rural roads are set to increase accordingly. It is a sound strategy that additional funds for development of rural roads are being generated at the national level, and the funds so generated are distributed on nationally agreed norms so that the states with poor rural road infrastructure are brought on par with the comparatively better off states.

As part of the strategy of promoting rural investment, the banking sector has earmarked funds for rural credit and unutilized portion of this credit is available at low interest as a long term loan to state governments under a facility called Rural Infrastructure Development Fund (RIDF) maintained by the National Bank for Agriculture and Rural Development (NABARD).

Given the recourse crunch most state governments face, (barring a few states, which are able to take recourse to RIDF loans), not much allocations other than under PMGSY are going into the rural road network. The World Bank and the ADB have also agreed to extend loan assistance for rural roads under the PMGSY. This is in addition to some funds coming as part of agriculture development projects.

Some states levy cess on food grains through their market committees and proceeds utilised, among other items, for construction and maintenance of roads in rural areas, for example, Punjab, Haryana, Rajasthan, Madhya Pradesh and Uttar Pradesh. In addition, some kind of a rural development cess is also levied and road improvement and maintenance are being funded out of such resources as well. In sugar cane belts, some cess is levied on sugar and roads constructed and repaired out of such proceeds.

Funds for roads are also available from other employment oriented schemes such as Sampoorna Grameen Rozgar Yojana, Command Area Development Agencies, Local Area Development funds of Members of Parliament and Members of State Legislative Assembly. Some funds might also become available out of the National Rural Employment Guarantee Programme – a recent initiative of the Government of India. However, given the orientation towards local employment at unskilled level, these funds can at most be utilised for construction of internal tracks or maintenance of non-core roads.

12.3 Strategies for Mobilization of Funds

Independent road fund

In the face of huge requirements for both development and maintenance, all possible sources of financing would need to be tapped. It needs to be appreciated that there is practically no scope for private sector financing of rural roads since they carry very low volumes of traffic. The Central Government has already

created a Dedicated Road Fund as briefly mentioned earlier. There is urgent need to augment the current CRF for enabling higher outlays for rural roads under the Bharat Nirman programme as priority. A few states have also set up their own state level dedicated funds to bridge the financing gap. Actually every state should set up such funds at least for the maintenance of roads. The state governments of Uttar Pradesh and Karnataka have set up funds for maintenance and rehabilitation of roads. Box 12.1 gives details of State Road Fund for maintenance in Uttar Pradesh.

Box 12.1: U.P. Road Fund

- Year of Establishment : 1998
- Purpose : Maintenance of state roads
- Source : Increase in sales tax on
 - Motor spirit from 14 to 20 per cent
 - High speed diesel from 16 to 20 per cent.
- Annual Proceeds : Rs.3,500 million (2004-05). Buoyant
- Collection : By oil companies
- Mechanism : Oil companies after collection, transfer the proceeds to the Consolidated Fund of the State.
- Management :
 - (i) Advisory Committee (22 members) headed by Minister Public Works, Representatives of Government Departments and users are members
 - (ii) Allocations are made as per plans approved by the Committee.
 - (iii) Rules and Regulations have been approved by the Accountant General.
 - (iv) Details of Expenditure kept by Engineer-in-Chief.

Such funds will require proper management along with a consultation procedure with road users so that the funding is distributed on an accountable and acceptable basis. Clear rules for allocation and accountability have to be devised. Division of fund between various categories of roads, between development and maintenance has to be decided by the government. Proper monitoring system and accounting and audit procedures will also need to be devised so that the proceeds from the fund are used only for roads and associated activities.

Market Committee Funds

Another strategy should be extending the scheme of levying marketing fee and rural development cess on agriculture produce to all states. The state governments may seek the support of the farmer's

community in this endeavour. The needs of rural roads can then be supplemented by this approach so as to accelerate the process. Part of these funds should be used for maintenance of rural roads.

Stamp Duty on Land Transactions

There have been suggestions that since land values close to roads tend to increase sharply, beneficiaries may be expected to share by way of paying stamp duty on sale of land. The state governments may examine the practicality of this proposition as a possible supplementary resource.

Vehicle Fees

In addition to taxes on fuels, additional funds should be generated through special purchase tax on two wheelers, cars and agricultural tractors. Part of the funds so collected may be allocated for rural roads and provision of road transport services in rural areas.

Domestic Borrowings

Recently, NABARD in India has come up in a significant way to provide loan assistance for construction of rural roads in several states. This is proving useful in accelerating the programme of improving accessibility to our villages and thus contributing to the alleviation of poverty and socio-economic growth of our rural areas.

For a financial institution like NABARD, it is difficult to have technical expertise to ensure that the projects they fund are well conceived and executed. It may be worthwhile to consider providing the NABARD loans with technical and management inputs of NRRDA to enhance the financial and technical discipline and uniform standards being applied in respect of these roads also on the lines of the PMGSY programme.

Borrowings from Multi-lateral Agencies

The multi-lateral financing agencies like the World Bank, ADB and JBIC have been providing loan assistance for highway projects in the center and the states. Normally, the projects executed through external borrowings are well designed and constructed. The external funding agency also insists on the state governments to ensure that the assets created are well maintained. The World Bank and ADB have approved loan assistance for speeding up the work of village connectivity in the states of Himachal Pradesh, Jharkhand, Rajasthan, Uttar Pradesh, Chhattisgarh and Madhya Pradesh. The ADB is also taking care of Assam, Orissa and West Bengal. The World Bank is looking at the needs of Bihar, Jammu & Kashmir, Arunachal Pradesh, Mizoram and Uttarakhand. It is important to continue to tap such sources for some more time so as to consolidate the network and bring in further reforms particularly sustainable maintenance of assets being created. Their interest in this sector is a direct evidence of importance these agencies give to poverty reduction and infrastructure development.

There is need to mop up more resources to accelerate the pace of accessibility to villages in the low connectivity states to improve the socio-economic well being of the rural people and proceed towards achieving the Millennium Development Goals. It may be a good strategy to route all externally funded rural road projects through the MORD. This will result in uniform standards being applied to the projects. The implementation of works in the field would continue to be with the state governments as in PMGSY programme.

Maintenance Strategies

13.1 Need

Rural roads comprise over 85 percent of the road network and their being kept in serviceable condition is crucial to the agricultural growth and affording means of access to millions of rural people to social facilities viz. medical, education as also to market. Lack of maintenance affects the poor people badly as the time for access to markets and other social infrastructure is increased. There is potential danger, then, of these assets falling into disuse and eventual disintegration. The current replacement value of the existing rural road network is estimated at Rs. 200,000 crore. The resulting loss in value of road assets would be as high as Rs. 10,000 crore per year equivalent of 40,000 km of roads being eroded every year. Unfortunately, the road authorities are insulated for the ill effects of maintenance, as they are not directly exposed to the economic and social consequences or the organised pressure for better roads. Apart from the question of maintenance of the road assets, there are also equally important concerns such as prevention of ribbon development and removal of encroachments. It is seen that there are no regulatory provisions in the country to preserve and manage the rural road assets.

13.2 Challenge

The challenge before us is both expansion of the network to provide road links to unconnected habitations and at the same time maintenance of the existing vast rural road network built at huge cost to the economy over the past over fifty years. A balance between road building and road maintenance has to be achieved. Timely upkeep and maintenance would help in availability of roads for passage of traffic continuously particularly in monsoon, reduce time of travel besides reducing rate of deterioration and adding to safety of road users. Availability of funds is one of the major constraints in preserving the assets. The Central Government is already contributing a major share of funds in construction of new roads and upgradation of core network. The state governments need to attach high priority to maintenance and provide reasonable allocations for maintenance so as to ensure serviceability of the network. Needless to add that good maintenance also enhances image of

the government. For sustainable maintenance of the road assets, strong political will backed with administrative and technical support is required. There is evidence of increasing awareness and commitment to maintenance by the States in the recent years. The tempo needs to be built up and continued.

13.3 Institutional Initiatives

India is not the only country where the roads are poorly managed and badly maintained. Several countries in Africa suffered similarly and, therefore, the UN Economic Commission for Africa and the World Bank launched a Road Maintenance Initiative (RMI) in late 1980's. The RMI originated in the need of African countries to halt and, it is hoped, reverse the massive deterioration of the African road networks. It was based on two essential postulates:

- (a) the core problem of road maintenance is not rooted in technical matters but is political and institutional,
- (b) any change in policies, to be effective, must be rooted in a firm awareness, at the highest level of government, of the importance of road maintenance.

As a result, several countries in Africa set up dedicated funds for road maintenance. China has introduced a system of road maintenance fee. This fee is collected from vehicles moving in a district and the amount of fee depends upon the payloads of vehicles.

13.4 Finance Commission's Recommendations

The 12th Finance Commission considered the issue of maintenance of state roads and bridges by the state governments. To quote from the Committee Report: "It is far more important to ensure that assets already created are maintained and yield services as originally envisaged than to go on undertaking commitments for creating more assets. We notice that maintenance of roads and bridges has not been given adequate importance by the states. We are, therefore, recommending additional grants separately for maintenance of roads and bridges, and maintenance of buildings."

The Finance Commission decided to provide an amount of Rs.15,000 crore over the period 2006-10. This amount is in addition to the normal expenditure, which the states would be incurring on maintenance of roads and bridges (Table 13.1).

Table 13.1: Amounts Recommended by 12th Finance Commission for Maintenance of Roads and Bridges (Non-Plan)

(Rs. in crore)

Year	Normal Expenditure (under Major Head 3054)	Grant	Total
2005-06	6417.66	—	6417.66
2006-07	6738.53	3750.00	10488.53
2007-08	7075.46	3750.00	10825.46
2008-09	7429.24	3750.00	11179.24
2009-10	7800.69	3750.00	11550.69

The year 2005-06 was intended for the states to make preparations to absorb the grant funds. The distribution of this grant among the states is given in **Appendix-2**. The amount of normal expenditure is also shown. The Commission further observed that the element of grant should be spent on non-salary maintenance items for roads and bridges. Obviously, the idea is that the grant is used for normal routine maintenance of roads and periodic renewal of road surface where conditions so justify. These amounts are for all roads (other than national highways) within the jurisdiction of the states. Some states have already decided distribution of these funds between rural roads and state highways, major district roads giving a fair share to each category of roads.

13.5 Current Situation

Current situation on maintenance of rural roads in the country is broadly as under:

- (a) There is multiplicity of agencies handling the work of rural roads. Except for PWDs and some rural engineering organizations, practically no funds for rural roads maintenance are allocated. There is no clear ownership of rural roads being built except under the PMGSY where five year routine maintenance is ensured through state governments formally allocating funds for the purpose. A few states have taken initiative recently in setting up dedicated funds for roads. Uttar Pradesh and Karnataka have road fund only for maintenance. Some other states have set up road funds for both development and maintenance. As a result, budget allotments for maintenance are now showing an upward trend. But there is still a wide gap between availability of funds and those required for proper maintenance.
- (b) There is virtual absence of an institutionalised system of inventory and condition survey and planning and management system for rural roads, which can identify and prioritise maintenance interventions for the core network.
- (c) The PRIs are not raising any funds for maintenance. Although they are expected to be ultimately made responsible for maintenance, they are not being provided with funds for maintenance by the state. Moreover, except in a few states, they do not have any technical support to undertake such activities.
- (d) Andhra Pradesh has introduced performance based contract system for carrying out routine maintenance of roads, in three districts of the state, as a pilot project. This would be gradually extended over the entire state. The work programme each month is based on the initial condition surveys as well as monthly checks. Annual bids are received and average payment allowed every month. Deductions are carried out for any work missed out during the month.
- (e) About 80 percent of rural roads are in poor condition due to a combination of several factors, lack of funds and poor quality of construction. The culture of quality construction of rural roads is now improving with the PMGSY setting up three tier-control in this direction. Attention to drainage and compaction of various layers of embankment and pavement will also help in reducing the maintenance burden.

13.6 Major Issues

Among several issues to be addressed for ensuring maintenance of rural roads on sustainable basis, the most critical are:

- *Government Policy:* A firm policy and commitment of the government in the states to maintain the rural roads to serviceable levels all the year round. Preservation of existing road assets has become a matter of critical importance. The state governments would need to provide full funds under non-plan for maintenance as per recommendations of the Finance Commission from time to time.
- *Dedicated Funds:* A dependable and adequate flow of funds on continuous basis to enable the road agencies to effectively plan and implement their maintenance programmes.
- *Maintenance Backlog:* Finding ways and means of phased removal of the backlog of periodic maintenance and bringing the roads to maintainable situation.
- *Linkage to Initial Construction:* Ensuring proper design and quality construction in the first instance as this would reduce the maintenance burden subsequently.
- *Maintenance Management System:* Improving maintenance planning and accountability through creation of road registers, setting up database and simplified maintenance management systems so as to optimize use of allocated funds and prioritize maintenance interventions, with first charge on the core road network.
- *Institutional Reforms:* Strengthening institutional arrangements through productivity improvement of gang labour, tightening supervision and monitoring and auditing arrangements, training of personnel to improve local skills.
- *Contract Maintenance:* Introducing innovative ways of execution of maintenance works such as encouraging creation of micro-enterprises and labour cooperatives.
- *Panchayati Raj Institutions:* Building up the capacity and capability of Panchayati Raj Institutions to undertake the maintenance of rural roads. Providing technical support to these institutions.
- *Modernization:* Modernization of maintenance operations, introducing low cost equipment for pothole repairs, grading and use of modern materials.
- *Experience Sharing:* Regular awareness programmes of what works and what does not work. Documentation of successful strategies and dissemination through publications, workshops at state, national and international levels.

13.7 Strategies

Keeping in view the current scenario in the country and promising practices in the country and elsewhere, the following strategies may be adopted by the states to put maintenance of rural roads on

a sound footing.

- (a) *Rural Road Management Act*: To give adequate powers to the departments in charge of rural roads, it is recommended that a Rural Road Management Act be introduced, which clearly:
- defines the powers, functions and obligations of the road authority
 - requires a register of all public roads in each block being kept with the Zilla Panchayat.
 - lays down serviceability standards to be adhered to
 - governs the regulation of rural roads
 - requires that an asset management system be instituted
 - mandates that the Annual Report of the State Rural Road Authority in exercising the functions be tabled in the State Legislature.

The NRRDA (MORD) may take the lead in preparing a draft Model Act.

- (b) *Realistic norms*: A more detailed study of funds required for maintenance of rural roads on realistic basis is needed with clear break up for routine and periodic maintenance for earth, gravel, water-bound macadam, black-top roads in different traffic, terrain and climatic conditions prevailing in the country. The norms should consider the frequency of various maintenance tasks required. The states should spell out minimum essential requirements.
- (c) *Dedicated funds and their management*: The states should set up dedicated funds for maintenance by transferring funds from various sources – government budget, grants recommended by the Finance Commission, any additional levies like cess on agricultural produce, additional sales tax on petrol and high speed diesel, one time tax on agricultural tractors. A proper management system of the fund should be set up by the states for planning, implementation and monitoring of the maintenance works (on the lines of the initiative taken by the states of Uttar Pradesh and Karnataka). It has been the experience in the past that not all the funds recommended by the Finance Commission for maintenance of roads are provided to the road agencies for the intended task and are diverted. The state governments may attach high priority to maintenance of assets and ensure that at least a reasonable portion of the grants for maintenance of roads and bridges reserved for rural road maintenance. (The current CRF Act does not provide for maintenance of rural roads. When the accessibility status of the country matures in next few years, there may be merit in the central government reviewing the position and creating an appropriate window for maintenance also).
- (d) *Making roads maintainable*: There is growing recognition in the government that even rural roads have to be properly designed and need to follow proper standards laid down by the IRC. Such roads would require less maintenance efforts. An Action Plan should, therefore, be drawn to remove the maintenance backlog and bringing roads to maintainable position in a time bound manner.

- (e) *Panchayati Raj Institutions:* The states may apply their resources to the core road network and in the first phase, the non-core roads may be devolved to the Panchayati Raj Institutions for maintenance through community participation. An incentive-based system for non-core roads may be evolved where the state government could give partial subsidy. The road agencies should assist these local bodies by providing the needed technical support and developing their skills in undertaking maintenance operations. The road agencies themselves would need capacity building through training.

Over time, maintenance of even core rural road network should be undertaken by the PRIs. The Panchayats can be provided with equipment such as light compactors of walk-behind-type, drum mixer, bitumen spraying equipment and basic tools. The District administration could also make available the material resources required for maintenance such as small quantity of stone metal, chips, bitumen, etc. Identified villagers in the area served by the road could be imparted training in the various maintenance tasks of minor nature such as repairs to pot holes and short damaged stretches of road, maintenance of berms, cleaning of drains and culverts. It is felt that involving the people living in habitations where connectivity has been provided would stimulate a sense of ownership and pride in maintaining the roads in good condition. Payment of wages to the workers involved in maintenance activities could also be considered based on the actual days on which they were engaged on specific activities, integrating the expenditure on these activities with other schemes such as the Rural Employment Guarantee Scheme, Sampoorna Grameen Rozgar Yojana, etc.

- (f) *Planning of maintenance works:* A simplified maintenance planning and management system may be instituted by each state for carrying out inventory and visual condition surveys. It is now quite convenient to set up database on GIS platform. The concept of Pavement Condition Index has already been introduced for PMGSY roads. The system will help in identifying and prioritising maintenance interventions for the core network in each district. Annual maintenance plans should be drawn up on that basis and formally submitted for approval of the District level Panchayati Raj Institution and thereafter of the standing committee on rural roads under the chairmanship of Chief Secretary. Expenditure incurred for maintenance should be subjected to both technical and financial audits to improve transparency and performance. A system could be evolved by the states where the value of the road assets in each block could be worked out every year based on road inventory and visual inspection and results published in the media.
- (g) *Review Gang Labour System:* The existing system of road gang is inefficient. In some countries, the system of mobile gangs and reorganisation of maintenance operations for improved efficiency of the existing gangs either as a patrol gang system or area wide system has been introduced. In some others, for example, Argentina, Brazil and Peru, the existing gang labour were converted into micro-enterprises, who now undertake not only maintenance works but also earthworks for road construction. What would be a feasible and practical solution in India is still a grey area and needs to be studied in a few States at district level. Such a study should include strategy for

redeployment of existing gang labour and junior supervisors into cooperatives and outsourcing of maintenance to small contractors. Provision of proper tools and plant for maintenance operations by the gang labour is essential to improve their productivity.

- (h) *Manuals*: User-oriented manuals for maintenance operations should be prepared taking into account sound engineering practices. These manuals should be in local language for easy understanding by the PRI. The Indian Roads Congress should take the lead in this direction.
- (i) *Disaster management*: A special task force should be set up in hill states and coastal areas, etc. to deal with emergency situations like landslides and disaster due to cyclones, heavy floods. Disruptions to traffic need to be minimized. To manage the problem due to landslides, care is required to prevent seepage and remove obstructions to flow of natural water courses. A part of the proceeds from the Central Road Fund may be earmarked for this.
- (j) *Instituting awards for the technical staff*: Maintenance activities have no glamour and receive low priority from the engineering staff. The maintenance departments need to institute awards for the best-maintained sections of the road network and reward the supervisory staff for their good work.
- (k) *Experience Sharing*: There is need to document the strategies adopted by the States in ensuring sustainable maintenance of rural roads and sharing of experience through periodic seminars/workshops at state, national and international levels. The NRRDA can take the lead in this direction with support from IRC, CRRRI and NITHE.

13.8 Paradigm Shift

Though investment in maintenance is extremely cost effective in comparison to having to build the entire road all over again; management, accounting and policy systems all tend to constrain investment in construction rather than in maintenance. Unless modern, transparent and scientific maintenance practices are evolved with clearly measurable indicators, the situation is not likely to change. The NRRDA needs to bring out a detailed Maintenance Manual prescribing technical, management and accounting standards and evolve efficient and workable maintenance service procurement procedures in order to give effect to a Rural Road Management Act.

Employment Potential

14.1. The Need

To provide employment opportunities to all job seekers is one of the greatest challenges our country is facing today. According to Planning Commission study, there is current backlog of 34 million unemployed persons. Further, there is need to generate around 200 million additional employment opportunities in the next 20 years.

14.2. Employment Oriented Programmes

Several programmes by the central government and state governments have been taken up in the past few decades, which are basically oriented to generation of employment as part of poverty alleviation strategies. Some of these programmes are given in Box 14.1.

Box 14.1: Major Employment Generation and Poverty Alleviation Programmes

Swarnjayanti Gram Swarojgar Yojana (SGSY)

SGSY is a CSS funded programme on cost sharing basis between the Centre and the States in the ratio of 75:25. A holistic self-employment generation programme, it was launched from April 1, 1999 by restructuring the earlier Integrated Rural Development Programme (IRDP) and allied programmes. The emphasis of SGSY is on a focused approach to poverty alleviation, capitalising advantages of group lending and overcoming the problems associated with a multiplicity of programmes. Up to December 31, 2006, 24.38 lakh self-help groups (SHGs) have been formed and 73.25 lakh swarojgaris have been assisted with a total outlay of Rs.16,443.66 crore.

Sampoorna Grameen Rozgar Yojana (SGRY)

SGRY, launched on September 25, 2001 to provide additional wage employment in the rural areas, has a cash and food grains component. The cash-component of SGRY is funded on the same sharing basis as SGSY, while foodgrains are provided free of cost to the States and UTs. In 2005-06, 82.18 crore person-days of employment were generated with the Centre releasing Rs. 5497.43 crore as cash component and about 37.30 lakh tonnes of food grains to the States/UTs. Besides, under the special component of the SGRY, with the States/UTs meeting the cash components, Centre released 15.64 lakh tonnes of food grains to the 11 calamity affected States. In 2006-07 up to October 31, 2006, the number of person-days of employment generated under SGRY was 18.41 crore while the Centre's contributions in terms of cash and food grains component up to December 31, 2006 were Rs. 2,762 crore and 16.67 lakh tonnes, respectively. Under the special component, about 4.44 lakh tonnes of food grains have been released to calamity-hit States in the current year up to December 2006.

Indira Awaas Yojana (IAY)

IAY is a CSS funded programme on cost-sharing basis between the Centre and the States in the ratio of 75:25. In the case of UTs, the entire funds are provided by the Centre. The target groups for housing under IAY are households below poverty line living in rural areas, particularly those belonging to SC/ST and freed bonded labourers. Up to December 2006, with cumulative expenditure of Rs. 29,246.27 crore, 153 lakh houses have been constructed/upgraded.

Swarna Jayanti Shahari Rozgar Yojana (SJSRY)

In December 1997, the Urban Self-Employment Programme (USEP) and the Urban Wage Employment Programme (UWEP), which are the two special components of the SJSRY, substituted for various programmes operated earlier for urban poverty alleviation. The SJSRY is funded on the same sharing basis as IAY and SGSY. The number of urban poor assisted for setting up micro/group enterprises in 2005-06 was 0.98 lakh; while in the current year the number achieved by December 31, 2006 was 0.53 lakh. The number of urban poor imparted skill training in 2005-06 was 1.42 lakh. In the current year, the number achieved by December 31, 2006 was 0.72 lakh. Under UWEP, the man-days of employment generated was 43.48 lakh in 2005-06 and 1.78 lakh in the current year till now. Coverage of beneficiaries under the community structure component was 337.4 lakh both in 2005-06 and the current year up to December 31, 2006.

Valmiki Ambedkar Awas Yojana (VAMBAY)

VAMBAY, launched in December 2001, facilitates construction and upgradation of dwelling units for slum dwellers, and provides a healthy and enabling environment through community toilets under Nirmal Bharat Abhiyan, a component of the scheme. The Central Government provides a subsidy of 50 per cent, with the balance provided by the State Governments/Union Territories. Cumulatively, up to March 2006, Rs. 936.63 crore had been released as Central subsidy for the construction/upgradation of 4,58,630 dwelling

units and 65,331 toilets seats. For 2006-07, Central allocation of Rs. 75 crore has been made for meeting the committed liabilities for on-going projects. VAMBAY has been subsumed in Integrated Housing and Slum Development Programme (IHSDP) launched along with Jawaharlal Nehru National Urban Renewal Mission (JNNRUM) on December 3, 2005.

Jawaharlal Nehru National Urban Renewal Mission (JNNURM)

JNNURM, which is for a seven year period from 2005-06, has two main components – Basic Services to the Urban Poor (BSUP) Programme and Integrated Housing and Slum Development Programme (IHSDP). BSUP was launched to assist cities and towns in taking up housing and infrastructural facilities for the urban poor in 63 selected cities in the country. IHSDP for taking up housing and slum upgradation programmes in non-BSUP cities was launched along with BSUP in December 2005. The allocation for JNNURM in 2006-07 (BE) is Rs. 4,900 crore. **National Rural Employment Guarantee Scheme (NREGS)** With the NREG Act being passed in September, 2005, the NREGS was implemented from February 2, 2006 in 200 identified districts of the country with the objective of providing 100 days of guaranteed unskilled wage employment to each rural household opting for it. The ongoing programmes of SGRY and National Food for Work Programme (NFFWP) have been subsumed under NREGS in these districts. NREGS will cover all districts of the country within five years. The NREGS, a demand-driven scheme, has its focus on works relating to water conservation, drought proofing (including afforestation/tree plantation), land development, flood-control/ protection (including drainage in waterlogged areas) and rural connectivity in terms of all-weather roads.

Source: Economic Survey, 2006-07.

Several earth tracks to villages in rural areas were constructed as part of some of these programmes. Focus of these programmes has been that of providing employment opportunities to the rural poor. Some of such tracks may have to be considered for further improvement depending upon their existing condition and utility in providing access to habitations or farms.

14.3. Rural Roads as Productive Employment Opportunity

Access to gainful employment is an essential condition for citizens to exercise their economic rights in a market democracy. Jobs for All would naturally be an important goal. As indicated in Para 14.2, India has taken a major initiative of National Employment Guarantee Programme.

The salient features of the National Rural Employment Guarantee Act, 2005 are given in Box 14.2.

Box 14.2: National Rural Employment Guarantee Act, 2005

Objective:

- Enhance livelihood security of the households in rural areas by providing at least 100 days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work.

Main Features:

- Eligible applicant entitled to get work within 15 days of application. If applicant is not provided employment, he/she shall be entitled to a daily unemployment allowance. Allowance shall be paid at the rate not less than 1/4th of the minimum wages for the first 30 days and not less than half of the minimum wages for the subsequent days.
- Employment within a radius of 5 km of village of applicant's residence, otherwise an additional extra-wages at 10 percent of the wage.
- Only labour intensive works to be taken up. Contractors shall not be engaged.
- Material component of the works including the wages of skilled and semiskilled labour not to exceed 40 percent of the total cost. 25 per cent of such costs will be borne by the state governments.
- Focus of scheme includes rural connectivity to provide all-weather access, although priority is given to water conservation related works.
- Until the Central Government notifies the wage rate, the statutory minimum wage rates for agriculture workers fixed by the respective state governments would be applicable subject to a minimum of Rs. 60 per man-day.
- Wages may be paid wholly in cash or partly in kind, provided minimum cash is 25 percent of wages.
- Each state government to prepare a scheme within six months to operationalise the provisions of this Act.
- Collaborative partnership between the Centre and the State with principal role to Panchayats at all levels for planning, implementation and monitoring. Assisted by District Programme Coordinator (CEO of District Panchayat or Collector or any other officer decided by State) and Programme Officer at block level.
- Provision for Central and State Employment Guarantee Council for monitoring and advising on matters of implementation and promoting dissemination. Councils to have both official and non-official members.
- Central Government shall establish a National Employment Guarantee Fund and States shall establish State Employment Guarantee Fund. Appropriate arrangements for maintenance of records and audit of expenditure.
- Appropriate Grievance Redressal Mechanisms by States at district and block levels.
- Ensure social audits by Gram Sabha and prompt action on objections.

Administrative Ministry:

- Ministry of Rural Development, Government of India.

Source: Ministry of Rural Development

Maintenance of rural roads is more employment intensive and may be considered as a target activity of the NREG initiative. The lessons learned out of the employment-focused programme should be utilized in ensuring that productive assets are created and decent work opportunity is provided to the unemployed persons. There is possibility of synergies between the NREG scheme and the PMGSY project as the latter contributes to the creation of durable infrastructure and improve accessibility to social facilities like education, health care, etc.

14.4. Employment Intensity

The proportion of materials, labour and equipment in road works depends upon the technology chosen. Table 14.1 gives a broad assessment.

Table 14.1: Proportion of Labour, Materials and Equipment in Rural Road Construction

Technology chosen	Proportion of			
	Materials	Labour	Equipment	Total
Purely labour-oriented*	60	35-40	0-5	100
Labour oriented, but with selective use of light equipment (Intermediate technology)	60	25-30	10-15	100
Highly equipment oriented	60	5-10	30-40	100

* Applicable to tracks and uncompacted roads

Rural roads should be constructed by adopting the Intermediate Technology. An expenditure of Rs. 1 crore in rural roads is likely to create 40,000 man-days of employment (taking an average wage rate of Rs. 75 per day).

14.5. Employment likely to be generated

Taking into account the assessment of investments required in construction and maintenance of rural roads in different plan periods during the next twenty years, the employment in terms of man-days likely to be generated is given in Table 14.2.

Table 14.2: Employment Potential of Rural Roads

Period	Annual Investments	Employment Potential (Number of Man-days)
2007-12	Rs.11550 crore	460 million
2012-17	Rs. 17400 crore	700 million
2017-22	Rs. 23650 crore	950 million
2022-25	Rs. 28800 crore	1150 million

Majority of the job opportunities will be provided by the local contractors engaged in construction and maintenance of rural roads. By the very nature of such works, the employment would be in informal sector. This would call for attention to aspects like occupational health, safety of workers, social protection

and timely payment of wages, non-discrimination due to gender, etc. as per the various labour laws and guidelines issued by the Ministry of Labour and Employment. Being a member country of the United Nations, the guidelines and Acts on labour related aspects by the Ministry of Labour and Employment incorporate various objectives of the ILO viz promotion of rights at work, employment, social protection and social dialogue. The Standard Bidding Document on PMGSY works finalized by the NRRDA stipulate strict adherence to such requirements by the contractors during execution of rural road projects on the ground. There is need to monitor proper implementation of such guidelines from the point of view of assuring decent work opportunities and labour welfare. Creating better awareness among the contractors through periodic seminars by the rural road agencies with the support of the state level labour departments, polytechnics, Industrial Training Centers, Construction Industry Development Council, etc. would also help in this process. Employment in rural roads sector would thus be in harmony with the international practices and standards.

14.6. Spin-Off Effects

There are many spin-offs that can be expected from the rural road programmes that can lead to the creation of additional jobs. These will be:

- creation of better avenues for self-employment;
- on-farm employment opportunities due to shift from food grains to cash crops and multiple cropping;
- non-farm opportunities like grocery shops, tea stalls, small businesses and cottage industries;
- expansion of health, education and agro-based industries.

There is a need for undertaking studies to quantify such spin off employment potential by construction of rural roads. The general impression is that it is several times that of direct employment and is of continuing nature.

However, it is to be noted that continued spin-off benefits will accrue only if the Rural Road assets are well maintained and are not allowed to deteriorate. In fact, investment in maintenance is most cost-effective for job creation.

Material Requirements

15.1 Broad Annual Targets

- (i) The important road construction materials needed are:
- Soil for embankment
 - Stone aggregates
 - Bitumen
 - Cement
- (ii) The general specifications for rural roads require about 150 mm of WBM and 20 mm premix carpet and seal coat. This is taken as a broad basis of quantity estimates for materials.
- (iii) As per phasing of new construction and upgrading of rural roads discussed in Chapter 11, the following yearly targets are envisaged during various Plan periods (Table 15.1).

Table 15.1: Target of Annual Length for Construction and Upgradation

Plan Period	Construction (km)	Upgradation (km)	Total (km)
2007-12	26000 (1600 gravel)	11200	37200 (1600 gravel)
2012-17	40000 (4300 gravel)	23000	63000 (4300 gravel)
2017-22	44000 (10000 gravel)	43000	87000 (10000 gravel)
2022-25	-	73000	73000

- (iv) In addition to construction, maintenance would also involve procurement of materials. Requirement of materials for routine maintenance is nominal and is not being assessed here. For periodic maintenance, the following yearly targets were proposed (Table 15.2).

Table 15.2: Targets of Annual Length for Periodic Maintenance

Plan period	Length (km)
2007-12	50,000
2012-17	60,000
2017-22	110,000
2022-25	140,000

15.2 Stone Aggregates and Bitumen

- (i) Assuming 150 mm thickness of WBM, aggregate quantity per km works out to 525 cum. In addition, stone chips would be needed for premix carpet. For one km, about 100 cum. of chips will be required. This gives a total requirement of 625 cum. per km.
- (ii) For 20 mm premix carpet with seal coat, prime coat and tack coat, a quantity of 10 tonnes of bitumen is required per km.
- (iii) Annual requirements would be as given in Table 15.3.

Table 15.3: Annual requirements of stone aggregates and bitumen in construction and upgradation

Plan Period	Length of construction and upgradation (excluding gravel roads)	Annual quantity of stone aggregates (cum)	Annual quantity of bitumen
2007-12	35600 km	22.2 million	0.40 million tonnes
2012-17	58700 km	36.7 million	0.60 million tonnes
2017-22	77000 km	46.7 million	0.80 million tonnes
2022-25	73000 km	45.6 million	0.75 million tonnes

The above estimates are countrywide values. States that are not endowed with stone deposits within economical leads (such as the plains of U.P., Bihar and W. Bengal, parts of Assam, Tripura and Mizoram) shall have to seriously think of alternative materials for pavements. Soil-cement and other methods of soil-stabilisation are promising alternatives that should be explored. Some trial stretches should be taken up to familiarize the engineers and the contractors on the techniques. The State Laboratories should take up R&D to evolve appropriate mix design for stabilization.

- (iv) Bitumen will also be required for maintenance. Table 15.4 gives a broad assessment of quantity of bitumen required for maintenance annually during different Plan periods.

Table 15.4: Quantity of Bitumen Required for Maintenance

Plan Period	Annual length for periodic maintenance (km)	Quantity of bitumen
2007-12	50000	0.50 million tonnes
2012-17	60000	0.60 million tonnes
2017-22	110000	1.10 million tonnes
2022-25	140000	1.40 million tonnes

It will thus be seen from Tables 15.3 and 15.4 that annual quantity of bitumen required for rural roads will steadily increase from 0.90 million tonne per year to 2.15 million tonne per year over the next 20 years. These requirements will need to be taken into account along with the requirements of higher categories of roads by our refineries in planning their production. Since cold emulsion technology is being advocated for rural roads, the refineries should build adequate capacity to meet this demand.

15.3 Cement Requirement

The cement will be required in respect of rural roads for construction of culverts, minor bridges and cement concrete pavements on selective basis on rural roads passing through areas of weak soil or through habitations. Cement will also be required for soil stabilization to reduce dust and to improve the bearing capacity and strength of locally available soft aggregates.

Assuming that half the quantity of stone aggregates needed for rural roads may be given cement stabilization treatment, the annual quantity of cement for this purpose will vary from 0.4 million tonne to 1.4 million tonne per year over the next 20 years.

Length of rural roads to be undertaken with cement concrete pavement may not exceed 5 percent of the new construction under the PMGSY. For every one km of cement concrete rural road, we may require about 250 tonnes of cement. This will give a requirement of cement between 0.25 million tonnes and 0.35 million tonnes per year.

Looking at the high production capacity of our cement plants in the country (installed capacity 140 million tonnes) the cement requirement for roads is not a matter of concern.

15.4 Survey of locally available materials

A nation-wide survey of locally available materials covering every district should be undertaken on the basis of a similar work undertaken by the MOSRTH some years ago. Various state level research institutes under the overall guidance of CRRI/NRRDA can do this work.

15.5 Use of Fly-ash

Fly-ash is available in adequate quantity near thermal plants and its disposal is at present an environmental problem. Fly-ash can be used in the core of the road embankment, with adequate soil cover all around, in stabilisation of soil with lime, and as partial replacement of cement in concrete pavements. Its use, therefore, should be explored intensively.

Panchayati Raj Institutions

16.1 Constitutional Amendment

Panchayati Raj Institutions, as units of local self-government, have been in existence in the country for a long time. However, the 73rd Amendment to the Constitution of India passed in 1992 granted constitutional status to the Panchayati Raj Institutions in the country and is an attempt to bring about uniformity in decentralization of powers and responsibilities at the district level. These institutions are a true process for harnessing and channelising the people's innate abilities to bring about rural transformation in a way that every individual acquired his/her rightful place in the social, economic and political arena.

16.2 Vision for Panchayati Raj Institutions

The ambitious programme for construction of rural roads and in fact all rural infrastructure and the provision of basic services to the rural poor, cannot merely succeed with the availability of adequate funds. Equally important is the existence of an effective delivery mechanism, and its capability to absorb and utilize the funds in a cost-effective manner. An effective and responsive grass-root level organisation with a high degree of commitment, motivation, professional competence, and above all, integrity is the *sine qua non* for the success of any rural development programme. Having been constitutionally conferred statutory status, the PRIs have to evolve themselves in a healthy manner over the coming years and fulfill the vision and expectation the country has of transforming India to a fully developed status by the year 2025.

It is a happy augury that the process has already begun. Devolution of functional responsibilities and control of subjects listed in the Eleventh Schedule of the Constitution to the PRIs is slowly taking place. Financial resources are being made available to them. Elections have been held in many states and women, SCs and STs and other marginalized groups are progressively being inducted in large numbers into the

local set up. Public awareness is growing and civil society organisations and NGOs are closely watching how the system performs. Transparency and accountability in public spending are no longer wishful thinking, but are being insisted upon by the public awareness groups. The vision for the PRI over the next twenty years could be summed up as under:

- PRIs would fully take over control of all subjects listed in the Eleventh Schedule
- PRIs would be controlled by duly elected people's representatives, with adequate representation to the marginalized groups like women, SCs and STs
- PRIs would have the necessary management and accountancy competence.
- PRIs would seek support and assistance from PWD and other technical departments in the delivery of infrastructure development and provision of basic services
- A proper system of accounting and auditing of Panchayat finances would be developed to ensure transparency in use of public funds.
- The existing system of District Planning Committees would be strengthened for formulation of all rural infrastructure development plans.
- PRIs work in close association with the voluntary agencies, comprising of individual experts, NGOs, Community-based Organisations, Self Help Groups, etc.

The Panchayati Raj Institutions would thus emerge as the pivotal organisations at the District level in planning, construction and maintenance of rural roads, besides their other functional responsibilities, thus paving the way for increased opportunity for community involvement and promoting social and economic development of our rural areas.

16.3 Role of PRIs in the Rural Roads Sector

In the Rural Roads sector, the PRIs should grow as important functionaries, involving themselves in all aspects such as:

- network planning
- prioritizing of schemes
- facilitating land acquisition
- ensuring environmental safeguards
- rehabilitation of Project Affected Persons
- ensuring that the unemployed/underemployed are fruitfully employed in road construction and maintenance
- providing support in asset maintenance
- fostering road safety awareness among road users

Table 16.1 gives the role and functions of the PRI that should be envisaged throughout the country.

Table 16.1: Role and Functions of PRI

Level of Panchayat	Role and Functions to be devolved	Issues to be addressed
1. District Panchayat (at the district level)	<ol style="list-style-type: none"> 1. Ownership of all Rural Roads 2. Construction of all Rural Roads 3. Planning of maintenance of Rural Roads 4. Prioritization of Rural Road Improvement Programme 5. Conducting Traffic Surveys and Road Condition Surveys 6. Coordination with District Planning Committee 7. Maintenance of Through Roads under Rural Road Category 	<ol style="list-style-type: none"> 1. Obtaining technical support from PWD/RES, etc. 2. Contract Management 3. Quality Control 4. Financial Accounting and Audit 5. Updating Land Ownership Records 6. Use of IT for all Rural Road activities 7. Maintenance management
2. Intermediate Panchayats (at the Block level)	<ol style="list-style-type: none"> 1. Network Planning at Block level 2. Maintenance of Link Roads under Rural Road Category 3. Road Safety of all Rural Roads 4. Preservation of Environment on all Rural Roads 	<ol style="list-style-type: none"> 1. Maintenance Management 2. Technical support from PWD/RES
3. Gram Panchayat (at the village level)	<ol style="list-style-type: none"> 1. Selection of Alignment 2. Grievance Redressal 3. Local Road Safety 4. Maintenance of Roads within villages and non-core roads 	<ol style="list-style-type: none"> 1. Voluntary land transfer or land acquisition with full compensation 2. Watchdog function on quality and timely delivery of Rural Road works 3. Local participation in alignment selection

16.4 Technical Support to PRIs

For effective delivery of rural infrastructure by the PRIs, they need to be provided with adequate technical support. A separate Rural Roads Wing should be set up in each state. This Wing may be brought under the Panchayat Raj department of the state. The Executive Engineers in the field should be working directly under the District Panchayats, and they should be responsible to the Panchayats for all administrative matters. However, for all technical matters, the field Executive Engineers should report to the Superintending Engineers/Chief Engineer of the Rural Roads Wing.

The rural road works are by nature small and dispersed over a wide geographic area in blocks. Such works are difficult to supervise due to the demanding travel and logistics requirements. This has led to decentralisation of responsibility for provision and maintenance of rural works to Panchayati Raj Institutions (PRIs). For discharge of functions, expected of these PRIs, some states have set up full-

fledged Rural Engineering Service/Department to undertake all engineering works entrusted to the Panchayats. Some others entrust the works for execution to the Public Works Departments since they have a battery of experienced technical personnel and well laid down procedures for engagement of contractors and their capability in monitoring of quality during execution. **Appendix-3** gives a brief note on such a system prevailing in Gujarat. The District Development Officer of the District Panchayat is the Administrative Head. The Executive Engineer (Panchayat) is responsible to him for all administrative matters, e.g. inclusion of work in the budget, administrative approval, award of work, extension of time to contractors but for technical matters, he has to report to the Superintending Engineer/Chief Engineer (Panchayat) of the Roads & Buildings Department of the state. This appears to be a good combination as the Panchayati Raj Institution owns rural roads but technical execution is left entirely into the hands of the officers of the State Roads and Buildings Department.

As per the guidelines issued by the NRRDA on the preparation of District Rural Road Plans, the Panchayati Raj Institutions are involved in all crucial stages of planning of rural roads in the block and their integration at district level. It is important to bear in mind that local participation in planning also includes the involvement of local politicians. Their interest should be channeled into a structured planning system in which transparency and decision-making is secured in an orderly manner as demonstrated by PMGSY guidelines.

The PRIs in some states are playing a significant role during the works implementation and maintenance where they are supported by technical road agencies. In view of the huge programme of rural roads ahead in the coming years, it is necessary to ensure that the PRIs have the backing of technical agencies for efficient and quality execution of works on the ground. The technical agencies in themselves will need capacity building.

PRIs would need to play key role in maintenance of rural roads being constructed under the various programmes. An inventory of existing roads should be maintained at the respective level of PRIs for the roads under their jurisdiction. The Gram Panchayats may involve villagers in the maintenance system. PRIs may also play important role in community participation by inculcating in them a sense of ownership and the benefits accruing to them.

Gram Panchayats may come forward and take the responsibility of cleanliness of road and drains passing through their habitations. In some states, local people contribute labour for routine maintenance of link roads. The Gram Panchayats may be made responsible for plantation and maintenance of trees along the rural roads.

16.5 International Experience in Participation of Beneficiaries

In several developing countries such as China, Philippines and Indonesia, the participation of beneficiary communities has successfully been tried out. For example, in China, rural road construction is a joint effort of the local community and the government, inasmuch as the local villagers construct a road with assistance of the government who provide materials like bitumen, cement and steel, etc. The villagers,

who carry out routine maintenance works on rural roads, are given a subsidy by the local government. In Finland, local communities are motivated to maintain the rural roads through financial incentives by forming a 'road cooperative', which serves as a private road maintenance organisation. The road cooperatives get 30 to 80 percent of maintenance costs as a subsidy; the communities along the road according to pre-defined portions share the costs. Periodically, a technician from the engineering department visits a rural area for rendering the needed technical advice on maintenance problems to the cooperatives and also to monitor the quality of maintenance works. There are about 18,000 road cooperatives receiving subsidies from the government towards rural road construction and maintenance. In Austria, the local communities form associations, which are responsible for the construction and maintenance of rural roads, the financial assistance being provided by the federal and provincial governments.

The practice of villagers living along the access roads forming 'road cooperatives' for construction and maintenance of rural roads, subsidised by the local government may be given a fair trial in the Indian context also. The farming community has already been willing to provide land free of cost in several states. The sense of belongingness is getting inculcated.

16.6 Mechanism of Transfer of Funds to PRIs

As regards funds for new construction or upgradation, funds for Rural Roads are part of Plan funds, either directly from the center or through the states. For planned and coordinated investment, it would be appropriate if all funds are centralized with the SRRDA for state level accounting purposes, with District Panchayats being authorised to operate on the funds to the extent of their entitlement.

As regards funds for maintenance, it is necessary that with the transfer of all Rural Roads to PRI, the maintenance funds be also transferred to them. The future Finance Commissions may be approached by the states to recommend separate earmarked allocation of funds for maintenance of rural roads to the PRI. A mechanism similar to the one for new construction may be evolved by the states to devolve these funds to the Panchayats at different levels depending upon their area of responsibility.

16.7 Way Forward

The government should fund capacity building of District Panchayats so that they take over functions like construction management, maintenance management and road safety. The Ministry of Rural Development may include a component for such capacity building as a specific component in the externally aided projects (World Bank, ADB).

Research and Development

17.1 Background

The need for national research and development in all branches of science and technology was clearly recognized by the planners as early as the 1950's. The establishment of a chain of National Laboratories under the Council of Scientific and Industrial Research (CSIR) was a major step in this direction. The Central Road Research Institute (CRRI) was established as a part of this set-up. Some other road research institutes of a similar nature got established at the state level. The Highway Research Station (HRS), Chennai, Maharashtra Engineering Research Institute, Nashik, Gujarat Engineering Research Institute, Vadodara; Assam Road Research Laboratory, Guwahati; Uttar Pradesh Road Research Laboratory, Lucknow are some of the institutes set up by the State Governments. As early as 1946, a method of soil stabilisation for low cost roads using soft aggregates was evolved by Prof. Mehra and is well-known as Mehra's method. In the CRRI, a Rural Roads division was set up, and this division has carried out research on a variety of topics. Some of the major achievements are:

- (i) Evolving a systems approach to rural road development, which suggested a simple method for development of a rural road network.
- (ii) A study of the performance of nearly 400 rural road pavements in India and evolving a simple pavement design procedure.

The Ministry of Shipping, Road Transport and Highways (MOSRTH), initiated a series of studies in nine districts of India on the socio-economic impact of rural roads. The studies were subsequently synthesised by the CRRI.

17.2 Need for Continuing R&D Efforts

Since rural roads have now been recognized as a major thrust area, the need for concerted R&D efforts aimed at evolving the most suitable and economical designs and developing appropriate technologies

for construction, maintenance and rehabilitation of low-volume rural roads, cannot be over emphasized in the Indian context. Additionally, the influence of the type of terrain, climatic and other environmental conditions prevailing in different parts of the country are also to be taken into account. The Highway Research Board (HRB) of the IRC will have to expand their activities and coordinate with the Ministry of Rural Development and CRRI and identify and prioritise R&D projects in respect of rural roads. MORD can then assign area-specific R&D projects to the concerned States/UT. The task of analyzing the data obtained from the assigned R&D projects to different parts of the country can be carried out by CRRI jointly with the Regional R&D Institute/Labs in the various States. Essential pre-requisites for the success of such an R&D set-up include the needed facilities by way of well-equipped laboratories and experienced scientists carrying out the needed field and laboratory investigations. The HRB may bring out comprehensive Manuals on topics such as 'Unsealed Rural Roads'; 'Drainage and Erosion Control for Rural Roads'; 'Appropriate Technology for Rural Road Construction'; 'Maintenance and Rehabilitation'; 'Cost-Benefit Analysis of Rural Road Projects incorporating Social Benefits' etc. Each state should also set up road research advisory cell to co-ordinate research activities in the state and also act as a think tank.

17.3 Emerging R&D Areas

Some of the more important thrust areas for Medium Term R&D work and Long-Term R&D work requiring immediate attention are:

- Critical appraisal of design and construction practices being adopted for low volume roads around the world.
- Review of the existing geometric design standards pertaining to low volume rural roads.
- Evolving low cost drainage and erosion control measures for low volume roads and preparing a comprehensive manual
- Identification of sources of locally available materials for road construction at district level and determining the strength and other characteristics of such materials.
- Developing stabilisation techniques for improving performance of locally available softer materials.
- Evolving appropriate technologies for the construction and maintenance of low volume rural roads, both sealed and unsealed pavements.
- Evolving suitable and economical 'Performance-Based' pavement designs for low volume rural roads, for both sealed and unsealed pavements.
- Evolving suitable and economical designs for low cost Cross-Drainage structures.
- Encouraging the use of cold mix technology and emulsions.
- Socio-economic impact assessment of investments in rural roads
- Evolving designs for fabrication and manufacture of low-end technology and inexpensive machinery suitable for construction and maintenance of rural roads.

17.4 Budgetary Allocations

In view of the vital importance of R&D in the areas of planning, design, construction, maintenance and rehabilitation of rural roads, an appropriate percentage of the amount of investment in rural roads may be set apart for R&D work.

As has been the experience in the developed parts of the World, R&D efforts do pay handsome dividends in the long-run by way of more cost-effective, performance-based designs and improved performance of rural roads, with prolonged life and reduced maintenance costs.

17.5 Institutional Arrangements

The Ministry of Rural Development (MORD) and the HRB of IRC are ideally positioned to be the apex bodies to identify, fund and get the R&D schemes implemented. They can also monitor the progress of the projects. Since the Highway Research Board (HRB) of the IRC is like a Forward Looking Group for the R&D in the road sector as a whole, a close liaison is needed between the MORD/NRRDA and the HRB. The MORD may set up a small scientific committee for R&D in rural roads sector for this purpose.

A center for knowledge on rural roads may be established within the IRC with support from MORD for facilitating development of database, further research, dissemination of knowledge and information on various aspects of rural roads (planning, engineering, construction, maintenance, etc.) The IRC should also continue to network with existing national and international agencies concerned with rural roads.

The CRRI and the state level road research institutes will have to carry the major burden of the R&D work. With the increased focus on rural roads, the CRRI would need to augment its area of work for rural roads in close association with the MORD. Academic institutions, which have already been involved in various aspects of Rural Roads under the PMGSY, should join hands in this endeavour. They have already been playing a useful role in promoting research in the highway sector.

17.6 Application of Research Findings

It is noticed that some of the good work done on R&D does not find application in the field. The IMRA (Identification, Monitoring and Research Application) Committee of the HRB (IRC) should be entrusted with the task of dissemination of the research findings and application in the field. Modifications in codes, design guidelines and specifications should be taken up so that there is no lag between research and its adoption in the field. The NRRDA may consider inclusion of these aspects in the guidelines for implementation of PMGSY programme. The implementing agencies in the states may be encouraged to utilize the R&D results for non-PMGSY rural roads also.

17.7 Use of Innovative Materials

There have been several advances in the use of certain additives to traditional materials and local soils to improve their bearing capacity and road agencies have been encouraging their use initially by way of pilot projects. This is a step in the right direction. It is necessary to ensure that feedback of performance

of such materials is available to the Indian Roads Congress for wider dissemination and their incorporation in the design guidelines and specifications.

17.8 Augmentation of IRC Efforts

At present a separate Committee known as the Rural Roads Committee in the IRC deals with all matters pertaining to Rural Roads. While this Committee has been able to deliberate upon various issues so far, the major thrust that is given to Rural Roads calls for substantial augmentation of IRC work. A beginning should be made by including some of the State Secretaries and Chief Engineers in charge of Rural Roads as members of the Rural Roads Committee, Highway Research Board Committees. Subjects like design, specifications, performance, maintenance and R&D need to be focused for discussions. The IRC is also expected to network with global and national research agencies and knowledge forums in bringing out latest innovations and technologies having bearing on construction and maintenance of rural roads.

Implementation Strategies

18.1 Introduction

In the six years of implementation of PMGSY, a good absorption capacity has been built up in terms of management structures and procedures for implementation. It is clear, however, that further increases in absorption capacity will only come through institutional enhancements. This will require attention on several fronts, particularly:

- Road agencies in the government
- Panchayati Raj Institutions
- R&D organizations
- Training institutes
- Academic institutions
- Contracting sector
- Equipment manufacture
- Material supply

18.2 Road Agencies

Before the Central Government intervention through the PMGSY, rural roads had been an area of low investment and amorphous responsibility for planning, execution and maintenance. The benefits of PMGSY to the Rural Roads sector have been undeniable. It has brought about high technical and management standards and improved funding.

There is still multiplicity of organizations dealing with rural roads in several states. Main agencies are Public Works Departments, Rural Engineering Organisations, and Panchayati Raj Engineering

Department. Rural road authorities are now coming up at the state level mirroring the central agency – National Rural Roads Development Agency – which is a role model and a think tank at Central government level for promoting uniform guidelines for planning, engineering standards for rural roads, contract procedures and quality-control in execution of works.

There is need for a single specialised nodal agency in each State, which should be responsible for overall policy, planning and management of rural roads in the State. The states should also have uniform Works Accounting System. The one evolved for the PMGSY can serve as a guide. The States need to move in direction of a single sectoral agency. Until then, a nodal agency be identified and be made responsible for coordination with other agencies and ensuring integration of various programmes and schemes. Such an agency should also be able to dovetail with other development programmes relating to rural infrastructure and public transport.

The road agencies should move forward in becoming repository of computerised database in respect of rural roads covering inventory, condition survey of roads and bridges, achievements in connectivity, traffic data and utilising GIS and other IT- enabled facilities.

18.3 Institutional Set-up

The states have to strengthen their own capabilities for handling the challenging task of providing and maintaining rural road connectivity. In some states, there are no dedicated divisions for rural road works, and the work load of normal state sector may keep the divisions busy for most of the time.

The targets set forth for the Rural Roads: Vision 2025 are no doubt ambitious but are achievable. For this, the institutional set up at the state level, needs to be strengthened.

The Public Works Departments (PWD) in the states are very old institutions and have evolved management and accounting procedures over time, which needs to be adapted to suit modern day management and accounting practices. Rural engineering organizations have come up to handle the extra workload particularly to meet rural development; and PRIs and their management systems need to be suitably strengthened on similar lines.

The PWD themselves have a variety of charges under them. Many have a combined roads and buildings cadre. Some states have a separate Highways Wing of the PWD (Tamil Nadu).

It is expected that in the next 20 years, rural development works would involve substantial engineering not only in respect of rural roads but also other civil engineering works viz. drinking water, minor irrigation etc. This may require creation of Rural Engineering Organisation where they do not exist. While they may be formally part of the Public Works Department or of Rural Development Department depending upon the perception of the individual State, it is likely that there would be substantial interaction with PRI, at least at the District level, in terms of planning, prioritization, budgeting and accountability. It is essential, therefore, to develop rural sector organizational structure in a manner that

caters to this most likely scenario in such a way that the engineering, technical management and financial accounting procedures are able to meet the challenge posed by such a transition.

Accordingly, irrespective of whether Rural Roads are currently with the PWD or with the REO, it is necessary to create specialised Rural Road Engineering Units (Divisions) so as to ensure the necessary technical expertise and management quality. Such rural roads divisions would be under a separate Rural Roads Wing of the PWD/Rural Development Department and should be headed by a full time Chief Engineer. An indicative organizational set-up for the Rural Roads Wing is given in Figure 18.1.

The Rural Roads Wing would help in:

- Adoption of planning and design practices specific to low volume roads;
- Ensuring adoption of simple measures for carrying out social and environment assessment and for suggesting mitigation measures.
- Effective monitoring of execution of rural road works
- Planning of maintenance operations and development of a sustainable Rural Road Maintenance Management System.

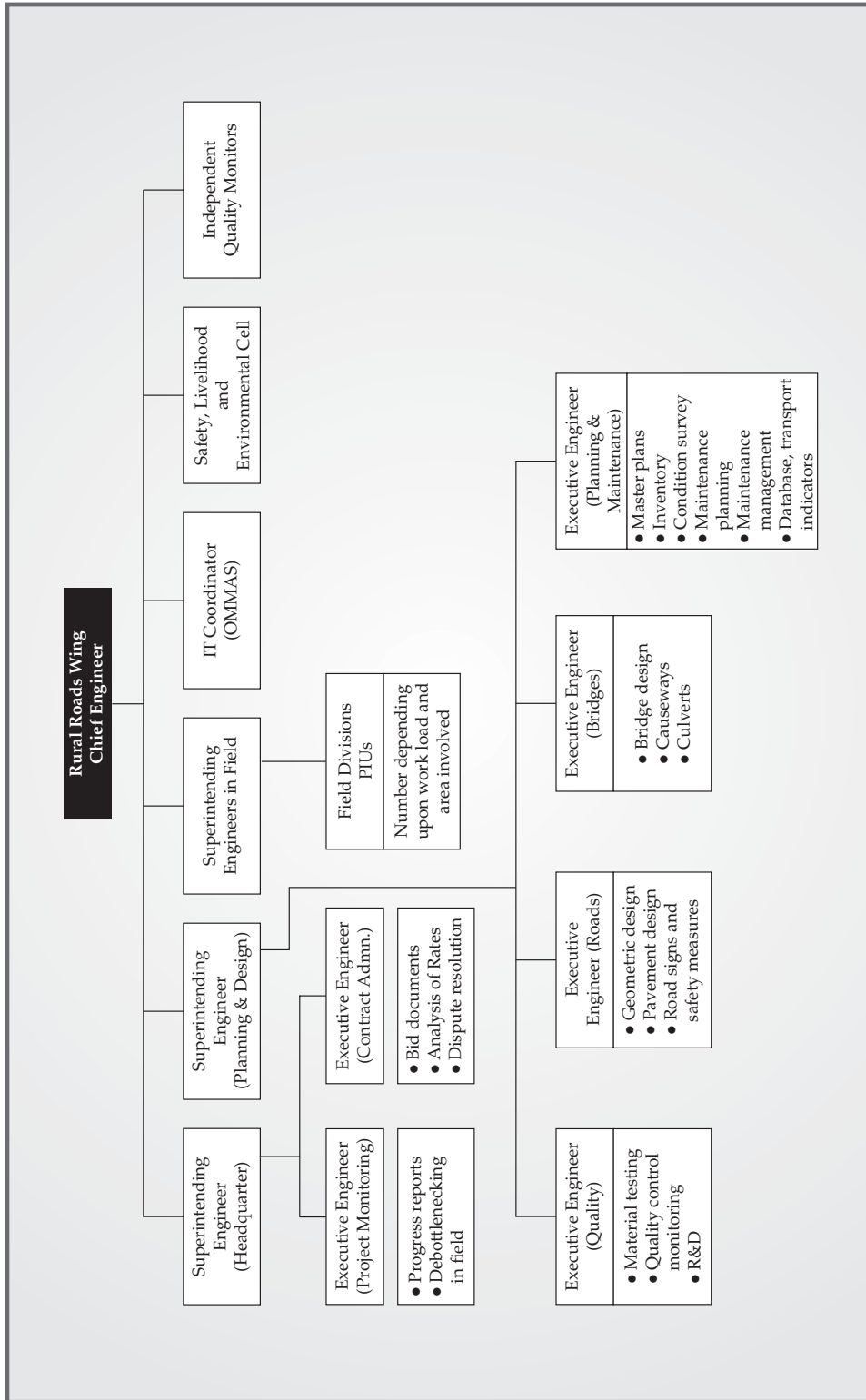
Essentially, the recommendation is that the organizational set up should be based basically on the concept of core-competence. It is essential to recognize that road engineering (whether for rural roads or main highways) is one subject and specialization is needed at least at this level if engineering inputs are to be of value.

The present practice of allowing the movement of engineers between roads, public health and other civil works is detrimental to professional growth as well as quality of programme delivery. As such it would be preferable to have a single cadre of civil engineers exclusively for road sector and in case the rural roads wing is with the Rural Development Department or with the PRI, they may be taken on deputation from the cadre of road engineers.

The Rural Roads Wing also needs to be adequately supported on the technical side, including

- (i) A Central laboratory to test materials, exercise independent quality control, and carry out R&D on materials, processes and technology. The laboratory should be under the charge of an experienced Scientist or Engineer.
- (ii) A Design Cell, which can undertake environment assessment, geometric design, pavement design and bridge designs particularly suited for rural roads. An officer of the rank of Superintending Engineer assisted by two Executive Engineers and supporting staff may head the Cell.
- (iii) A Planning and Maintenance Cell, under an Executive Engineer: The Cell shall be responsible for preparing master plans, carrying out rural road inventory and condition surveys, preparing short and medium term maintenance plans and monitoring. This Cell should also report to SE Designs.

Figure 18.1: Indicative Organisational Set-up of Rural Roads Wing



- (iv) A separate cell to assist in carrying out social and environment assessment and to monitor implementation of mitigation measures during construction and maintenance operations
- (v) A Superintending Engineer at headquarter in charge of Project Monitoring and Contract Administration.
- (vi) An IT cell. India is in a happy situation in harnessing Information Technology enabled services. The role of IT in planning, setting priorities, procurement, contract management, maintenance management and accounting in the roads sector is yet to be fully exploited. The implementation of the On-line Management Monitoring and Accounting System (OMMAS) under the PMGSY has been a great stride forward in utilizing IT. The gains already made should be consolidated and efforts directed to make further progress, covering all rural roads.

18.4 Cadre Management

Both in the state PWD and Rural Engineering Organisations, there is huge stagnation of officers and staff particularly at Field Supervisor, Junior Engineer and Assistant Engineer levels. Instances are not lacking where Junior Engineers take even 20 years for promotion as Assistant Engineers. Similarly, Assistant Engineers take 15 to 20 years in becoming Executive Engineers. As these officers are key to execution of rural roads programmes on ground, it is necessary to review the whole system of cadre management. There is need to ensure reasonable career path opportunities for both engineering and secretarial staff officers. A maximum of 10 years should be aimed at one level, unless the performance of the staff is seriously lacking.

18.5 Contracting Sector

In several states, the contractors engaged in the construction of rural roads are by and large medium size highway contractors having heavy duty equipment/plants like Hot Mix Plants, Vibratory Rollers, Excavators, etc. The small-sized and scattered rural road works are in some cases being subcontracted by these contractors to petty inexperienced contractors. Currently the technology under the PMGSY contracts is seen to be equipment intensive. While this strategy could be pursued for larger works, for small-sized low volume rural road projects, appropriate technology aiming at an optimal man-machine mix needs to be promoted. In order to encourage the healthy growth of small local contractors for rural works and to increase their capacity, a number of steps need to be taken. Some suggestions in this regard are given in Box 18.1.

Another important aspect of fostering growth of small local contractors is the promotion of a full-fledged rural industry of manufacturing and maintaining simple tractor-towed implements and other low end technology equipment, which should be less expensive but effective in speedy and quality execution of various rural road construction operations as also for the maintenance of both sealed and unsealed roads. Additional benefits would be increased employment opportunities to the local beneficiary communities.

As the road sector grows, not only for rural roads but for other higher categories too, there is a need to introduce State-National registration of contractors, which can be updated periodically.

Box 18.1: Steps for Growth of Small Local Contractors

- For the construction and maintenance of small sized low volume rural road projects, the adoption of intermediate technology deploying simple tractor-towed implements and other small capacity equipment may be the preferred choice.
- Contractors specialising in different activities of road works, e.g, earthwork, supply of materials, bituminous works, culverts and bridges, shall be registered under different categories based on size and nature of work.
- The small contractors and specialized contractors shall be encouraged to serve as subcontractors to large contractors under a formal subcontract, so that they gain expertise and slowly graduate to take up large size contracts.
- The contractor should be given mobilization advance against new machinery that he purchases for the rural road works. Also the contractor may be given advance against materials brought to the site, which would lessen the cash-flow problems faced by many of the local contractors.
- There is need to formulate different size contract packages for rural roads so as to enable small contractors to gain independent entry for small size contracts to start with.
- The concept of equipment banks in the private sector is coming up. This needs to be encouraged. There are several activities where equipment is required for short duration at a time although needed on several occasions. This would help small contractors as they cannot invest in procurement of equipment but all the same will need them for execution of works.
- There is also need for capacity building of small contractors through training in works and simple business accounting practices. The ITIs and Polytechnics could be used to impart training. The equipment manufacturers should also come forward in training of foremen and operators. Stress is to be on both the know-how and the show-how of workmanship.

18.6 Consultancy Sector

While there has been a rapid growth of consultancy on highway projects in the country, during the past decade or two, the same cannot be said of consultancy on low volume rural road projects. The procedure generally being adopted all over the country for PMGSY roads is that the DPR are prepared by the concerned road agency, etc., which are sent for scrutiny to the State Technical Agency (STA) or Principal Technical Agency (PTA) for approvals before the construction work is taken up. The STA and PTAs are generally academic institutions like Regional Engineering Colleges, IIT, CRRI, etc. During construction, the monitoring of the quality of works being executed is carried out by the state level quality monitors and on sample basis by the National Quality Monitors (NQM) appointed by the NRRDA.

It has been observed that national level consultants are not attracted to the Rural Roads sector because of the present system of awarding the assignment to the lowest offer. Many a times, the lowest offers are from inexperienced consultants, who do not have sufficient manpower or survey and investigation equipment.

With large investments being planned for the Rural Roads sector in the coming years, the healthy growth of consultancy sector is imperative. This can be fostered through various measures such as:

- (i) Selection of consultants based on Quality plus Cost Basis, rather than on cost alone;
- (ii) Working out reasonable rates for survey and investigation work, and using them as benchmarks.
- (iii) Attracting young entrants, offering them good pay and career prospects;
- (iv) Offering training courses to the young professionals, with training modules specially designed to serve the needs of planning, design, construction and maintenance of Rural Roads;
- (v) Maintaining a centralised data base on consultants for a variety of jobs, and updating the same periodically, based on performance.

18.7 Assessment of Manpower Needs

The investment in development and maintenance of rural roads has been worked out in Chapter 11. The annual outlay envisaged is Rs.7500 crore during the 11th Five Year Plan to Rs.18200 crore in the 14th Five Year Plan (2022-27).

To effectively manage such a large work load, the ideal set up should be a lean and thin government organisation, with all major activities like survey, investigations, designs and construction, being outsourced to consultants.

There should be one Project Implementation Unit (PIU) in each district, capable of handling capital works to the tune of Rs.10-20 crore per year and maintenance works to the tune of Rs. 5 crore per year.

Assume 4 graduate engineers and 12 diploma engineers and surveyors for one division. Table 18.1 gives a broad assessment.

Table 18.1: Manpower Needs

	Graduate Engineers	Diploma Holders and Surveyors
Number of engineers needed to be in place in road agencies	2,400	7,200
Add for consultants and contractors	250	800
Total	2,650	8,000

Yearly fresh recruitment may be say 150 graduate engineers and 400 diploma holders. The same division should be responsible for maintenance also. It is envisaged that work of maintenance on ground would be handled through the system of Panchayati Raj Institutions with technical support of the PIU and increasing share of work being undertaken by small scale contractors and labour cooperatives.

Each state would need to work out realistic requirement of manpower depending upon the extent of programmes needed year-wise in the next few years and the staff and skills already available. The position should be reviewed from time to time and close liaison maintained with the engineering colleges and polytechnics to ensure that the needed numbers are available.

The Indian Roads Congress should take the lead in evolving course curricula in respect of Rural Road Engineering covering investigations, design, technology of construction and maintenance aspects, etc. for adoption by Engineering Colleges, NITs and IITs as part of degree in civil engineering qualifications.

18.8 Capacity Building and Training

18.8.1 Background

The massive rural road development programme under PMGSY, aimed at connecting some 179,000 unconnected habitations with a population of 500 and above, needs to be followed by an equally massive programme, beyond PMGSY, for connecting the remaining 168,000 habitations with a population below 500. The colossal task of providing 100 percent connectivity is further compounded by the Herculean effort required for maintaining the vast rural road network thus created. In the present set-up, the aspect of imparting adequate training to the staff engaged in rural road development works, right from senior-level rural road engineers, down to the unskilled workers at the ground level, leaves a lot to be desired.

There is need for state level training centers or institutions for the road sector including rural roads. The State Government could be provided funds out of the existing CRF allocations for this purpose to start with. Later, there could be a small charge on the project cost for this purpose and proceeds utilized for training and capacity building.

Concerted efforts are needed to identify the capacity building and training needs at various levels and to chalk out a time-bound programme for this purpose. Continuous skill enhancement on the part of government engineers is necessary to keep abreast of the latest trends and developments in road technology. This must be supplemented with knowledge and skill on project management, financial and legal matters. Sufficient funds should be budgeted to the departments for conducting the training and creating infrastructure for training facilities. Salient details of the capacity building and training needs for various levels of staff engaged on rural roads are discussed in the subsequent paragraphs.

18.8.2 Training Needs

The training needs may be assessed as under:

- (i) At entry to all
- (ii) Refresher courses (once in 5 years)

Number of Engineers to be trained:

	Graduate Engineers	Diploma Holders
At entry (every year)	150	400
Refresher courses (once in 5 years)	530	1600

18.8.3 Training Modules

Training modules should be prepared separately for:-

- (i) Government Engineers
- (ii) Consultants and Quality Monitors
- (iii) Contractors
- (iv) Operators of equipment
- (v) Skilled, semi-skilled and unskilled workers

Some suggestions are given in *Appendix-4*

18.9 Institutions for Training

We have NITHE as a training institute at national level for highway engineers. This institute has been engaged in the recent past for conducting several training programmes for engineers of the state PWDs and Rural Engineering Organisations undertaking rural road works under the PMGSY. It has to further gear up its activities to respond to the needs of training in the coming years. The CRRI is also providing good support in this effort, besides their R&D activities. State-level training centres should also be set up where they do not already exist. It may be noted that state level institutes like GERI (Gujarat Engineering Research Institute), MERI (Maharashtra Engineering Research Institute) Assam Road Research Laboratory, Guwahati and HRS (Highway Research Station, Tamil Nadu) are already engaged in training activities. For contractors, National Academy of Construction (NAC) set up by the State of Andhra Pradesh is a very good initiative. In fact, the NAC is a role model to be replicated in a few regions of our country for training of construction workers, supervisors and contractors managers. The NAC, Hyderabad can serve the entire southern region with additional financial support of contractors from that region. Similarly, NICMAR and CIDC undertake training of contractor's personnel. Their services should be utilised. Actually even all these training institutions will also need strengthening and support of the Government.

There is thus need for a coordinated capacity building initiative covering:

- Road agencies (PWDs, RES, REOs, etc.)
- State technical agencies, quality monitors
- Contractors and their workers and equipment operators
- Consultants

Each state should work out a comprehensive Training Need Assessment and then scaled up at the national level for a detailed Action Plan by various players responsible for the needed actions. Box 18.2 gives a broad performance requirement of persons engaged in rural roads.

Box 18.2: Performance Requirements

Rural road agencies:
(engineers and supervisors)

- Capable of carrying out overall planning, project preparation, management and monitoring activities related to rural road construction, improvement works.
- Capable of preparing and supervising rural road construction and improvement contracts and familiar with procedures of quality control and payments.
- Capable of effectively plan, organise and manage routine maintenance of rural roads carried out by gang labour and local petty contractors.
- Capable of providing detailed on-the-job instruction to and supervision of small contractors engaged in routine and periodic maintenance.
- Capable of accounting for the funds and ensuring timely flow of funds to meet the commitments for contractors.

Small-scale contractors

- Capable of organising and carrying out works using intermediate technology (judicious mix of labour and machines).
- Capable of successfully managing construction works, managing large group of workers, the company’s business and the ability to organise and control all required assets and machinery.
- Know-how to procure roadwork contracts including all tendering and pricing procedures.

18.10 Collaboration with International Organisations

The International Labour Organisation (ILO) and International Focus Group (IFG) of Rural Road Engineering have gathered considerable experience and expertise in training of small-scale contractors and ground level workers and field supervisors. The Transportation Research Board (TRB) of USA conducts periodic conference on Low Volume Roads. The training institutions in the country will do well to collaborate with them in these efforts.

18.11 Setting up of Chairs for Rural Roads

Rural roads did not earlier receive the needed attention at both technical and socio-economic level. There is positive correlation between accessibility and poverty reduction as brought out in earlier chapters. As the rural road activities are stepped up, there is a need to develop independent think-tanks and academicians on various aspects of rural roads like engineering, safety, environmental issues, and socio-economic impact. The government needs to fund positions in institutions like NCAER, IIPA, IIMs, IITs and NITs. Eminent persons with transportation, agriculture economics, poverty and rural road engineering related disciplines need to get institutional support in this endeavor.

The Path Forward

19.1 Adoption of Vision Document by Government

The Ministry of Rural Development may submit the Vision: 2025 on rural roads to the Planning Commission and the State Governments for their acceptance. Their comments and suggestions for the formulation of detailed 20-year Plan in each state may also be solicited.

19.2 Formulation of Detailed Action Plan by States

Action should then be taken by each State to formulate a 5-year Action Plan in the light of recommendations of the states and propositions made in the Vision Document. Focus should be on implementation strategies including institutional and organizational issues. It should be possible for the states to prepare such a Plan in one year time.

19.3 Maintenance Management

The states may consider enactment of rural road management act proposed in the Vision Document so as to introduce asset management principles in preservation of rural road assets being created with huge investments. The Ministry of Rural Development may take the lead in preparing a draft Model Bill for this purpose. Arrangements to provide the needed funds for maintenance of rural roads out of the grants recommended by the Twelfth Finance Commission may be undertaken on priority basis.

19.4 Assessment of Resources

The states should work out plan-wise targets of connectivity and resources required in terms of finances, material, manpower and machinery for achieving these targets. Cost cutting strategies proposed in the Vision Document and measures to maximise use of locally available materials need to be urgently taken by all states.

19.5 Capacity Building

Institutional arrangements may also be planned and put in place for capacity building and skill enhancement of road agencies, panchayati raj institutions, local contractors and workers. The Ministry of Rural Development may provide the lead role in this direction. The NITHE should develop a specific time bound Action Programme for training of road agencies and support in training of contractors and consultants.

19.6 Dialogue with Equipment Industry

The Ministry of Rural Development, Ministry of Shipping, Road Transport & Highways and the IRC should undertake a dialogue with the equipment industry for manufacture of low-end technology and inexpensive machinery suitable for rural roads. A time bound Action Plan should be jointly worked out as part of a cost cutting strategy and growth of small-scale contractors. An inter-ministerial working group may be constituted for this purpose.

19.7 Periodic Review and Updating of Vision

The Ministry of Rural Development and the States should monitor the implementation of the Plan on a regular basis, review and update the Plan every five years in the light of actual achievements, the demand of the economy and other developments taking place.

19.8 Enhanced role for Road Research

The Central Road Research Institute may further increase its focus and effort on R&D needs of the rural road sector to find innovative and cost-effective technologies. The Central Government and State Government should also support IITs, NITs and other academic engineering colleges in taking up identified research schemes

19.9 Professional Support by the Indian Roads Congress

The Indian Roads Congress should enhance its support by regular review and updating of standards, manuals and codes of practice on planning, design, construction and maintenance of rural roads. Illustrated handouts are needed for the benefit of field supervisors, maintenance road inspectors and local contractors and workers in local language.

Appendix-1

**A Broad Assessment of Physical and Financial requirements for Rural Roads
(Reference Para 11.6)**

1. New connectivity (Habitations not covered)**A. Number of Habitations**

(i)	Total number of unconnected habitations		346,607
(ii)	Number of habitations likely to be covered under PMGSY		
	(a) Number being covered directly	178,768	
	(b) Number likely to be covered incidentally	11,232	
		190,000	190,000
(iii)	Balance number of unconnected habitations		156,607
(iv)	Deduct number of unconnected habitations with population less than 100 (quick estimates)	Say	<u>16,607</u>
(v)	Number of habitations to be provided with rural road connectivity		140,000

B. Length Required

It is noted that under PMGSY, an average of 2.1 km per habitation is required for new connectivity for all categories of habitations. However, for lower size habitations, the average comes to 2.2 km per habitation. It is proposed to adopt this figure for a broad assessment of length for new construction.

$$\text{Length} = 140,000 \times 2.2 = 308,000 \text{ km}$$

Say 310,000 km

Of this say 40,000 km may be black-top (BT) and balance 270,000 km may be gravel (Better estimates will become available when the states have undertaken the exercise by themselves).

C. Estimated Cost

These roads will carry generally very low volumes of traffic. Stress is being laid on reducing the cost of construction by maximising use of locally available materials, rationalising pavement design and width standards especially for roads connecting low size habitations. Unit costs also vary depending upon terrain and climate conditions. Estimated cost for BT road might vary between Rs.2.8-3.2 million per km

and that for gravel road between Rs.1.4-1.8 million per km. Accordingly, an average of Rs.3.0 million per km for BT road and Rs.1.6 million per km for gravel road is considered for a broad cost assessment.

Estimated cost- $40,000 \times 3.0 + 270,000 \times 1.6 = 120,000 + 432,000 = \text{Rs. } 552,000 \text{ million}$

2. Upgradation

Apart from new construction to provide connectivity to lower size habitations, during the next 20 years, there will be need for upgrading of existing roads of the core network and some of the PMGSY new roads already built or being built under the programme. This is assessed as under:

- (i) The length of core network of rural roads is worked out as 1,134,114 km as per DRRPs and data available.
- (ii) The length of new roads for connectivity to lower size habitations works out to 310,000 km.
- (iii) The total core network for rural roads may be taken as $1,134,114 + 310,000 = 1,444,114$ km minus possible overlap, say a core network of 1,400,000 km of rural roads.
- (iv) A length of 337,122 km is going to be upgraded under the PMGSY. Of the balance, we may consider say another 700,000 km for upgrading. The roads being newly constructed under PMGSY may not need heavy upgrading for quite some time. Such roads will, however, need upgrading after the year 2016 or so.
- (v) It is, therefore, proposed to keep a target of 700,000 km of upgrading over and above 337,122 km already identified as part of PMGSY.
- (vi) Cost for upgrading may vary from Rs.20 to 30 lakh per km depending upon the treatment required and terrain conditions. An average cost of upgrading these roads is taken as Rs.25 lakh per km. This would give a total cost of Rs.1,750,000 million.

3. Total Task for Development of Rural Roads (PMGSY and Beyond PMGSY)

3.1 The total task of rural roads construction and upgrading as on 1.1.2007 is as given in Table 1.

Table 1: Total Task Ahead (As on 1.1.2007)

	PMGSY		Balance Requirements (Beyond PMGSY)		Total	
	Length (km)	Cost (Rs. million)	Length (km)	Cost (Rs. million)	Length (km)	Cost (Rs. million)
New construction	242,017	565,044	310,000	552,000	552,017	1117,044
Upgrading	307,435	425,592	700,000	1750,000	1007,435	2175,592
Total	549,452	990,636	1010,000	2302,000	1559,452	3292,636

3.2 Phasing of programme relating to new construction and upgrading:

- (i) Suggestive phasing of the task ahead has been worked out giving high priority to Bharat Nirman and the remaining programme under the PMGSY but also initiating the work of new connectivity to lower size villages gradually by providing gravel roads to start with. This phasing also implies that new connectivity under PMGSY may go beyond the 11th Plan and upgrading beyond the 12th Plan. Stress should be on consolidating the network being built year to year. Upgrading work for roads not forming part of PMGSY is currently proposed more towards the later period and could even go beyond the year 2025. Actually upgrading of roads should be seen as a continuous process to respond to the demand of the economy. This would also even out to some extent the yearly requirement of funds.
- (ii) Tables 2,3 and 4 give indicative phasing in respect of new construction, upgrading and the combined one for the total rural roads programme. The phasing proposed takes into account the current absorption capacity and at the same time the need for a steady increase in the capacity to meet the aspirations of rural people and ensuring a holistic rural development in our country.

Table 2: Phasing of New Construction

Period	PMGSY		Beyond PMGSY		Total		Investments per year (Rs. million)
	Length (km)	Cost (Rs. Million)	Length (km)	Cost (Rs. Million)	Length (km)	Cost (Rs. Million)	
2006-07*	2000	4,800	-	-	2000	4,800	-
2007-12	100,000	240,000	30,000	50,000	130,000	290,000	58,000
2012-17	140,017	320,244	60,000	102,000	200,017	422,244	84,500
2017-22	-	-	220,000	400,000	220,000	400,000	80,000
2022-25	-	-	-	-	-	-	-
Total	242,017	565,044	310,000	552,000	552,017	1117,044	

* Balance Period

Table 3: Phasing of Upgradation

Period	PMGSY		Beyond PMGSY		Total		Investments per year (Rs. million)
	Length (km)	Cost (Rs. Million)	Length (km)	Cost (Rs. Million)	Length (km)	Cost (Rs. Million)	
2006-07 ^o	2,000	3,000	-	-	2,000	3,000	-
2007-12	50,000	70,000	6,000	15,000	56,000	85,000	17,000
2012-17	100,000	140,000	15,000	37,500	115,000	177,500	35,500
2017-22	155,435	212,592	60,000	150,000	215,435	362,592	73,500
2022-25	-	-	219,000	547,500	219,000	547,500	110,000
TOTAL	307,435	425,592	300,000	750,000	607,435	1175,592	

* NOTE: A length of 700,000 km for upgradation beyond PMGSY is the total assessed requirement but of this, it is proposed to cover only 300,000 km during the next 20 years keeping the resources and absorption capacity in sight.

^o Balance Period

Table 4: Combined Phasing of Investments in New Construction and Upgrading*(Rs. million)*

Period	PMGSY		Beyond PMGSY		Total of new + Construction upgrading			Average investments per year
	New Construction	Upgrading	New Construction	Upgrading	PMGSY	Beyond PMGSY	Total	
2006-07*	4,800	3,000	-	-	7,800	-	7,800	-
2007-12	240,000	70,000	50,000	15,000	310,000	65,000	375,000	75,000
2012-17	320,244	140,000	102,000	37,500	460,244	139,500	599,744	120,000
2017-22	-	212,592	400,000	150,000	212,592	550,000	762,592	152,000
2022-25	-	-	-	547,500	-	547,500	547,500	182,000
TOTAL	565,044	425,592	552,000	750,000	990,636	1302,000	2292,636	

* Balance Period

4. Maintenance Requirement and Phasing

4.1 Side by side, rural roads will require maintenance of existing roads and those being newly constructed. At present, maintenance allocations for rural roads are very low compared to needs for both periodic maintenance and routine maintenance. Most states have replied that due to constraint of resources, maintenance of rural roads cannot be undertaken by them as per norms laid down by the committee of experts. Under PMGSY, the states have undertaken to provide for funds for routine maintenance for a period of 5 years after construction, as this is a requirement of the PMGSY guideline. A few states have also started setting up state level funds for roads and do provide some funds for maintenance of rural roads. However, the position is worrisome. A steady increase in maintenance allocations by the states is inevitable if the huge investments being undertaken in construction of rural roads are to be preserved and protected. The 12th Finance Commission has highlighted these aspects also. A broad assessment of the maintenance requirements is worked out as under:

- | | | |
|-------|--|--|
| (i) | Total core network | 1,400,000 km |
| | (when new construction work of both PMGSY and non-PMGSY is completed) | (1,120,000 km BT
280,000 km gravel) |
| (ii) | For periodic maintenance (a cycle of 8 years for BT roads and 5 years for gravel roads is proposed) | Annual programme of renewal
140,000 km BT
56,000 km gravel |
| (iii) | Cost for BT renewal @ Rs.500,000/km
Cost for gravel renewal @ Rs.150,000/km
Annual costs for periodic maintenance: | BT Roads – Rs. 70,000 million
Gravel Roads – <u>Rs. 8,400 million</u>
Rs. 78,400 million |

(iv) Routine maintenance of core network

1,400,000 km @ Rs. 20,000/km

Rs. 28,000 million

Total**Rs. 106,400 million****Say Rs. 106,000 million**

This requirement is on completion of new construction.

4.2 A gradual increase in maintenance allocations is proposed in view of the financial situation of the states. Table 5 gives the proposed phasing.

Table 5: Phasing proposed for Annual Maintenance Allocations

Period	Periodic maintenance		Routine maintenance		Total allocations (Rs. million)
	Length	Cost (Rs. million)	Length (km)	Cost (Rs. million)	
2006-07*	-	-	-	-	-
2007-12	50,000 km BT 10,000 km Gravel	26,500	700,000	14,000	40,500
2012-17	60,000 km BT 40,000 km Gravel	36,000	900,000	18,000	54,000
2017-22	110,000 km BT 50,000 km Gravel	62,500	1,100,000	22,000	84,500
2022-25	140,000 km BT 56,000 km Gravel	78,000	1,400,000	28,000	106,000

* Balance Period

Appendix-2**Projection of Maintenance Expenditure for Roads and Bridges****(Reference Para 13.4)***(Rs. in crore)*

S.No.	State	2005-06	2006-07	2007-08	2008-09	2009-10
1.	Andhra Pradesh					
a.	Normal Expenditure	675.37	709.14	744.60	781.83	820.92
b.	Grant	0.00	245.03	245.03	245.03	245.03
c.	Total	675.37	954.17	989.63	1026.86	1065.95
2.	Arunachal Pradesh					
a.	Normal Expenditure	15.73	16.52	17.34	18.21	19.12
b.	Grant	0.00	11.09	11.09	11.09	11.09
c.	Total	15.73	27.61	28.43	29.30	30.21
3.	Assam					
a.	Normal Expenditure	300.62	315.65	331.43	348.00	365.40
b.	Grant	0.00	82.53	82.53	82.53	82.53
c.	Total	300.62	398.18	413.96	430.53	447.93
4.	Bihar					
a.	Normal Expenditure	258.90	271.84	285.44	299.71	314.69
b.	Grant	0.00	77.34	77.34	77.34	77.34
c.	Total	258.90	349.18	362.78	377.05	392.03
5.	Chhattisgarh					
a.	Normal Expenditure	203.23	213.39	224.06	235.26	247.02
b.	Grant	0.00	65.60	65.60	65.60	65.60
c.	Total	203.23	278.99	289.66	300.86	312.62
6.	Goa					
a.	Normal Expenditure	37.25	39.11	41.07	43.12	45.28
b.	Grant	0.00	9.87	9.87	9.87	9.87
c.	Total	37.25	48.98	50.94	52.99	55.15
7.	Gujarat					
a.	Normal Expenditure	435.62	457.40	480.27	504.29	529.50
b.	Grant	0.00	223.80	223.80	223.80	223.80
c.	Total	435.62	681.20	704.07	728.09	753.30

S.No.	State	2005-06	2006-07	2007-08	2008-09	2009-10
8.	Haryana					
a.	Normal Expenditure	141.92	149.01	156.46	164.29	172.50
b.	Grant	0.00	45.68	45.68	45.68	45.68
c.	Total	141.92	194.69	202.14	209.97	218.18
9.	Himachal Pradesh					
a.	Normal Expenditure	292.75	307.39	322.76	338.89	355.84
b.	Grant	0.00	65.41	65.41	65.41	65.41
c.	Total	292.75	372.80	388.17	404.30	421.25
10.	Jammu & Kashmir					
a.	Normal Expenditure	37.53	39.40	41.37	43.44	45.62
b.	Grant	0.00	29.42	29.42	29.42	29.42
c.	Total	37.53	68.82	70.79	72.86	75.04
11.	Jharkhand					
a.	Normal Expenditure	92.05	96.65	101.48	106.56	111.89
b.	Grant	0.00	102.26	102.26	102.26	102.26
c.	Total	92.05	198.91	203.74	208.82	214.15
12.	Karnataka					
a.	Normal Expenditure	237.96	249.86	262.35	275.47	289.24
b.	Grant	0.00	364.53	364.53	364.53	364.53
c.	Total	237.96	614.39	626.88	640.00	653.77
13.	Kerala					
a.	Normal Expenditure	448.92	471.36	494.93	519.68	545.66
b.	Grant	0.00	160.58	160.58	160.58	160.58
c.	Total	448.92	631.94	655.51	680.26	706.24
14.	Madhya Pradesh					
a.	Normal Expenditure	259.31	272.28	285.89	300.18	315.19
b.	Grant	0.00	146.72	146.72	146.72	146.72
c.	Total	259.31	419.00	432.61	446.90	461.91
15.	Maharashtra					
a.	Normal Expenditure	1065.74	1119.03	1174.98	1233.73	1295.42
b.	Grant	0.00	297.42	297.42	297.42	297.42
c.	Total	1065.74	1416.45	1472.40	1531.15	1592.84

S.No.	State	2005-06	2006-07	2007-08	2008-09	2009-10
16.	Manipur					
a.	Normal Expenditure	48.29	50.71	53.24	55.91	58.70
b.	Grant	0.00	19.24	19.24	19.24	19.24
c.	Total	48.29	69.95	72.48	75.15	77.94
17.	Meghalaya					
a.	Normal Expenditure	52.50	55.13	57.88	60.78	63.81
b.	Grant	0.00	21.60	21.60	21.60	21.60
c.	Total	52.50	76.73	79.48	82.38	85.41
18.	Mizoram					
a.	Normal Expenditure	21.76	22.85	23.99	25.19	26.45
b.	Grant	0.00	10.53	10.53	10.53	10.53
c.	Total	21.76	33.38	34.52	35.72	36.98
19.	Nagaland					
a.	Normal Expenditure	11.35	11.92	12.52	13.14	13.80
b.	Grant	0.00	30.22	30.22	30.22	30.22
c.	Total	11.35	42.74	42.74	43.36	44.02
20.	Orissa					
a.	Normal Expenditure	170.59	179.12	188.08	197.48	207.36
b.	Grant	0.00	368.77	368.77	368.77	368.77
c.	Total	170.59	547.89	556.85	566.25	576.13
21.	Punjab					
a.	Normal Expenditure	106.27	111.58	117.16	123.02	129.17
b.	Grant	0.00	105.24	105.24	105.24	105.24
c.	Total	106.27	216.82	222.40	228.26	234.41
22.	Rajasthan					
a.	Normal Expenditure	181.37	190.43	199.96	209.95	220.45
b.	Grant	0.00	158.33	158.33	158.33	158.33
c.	Total	181.37	348.76	358.29	368.28	378.78
23.	Sikkim					
a.	Normal Expenditure	17.84	18.73	19.67	20.65	21.68
b.	Grant	0.00	4.66	4.66	4.66	4.66
c.	Total	17.84	23.39	24.33	25.31	26.34

S.No.	State	2005-06	2006-07	2007-08	2008-09	2009-10
24.	Tamil Nadu					
a.	Normal Expenditure	474.06	497.77	522.66	548.79	576.23
b.	Grant	0.00	303.60	303.60	303.60	303.60
c.	Total	474.06	801.37	826.26	852.39	879.83
25.	Tripura					
a.	Normal Expenditure	40.04	42.04	44.14	46.35	48.66
b.	Grant	0.00	15.37	15.37	15.37	15.37
c.	Total	40.04	57.41	59.51	61.72	64.03
26.	Uttar Pradesh					
a.	Normal Expenditure	555.23	582.99	612.14	642.75	674.89
b.	Grant	0.00	600.79	600.79	600.79	600.79
c.	Total	555.23	1183.78	1212.93	1243.54	1275.68
27.	Uttarakhand					
a.	Normal Expenditure	46.11	48.41	50.83	53.37	56.04
b.	Grant	0.00	81.14	81.14	81.14	81.14
c.	Total	46.11	129.55	131.97	134.51	137.18
28.	West Bengal					
a.	Normal Expenditure	189.35	198.82	208.76	219.20	230.16
b.	Grant	0.00	103.23	103.23	103.23	103.23
c.	Total	189.35	302.05	311.99	322.43	333.39
Total Normal Expenditure		6417.66	6738.53	7075.46	7429.24	7800.69
Total Grant		0.00	3750.00	3750.00	3750.00	3750.00
Grand Total		6417.66	10488.53	10825.46	11179.24	11550.69

Note: 1) Grant referred to above are for major head 3054 – sub major heads 03 and 04 – non plan.

2) Normal expenditure referred to above is under major head 3054 – non plan.

Appendix-3

**System of Panchayati Raj Institution for
Execution of Rural Roads Construction and
Maintenance Works in Gujarat**

(Reference Para 16.4)

The panchayat raj system is functioning in Gujarat since 1961. Primary health, primary education, construction and maintenance of major district roads and rural roads and part of some activities of agriculture, animal husbandry, cooperation, etc. are entrusted to panchayat institutions. Construction and maintenance of major district roads and rural roads are entrusted to district panchayats.

For their construction and maintenance, 100 percent grant-in-aid is given by state government through Roads and Buildings Department. Grant for technical and non-technical staff of division and subdivision officers is also given to district panchayat by the state government. There is a dedicated Chief Engineer (Panchayat) in the State Roads and Building Department. A few Superintending Engineers (Panchayat) are posted in the field for monitoring and overseeing the works entrusted to Panchayat (R&B) Divisions.

In each district, one Panchayat (R&B) Division headed by an Executive Engineer is working. There are 145 Panchayat (R&B) sub-divisions headed by Deputy Executive Engineers. One sub-division is incharge of one or two talukas depending upon the geographic area and work load. The sub-division is efficiently working with the help of 3 sectional officers of Assistant Engineer/Additional Assistant Engineer level. The Executive Engineers, Deputy Executive Engineers and Assistant Engineers are deputed by the Roads and Buildings Departments to the District Panchayat for the construction and maintenance of MDRs and rural roads. This provides full technical support to the District Panchayats.

The District Development Officer is the administrative head of the District Panchayat. He is, therefore, the administrative head of the Executive Engineer, Panchayat (R&B) Division. The Executive Engineer (Panchayat) is responsible for technical matters relating to preparation of estimates, execution of works of construction and maintenance major district roads, rural roads and buildings. The technical powers are absolute with the Superintending Engineer and Chief Engineer who are working directly under the R&B department of the state government.

The powers for approval of technical sanctions, excess-saving with respect to technical sanctions and additional items of work not foreseen in the original sanction of estimates are delegated as per the PWD Manual at EE, SE and CE levels.

For any work, it has to be first included in the state budget. Administrative approvals to the works are accorded by the District Panchayat (Zilla Parishad).

Technical sanctions follow the administrative approvals. Thereafter, the Executive Engineer Panchayat (R&B) Division invites the tenders for new works or repairs. The tenders so received are scrutinized

and recommended for approval by the EE/SE/CE as per the delegation of powers. On the basis of detailed recommendations, the same are put up before the empowered District Panchayat Committee (Construction Committee/Standing Committee/General Body) for approval. After approval, necessary action is taken to award the work to the successful tenderer and works executed on ground. For any extension of time, the technical officers have to put up the case to the construction/standing committees of the District Panchayat who is empowered to decide the extension of time limit.

There is a two-tier system of quality control on Panchayat works. First tier is at the level of Deputy Executive Engineer/Executive Engineer who has to satisfy himself that the work is executed by the contractor as per specifications laid down for each item before recommending or approving the payment for that particular item. Then, there is second tier in the form of Independent Quality Control Units of the R&B Department. These units check all the works carried out by the District Panchayat.

The whole system is functioning satisfactorily. The technical officers of (R&B) Department keep transferring on deputation in District Panchayats. This brings to bear cross-fertilization of ideas and experiences on different categories of roads and nature of works. The Design Cell of the (R&B) Department is responsible for bridges and design of roads. The work of testing of quality is carried out with the support of Gujarat Engineering Research Institute located in Vadodara.

INDICATIVE TRAINING MODULES

(Reference Para 18.8)

1. For Government Engineers

While working out the capacity building and training needs for the technical personnel engaged in rural road development works, it is necessary to consider separate training modules for the Senior Rural Road Engineer (EE, SE, CE) and Junior-level-Engineers (AE, JE, Field Supervisors), as under:

- (i) For Senior-level Engineers, a short-term training course of one week duration to be arranged by a training institution like NITHE, covering the following topics is proposed:
 - Policy issues
 - Core network plans
 - Project preparation
 - Geometric design and safety elements
 - Design of pavements and CD works
 - Construction management and contract administration
 - Management of social and environmental aspects
 - Maintenance planning and management system
- (ii) For Junior-level Engineers and Field Supervisors, it is considered necessary to provide on the job training in the field with a few classroom presentations. Full-scale field demonstrations need to be arranged on pilot projects covering the following:
 - Field surveys and investigations, including soil/material surveys, traffic counts, hydrological surveys, etc. needed in the preparation of DPR.
 - Pilot projects demonstrating best practices in construction and quality control for the common construction techniques including soil stabilization and surface dressing.
 - Pilot projects on maintenance of sealed and unsealed roads.

It is also considered necessary to make available to the Junior Engineers/Field Supervisors, illustrated handouts on each of the construction techniques commonly adopted for rural roads. Similarly, a comprehensive Rural Road Maintenance Manual needs to be made available to the junior-level technical personnel.

2. For Consultants / Quality Monitors

In India, the role of consultants in various low-volume rural road development activities has been rather limited. Being generally tuned to large highway projects, the consultants as well as Quality Monitors (NQM and SQM) need to be oriented to the problems specific to low volume rural roads. Orientation workshops may be arranged periodically covering the following topics:

- Policy issues
- Core network plans
- Project preparation
- Geometric design and safety elements
- Design of pavements and CD works
- Construction management and contract administration
- Management of social and environmental aspects
- Maintenance management system.

Also, it is necessary to make available to the consultants/QM the user-oriented manuals on planning, design, construction, drainage and maintenance of rural roads, besides the illustrated handouts on various construction techniques and maintenance tasks.

3. For Contractors

For capacity building of small contractors, it is considered necessary to arrange field demonstrations including video training films on:

- Construction and quality control for various construction techniques.
- Various maintenance tasks for both sealed and unsealed roads.

For the benefit of small contractors, it is also necessary to make available to them, illustrated handouts for each of the commonly adopted construction techniques and maintenance tasks for sealed as well as unsealed rural roads.

Later-on such local contractors would be in a position to take up performance based maintenance of rural roads as the main large units feel shy of taking up small maintenance works spread over large expanse in a district.

4. For Equipment/Plant Operators

It is common observation that the equipment/plant deployed for the construction and maintenance of rural roads can be quite different from those deployed on large highway projects. It is, therefore, necessary to train the equipment/plant operator in operating and maintaining small capacity/tractor-towed

equipment as well. Of special significance will be the intermediate technology developed for rural road works with an optimal man-machine mix, particularly for gravel/soil-aggregate road construction and maintenance. In view of the very limited educational background of equipment/plant operators, the following approach to training is proposed:

- Video training films on the operation and maintenance of different types of equipment/plant used in the construction and maintenance of rural roads.
- Field demonstration of operation and maintenance of equipment/plant used in rural road works.

5. For skilled, semi-skilled and unskilled workers

The important aspect of training ground-level workers in construction and maintenance of roads and cross drainage works is often ignored. However, the quality of road works and cross-drainage works will depend, to a large extent, on the manner in which workers in the field have accomplished the various tasks. In view of their very limited educational background, the ground level workers can best be trained by showing specially prepared video training films on various construction techniques and maintenance tasks. Such an approach has been successfully adopted in several countries in Asia and Africa. The video training films focus on such aspects of construction and maintenance that need special emphasis. Also, the various 'Do's' and 'Don'ts' can be effectively brought out in these films. Such training films need to be dubbed in the local language of the region, also bringing out extra care to be taken on special problems associated with the region. The topics of various video training films should include the following:

- Excavation, spreading, watering, mixing, compaction and curing
- GSB construction
- Lime/cement stabilization soil construction
- WBM construction
- WMM construction
- Providing gravel base and surfacing
- Culverts and causeways
- Surface dressing
- Premix carpet
- Maintenance of sealed/unsealed roads and CD works.

This can be followed by paid on-job training by attachment of these workers to construction contractors for a period of three to four months and certificate of competency awarded after satisfactory completion of field training. The ITIs and Polytechnics can be identified in the states for imparting of training to the construction workers. They can tie up with the construction contractors with the help of rural engineering organisations of the state governments.



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