

April 2019



DISCUSSION PAPER

RURAL ROADS AND THE SDGs

S Vijay Kumar



THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions for a Sustainable Future

© COPYRIGHT

The material in this publication is copyrighted. Content from this discussion paper may be used for non-commercial purposes, provided it is attributed to the source. Enquiries concerning reproduction should be sent to the address: The Energy and Resources Institute (TERI) Darbari Seth Block, India Habitat Centre, Lodhi Road, New Delhi – 110 003, India
The Energy and Resources Institute, Darbari Seth Block, India Habitat Centre, Lodhi Road, New Delhi – 110 003, India

Author

S Vijay Kumar Distinguished Fellow, TERI

Internal Review

Mr Amit Kumar, Senior Director, Social Transformation Division, TERI

External Review

Stakeholder Round Table with policymakers, researchers, and practitioners was conducted on the basis of the draft Paper to better understand the nature of the impacts and the feasibility of the recommendations.

ABOUT THE AUTHOR

S Vijay Kumar was earlier Director-General, National Rural Roads Development Agency (2002-05) and Secretary Ministry of Rural Development, Government of India (2012-13). In TERI he works on issues concerning resources and rural development, and heads the cross-cutting initiative on policy coordination and the SDGs.

SUGGESTED FORMAT FOR CITATION

Vijay Kumar S. (2019). Rural Roads and the SDGs. TERI Discussion Paper (New Delhi: The Energy and Resources Institute)

Editorial and design

Anushree Tiwari Sharma, Raman Jha, and Vijay Nipane, TERI Press

PUBLISHED BY

The Energy and Resources Institute (TERI)

FOR MORE INFORMATION

Sustainable Habitat Division, TERI, Darbari Seth Block
IHC Complex, Lodhi Road, New Delhi 110 003, India
Tel.: +91 11 2468 2100 or 2468 2111 | Fax: +91 11 2468 2144 or 2468 2145
Email: pmc@teri.res.in | Web: www.teriin.org

TABLE OF CONTENTS

Rural Roads and the SDGs: Summary	5
Introduction	7
Rural Roads and SDGs	9
Recommendations	21
Appendix: The Sustainable Development Goals	24
References	25

RURAL ROADS AND THE SDGs: MAY BE SIMPLE FOR ENGINEERING BUT DEFINITELY BIG ON POTENTIAL

Summary

Rural Roads are proven poverty reducers by providing access to basic services, reducing vulnerabilities and providing opportunities. The actual paths and mechanisms linking rural road development to enhancements in incomes and reduction in poverty are often complex and necessarily location-and-context specific. Improved roads and infrastructure can help reduce poverty by expanding earnings opportunities through easier access to markets and technology. The poor, like the others may benefit from these changes; but greater commercialization, rising land values, and shifts in growth across local farm and non-farm sectors may also hamper economic opportunities for very poor households, particularly where the initial level of social development is low.

Rural roads do not, of course, reduce poverty on their own. Rural roads can and do, catalyse and synergise complementary enabling and supportive policies and strategies, across a whole range of sectors. For best outcomes, these need to be devised and tailored to the situation of each area, its resources and infrastructure keeping also in view specific issues of gender and socio-economic segmentation. These complementary policies would need address issues of access to credit, raw materials, marketing services, skills, training, and open up opportunities closer to villages. Rural roads would, by improving local mobility, facilitate greater community participation and building of social capital, catalyzing latent entrepreneurship. It is an instinctive understanding of this potential that created the Pradhan Mantri Gram Sadak Yojana (PMGSY) programme¹ in the year 2000, to construct new all-weather rural roads to some 1.78 lakh unconnected villages; the world's largest rural road construction project, and still easily the most popular government programme in India.

This Paper attempts to use the SDGs as an analytical framework to understand the role and potential of the rural road network. Rural roads and the complementary policies and strategies in fact have impacts not only on poverty, but on many other socio-economic and human development indicators, and almost all of the SDGs. Most of the impacts are positive, and even those with negative consequences can be managed for reducing adverse impacts.

Over the last decade and more, huge investments have been made in rural road construction all over the country. This is an opportunity to leverage rural roads to their full potential for the achievement of the SDGs. The analysis in this Paper indicates that in the rural areas of India, not only must those responsible for achieving each SDG leverage the potential of the road connectivity for the purpose at strategy and implementational stages, but the authorities responsible for rural roads must make institutional, policy and management improvements in order to ensure that rural roads have the best potential for the purpose. In particular this would require the creation of coordination mechanisms like "State Road and Transport Development Boards" and regulatory systems like a "Rural Roads Management Act", as well as rational asset management strategies for the entire road network.

1. Some of the material is based on a contribution of the author to an earlier World Bank study of the PMGSY programme.

INTRODUCTION

As the Prime Minister rightly said at the UN Session adopting the Sustainable Development Goals (SDGs) in September 2015:

"Today, much of India's development agenda is mirrored in the Sustainable Development Goals.... Our attack on poverty today includes expanded conventional schemes of development, but we have also launched a new era of inclusion and empowerment..."

.....We are focusing on the basics: housing, power, water and sanitation for all...

.....Our development is intrinsically linked to empowerment of women and it begins with a massive programme on educating the girl child that has become every family's mission.....

...We are making our farms more productive and better connected to markets; and, farmers less vulnerable to the whims of nature....

..... We are reviving our manufacturing, improving our services sector, investing on an unprecedented scale in infrastructure; and, making our cities smart, sustainable and engines of progress..."

The list of the 17 Sustainable Development Goals is given in the Appendix. The challenge is not only achieving the goals themselves, but being able to address the 3 dimensions (social, economic and environmental) in an integrated way. The challenge is to understand the trade-offs in alternative strategies in a sector between the 3 dimensions, and the tradeoffs among the SDGs in a given strategy. The challenge is also to devise planning and governance systems that enable the right balance in an India-specific and State-specific context.

In the context of rural roads, there has been a long history of construction of village roads and paths as part of "employment generation" and "famine relief". However it is only in the last few decades that Indian planners realised that there is more potential in a road than in merely its construction, and actual existence of an access road can catalyse economic activity and create sustainable additional incomes; and that complementary

policies and strategies in fact have impacts not only on poverty, but potentially on many other socio-economic and human development indicators. It is the understanding of this potential that led to conceiving of a national rural roads programme: the Pradhan Mantri Gram Sadak Yojana (PMGSY) in the year 2000, a centrally funded, state managed, technically sound project to construct new all-weather rural roads to some 1.78 lakh unconnected villages. With over 5.58 lakh km of single-lane roads constructed in the 17 years since inception, it is the world's largest rural road construction project, and still easily the most popular government programme in India.

The Indian road network

India has a road network of over 5,603,293 kilometres as on 31 March 2016, the second largest road network in the world. At 1.70 km of roads per square kilometre of land, the quantitative density of India's road network is higher than that of Japan (0.91) and the United States (0.67), and far higher than that of China (0.46), Brazil (0.18) or Russia (0.08). However averages can be misleading as in the other cases population densities vary widely.

Qualitatively India's roads are a mix of modern highways and narrow, unpaved roads, and are being improved. As on 31 March 2016, 62.5% of Indian roads were paved.

What is presented below is an attempt to map the rural road sector activity onto the SDGs and the targets thereunder, both for positive and negative impacts. The mapping is attempted within a national context, with reference to national policies, strategies and programmes in the various sectors. The analysis indicates that mapping policies and programmes complementary to the rural roads network using an SDG framework can yield rich insights, probably far superior to analyzing individual SDG goals in the abstract. It yields insights not only as to how individual SDGs can be better implemented leveraging the connectivity provided by the rural road, but also how the rural road network can be more optimally managed

to improve their potential to facilitate the achievement of the SDG. A similar exercise conducted at State level will definitely yield further insights for policy planning purposes, and an analysis at District level using the SDG framework can be a tool to help ensure that investments in support of the various SDGs are indeed optimized.

Road classification	Authority responsible	Length (km)	Share of network length
National Highways	Ministry of Road Transport and Highways	101,011	1.80 %
State Highways	Public Works Department of State/Union Territory	176,166	3.14 %
Major District Roads	Public Works Department (PWD) of State/UT	561,940	10.03 %
Rural roads	Rural Works Deptt/PWD/Panchayats	3,935,337	70.23 %
Urban roads	Municipalities /PWD	509,730	9.10 %
Project roads	Various State Govts/PSUs/BRO	319,109	5.70 %
Total	---	5,603,293	100 %

RURAL ROADS AND SDGs



Reduce Poverty in all its forms everywhere:

Rural Roads are proven poverty reducers by providing access to basic services, reducing vulnerabilities, increasing resilience and providing opportunities. The actual paths and mechanisms linking rural road development to enhancements in incomes and reduction in poverty are often complex and necessarily location-and-context specific. Improved roads and infrastructure can help reduce poverty by lowering transport and other input costs and expand earnings opportunities through easier access to markets and technology. The poor, like the others may benefit from these changes; but greater commercialization, rising land values, and shifts in growth across local farm and non-farm sectors may hamper economic opportunities for very poor households, particularly where the initial level of social development is low. The very poorest households may not be able to capture the cost and productivity benefits of the road project quickly enough. In remote tribal areas with the poorest sections of the population, the majority, closely dependent on the natural resource base of forests and rivers for food, the impacts of a road may in fact be negatively impacted in terms of preservation of their resource base. In less remote areas, households above the “poorest of the poor” (in terms of per capita food expenditure) may be quicker to experience positive gains with increase in mobility in terms of broadening or changing sectors of activity away from agriculture and toward non-farm work.

Because the poorest people may not have the resources to travel to, or afford, the newly accessible markets and services, rural roads are likely to result in overall poverty reduction but not necessarily in poverty eradication and socio-economic equity. Rural roads programmes need to be integrated with other pro-poor measures to increase equity and minimise the potential for negative socio-economic and cultural effects of opening roads



on some rural women, men and children. These policies would need address issues of access to credit, raw materials, marketing services, skills, training, and open up opportunities closer to villages and facilitate greater community participation and building of social capital, catalyzing latent entrepreneurship.

Another important issue is that the transport sector seldom fully appreciates its role in terms of poverty alleviation, and so national, sub-national and local Governments will not only need to have very clear, pro-poor policies if the rural poor are to gain significantly from the potential employment benefits of rural road construction and maintenance, but will need to leverage the potential of the transport sector for the purpose.

An important concomitant issue for poverty reduction is that the roads constructed should be properly maintained. It is the continued existence of the road rather than its construction that has the potential for poverty reduction. This requires that the community has ‘ownership’ for the connectivity right from road alignment and design onwards and is empowered to ensure adequate maintenance of the road and perhaps even to facilitate transportation services. Needless to say, road management authorities need to ensure resources are allocated not only for the construction but also the maintenance of rural roads.



End hunger, achieve food security and improved nutrition and promote sustainable agriculture:

Rural Roads enable flow of agricultural inputs and credit, extension and new technologies, enable efficient and less costly movement of farm produce to markets and

end-users, reduce agriculture waste and spoilage and facilitate agro-processing. The road reduces the cost of delivered inputs, including resources and agricultural extension services as well as the cost of transporting agricultural products to markets, by reducing vehicle operating costs and allowing economies of scale and improving the quality, regularity and reliability of the service. All this extends the radius of potential markets. This results in more intensive cultivation using better technologies and inputs specially fertilizers, and increased production of cash crops, changes in the agricultural output mix in favour of more high productivity, high-value crops including perishable fruits and vegetables, marked growth in off-farm processing-related employment opportunities, and reduction in packaging costs and spoilage of perishable produce. The ultimate effect is increased farm incomes.

All-weather road access not only increases income from farming activities, but also makes prices more stable and thus enables the poorer farmers to take more risky but profitable decisions regarding inputs, technology, production patterns and marketing strategies, even when conditions are more risky due to say, climate variability.

An all-weather well maintained rural road results in elimination of interruptions due to frequent road closures during rainy seasons and in reduction, often substantial, in vehicle operating costs (VoCs). This leads to investment in better quality and higher capacity vehicles which further reduce transportation costs. In turn, this impacts on input costs in agriculture.

In many areas provided rural road connectivity, subject to agro-climatic conditions, there is a gradual shift in cropping patterns to cash crops, or crops with potential for higher market realisation or value addition. In many areas, incomes are higher than previously ; but notably, as yet not more regular than before, because not all supporting infrastructural services are in position. In many areas, these gains in income were realized mostly through direct movements; complementary action, in the form of both private investment and public intervention, is still variable and lagging, and needs immediate attention .

Rural roads can improve the *Aanganwadi*¹ supply chain infrastructure in remote and under-served areas to

¹ Meaning "courtyard" Aanganwadis are rural childcare services started in 1975 as part of the ICDS programme to combat child hunger and malnutrition. The centres are run by Aangan Wadi Workers (AWW).



ensure that all children receive proper and regular food supplementation, their growth is continuously monitored, and corrective action taken in case of high morbidity and poor health outcomes. Food supplementation programmes like Supplementary Nutrition Programme (SNP)² under the Integrated Child Development Programme (ICDS)³, Mid Day Meal Programme (MDM)⁴ for school children and Public Distribution System (PDS)⁵ can also be strengthened with the assistance of the rural road network. Rural roads can improve access to Fair Price Shops (FPS) for the most vulnerable sections of the rural population particularly those in remote areas.

Rural roads are particularly important in mitigation and adaptation strategies in areas with high rural populations. Rural roads facilitate adaptation to climate change impacts on agriculture such as droughts, and improve the potential for food security by facilitating extension work for adaptive agriculture, and provision of new seed varieties and inputs and related package of practices. They also facilitate easier access to health and nutritional services for animal populations (particularly because of

² The programme is for children below 6 years of age, pregnant women and lactating mothers and is organised at the Aanganwadi.

³ Under the ICDS, food , preschool education, and primary healthcare is provided to children below 6 years of age and to their mothers. In addition to the designed outcomes, the programme has been successful in reducing gender disparities in children.

⁴ The MDM scheme is a school meal programme to provide free lunch (preferably a hot meal) in the school premises to children in primary and upper primary classes. It has increased enrollment and retention in schools particularly of the girl child.

⁵ Under the PDS subsidized foodgrains, sugar and kerosene are supplied to families below the official poverty line. The scheme has been used to address micronutrient deficiency by selling "fortified flour" and "fortified salt" etc.

higher temperatures, possible water quality deterioration, and new pathogens).

At the same time, rural roads may add to climate change impacts on agriculture unless properly managed. Higher waterlogging is likely to take place in many areas subject to high intensity of precipitation and a “ponding” effect of the rural road embankment. In some areas rise in water table may increase salinity as well. Proper planning of the alignment and full consultation with the local community particularly on the likely impact of extreme events is important to minimize such adverse impacts.



Ensure healthy lives and promote well-being for all at all ages:

Rural Roads allow quicker and easier access to primary health care, improve doctor attendance and service quality in public health institutions, and enable access to specialised health care. Constructing and maintaining rural roads, paths and bridges can lead to dramatically improved maternal health outcomes and healthier rural communities. Reducing the cost and time to reach health centres through improved transport also contributes to an increase in timely access of the poor to health care. While rural roads would certainly improve access to health care (preventive, such as immunization, as well as curative), poorer members of the communities might not benefit unless transport fares are waived, or the service is provided as a free public service for them.

The construction of an all-weather rural road has many other positive health outcomes:

- Increasing the efficiency for enrolling, training and deploying local human resource, particularly para-medical professionals including Accredited Social Health Activists (ASHAs)¹ and Auxiliary Nurse Midwives (ANMs).²

¹ ASHAs are community health workers engaged under the National Rural Health Mission to facilitate immunization, institutional deliveries and sanitation, etc., ASHAs support ANMs and AWWs.

² ANMs work at health Sub-centres of the Primary Health Centres (PHC) and render services relating to maternal and child health, family planning, health and nutrition education, immunization, emergency health care and home delivery.

- Rural roads can help in improving the nutritional status and habits across all age groups. Rural roads improve the delivery of food fortification and micronutrient supplementation, e.g. double fortification of salt with iron and iodine .
- Rural roads ensure a more decentralized system of public health management linked to local governance mechanisms such as the panchayats .
- Home-based essential new-born care/counselling and services on reproductive health by Accredited Social Health Activists (ASHAs), ANMs and Anganwadi Workers becomes easier with a road network. The Janani Suraksha Yojana (JSY) of institutionalised delivery for reducing maternal and neo-natal mortality among the poor pregnant women, including SC/ST/BPL families and the PM Surakshit Matritva Abhiyan (PMSMA)³ is also facilitated.

It is also possible that rural roads, particularly those used to transport quarry material and the like may be a source of dust and noise pollution for villages located on the alignment. Abatement measures need to be incorporated at planning stage in case alternative alignments are not possible.

Clearly, to maximise positive outcomes and to address potential negative impacts, the road network needs to be an essential planning layer for ensuring the realisation of the positive outcomes.



Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Improved access to education and increased rural/urban interaction due to the improved travel facilities is one of the outcomes generally seen as a consequence to the provision of road connectivity. Rural roads can lead to higher school enrollment for boys and girls by reducing the travel time between home and school. Enrolment from disadvantaged groups (including socio-economically backward sections, minorities and girls) tend to increase

³ PMSMA aims at reducing maternal and infant mortality. The programmes include ante-natal care of expectant mothers and special check-up by specialists during 2nd /3rd trimester.

significantly, as do enrolment from other groups. Much actually depends on how transportation services grow along the road. A good quality road can induce public policies in support, such as in Bihar that provided bicycles to girls continuing to secondary school, and found a 30 percent gain in enrollment.

Rural roads determine how many rural boys and girls go to primary and secondary schools and how adequately the schools are staffed. Rural roads greatly influence where new schools are built, and while primary schools are within walking distances of their catchment communities, secondary schools are more spaced out, requiring much longer average journeys. Optimal siting of schools and facilitating some kind of public transportation services can have very positive outcomes on enrollment and attendance.

It is not the road but the improvement in personal transportation which improves enrollment and attendance. Complementary policies to provide bicycles or facilitate public transportation services are crucial. Medium distance transport problems cause absences of even teachers from work for several days each month as teachers travelled long distances (by bicycle etc) to collect their salaries from Block HQ or other administrative centre. The lack of transport services also make it difficult to keep rural teachers at their posts, as they are constantly seeking transfer to better connected stations. Rural roads and associated transportation makes it easier to recruit and post and retain teachers in remoter rural areas. The effect of road access on teachers' attendance (since they may stay at a distance) in middle and senior schools



are also substantial. In fact better qualified teachers are willing to work in areas now served by roads, leading to an improvement in the quality of the service.

Some basic requirements of a functional school, better quality of teacher, punctuality and regularity of teachers, effective liaison with parents and community can be better ensured with a road network. Often schools in remote and inaccessible areas are filled by freshly appointed teachers, and the turnover rate is also high. Correcting the imbalances in rural-urban deployment and remote-close deployment is greatly facilitated by a good road network. In one sense, for a given local road network, planning needs to optimise between providing transport services and opening more schools. In remote and sparsely populated areas, the road network allows for a better optimisation.

On the other hand, greater access brought about by roads may open up greater labor market opportunities for children, raising the opportunity cost of schooling, and potentially causing them to drop out. In areas within easy reach of small towns, teenagers have been found to have dropped out of school and start working as access to labor market opportunities expanded.



Achieve gender equality and empower all women and girls

There is a widespread perception that while men have benefited in terms of seizing opportunities outside the village arising as a result of improved road connectivity and consequent mobility, the women, often less educated, or with less developed skill sets have not gained equally and have possibly been forced to engage more heavily in the village economy. Clearly, there is a need for better targeting of women and weaker sections of society to spread the benefits of rural connectivity further and deepen the impact. Development of complementary policies to increase productive endowments, especially skills and improving access to new opportunities arising from the road construction are clearly necessary.

In areas where Women Self Help Groups (SHGs) are emerging as a major force for change, supported by the

govt's "Aajeevika"⁴ programme, rural road connectivity can improve their vibrancy, increase their access to credit and help them to federate into area-based organisations and thus better participate in developmental processes. Producer Groups formed out of SHGs benefit in terms of easier access to raw materials and supplies, better access to markets and market related information, better process etc.

There are multiple social benefits as well. Social capital effects are possible to the extent that the road makes it easier to maintain networks of contacts facilitate their access to information and increase their political and social participation. Better social networking and improved connectivity (road as well as telecom) can improve the "radius for marriage alliances" as well as provide better family support to newlywed girls in rural areas. And as already mentioned in another context, rural roads not only increase school enrollment of young girls, they enable them to attend middle and secondary schools at a distance; and in many cases this enables girls with education to seek employment in nearby larger villages and urbanising areas. Needless to say, it is the transportation facilitation function that actually delivers these outcomes and public policies must address this issue to ensure positive outcomes.

In fact just as the rural road is an SDG enabler, the SHG network is also emerging as an SDG enabler, for instance by mobilizing communities in favour of education, healthcare, sanitation and nutrition, and re-forming as producer companies or as service-providing micro-enterprises for mid-day meals, rural transport services⁵ and even as MKSP⁶ Groups to promote farming of leased-in agricultural plots, organic agriculture, medicinal plants, and collection and processing of minor and non-timber

⁴ The Deendayal Antodaya Yojana-National Rural Livelihoods Mission(DAY-NRLM) , known as "Aajeevika" aims at ensuring that the poor find sustainable livelihood support by creating institutional platforms that enable them to access knowledge, skills, services and finances to increase household incomes. The Self-Help Group (SHG) is the basic organisational unit for the poor to come together for mutual support and reinforcement.

⁵ A new sub-scheme named "Aajeevika Grameen Express Yojana (AGEY)" as part of the DAY-NRLM has been started recently to encourage Self Help Groups under DAY-NRLM to operate road transport service in backward areas.

⁶ Mahila Kisan Sashaktikaran Pariyojana (women farmer empowerment scheme)

forest produce. The rural road is thus not only an "enabler" of SDGs, but also an enabler of other enablers.



Ensure availability and sustainable management of water and sanitation for all:

Safe Drinking Water : Rural roads are particularly useful in the execution of strategies to provide safe drinking water to all, particularly poor and vulnerable and remoter areas through better technical and administrative support since the roads better enable:

- Better focus on disadvantaged sections
- Operation and Maintenance
- Water Quality monitoring
- Sustainable management and Community Participation:

Planning support strategies based on the road network can enable laying down and enforcement of service standards in more reliable and cost effective ways.

Sanitation: Rural roads not only facilitate better focus on disadvantaged sections as well as Operation & Maintenance of sanitation services, but also the skilling, raw materials supply and product delivery processes of the Nirmiti Kendras (Production Centres and Rural Sanitary Marts) for the Swachh Bharat Mission⁷, which enables cost-effective coverage of remote rural areas.



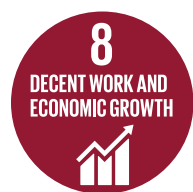
Ensure access to affordable, reliable, sustainable and modern energy for all:

Improving and extending access to energy services is one of the most urgent tasks that lies ahead since large sections of the rural population in the country still has poor access to electricity, and more than one-half rely on traditional biomass as their principal household fuel. The Rural Electrification Program (Rajiv Gandhi Grameen Vidyutikaran Yojana or RGGVY and its successor programme, the Deen Dayal Upadhyaya Gram Jyoti

⁷ Swachh Bharat Mission is a nation-wide programme to improve sanitation and hygiene. The objectives include eliminating open defecation, building household and community toilets, managing human waste and improving cleanliness in urban areas and community spaces.

Yojana or DDUGJY⁸) which aims primarily to help provide lighting solutions has led to an increase in consumption of electricity across all income classes, but much less so for the low income households. The efficiency of the distribution system and issues relating to the quality of the supply (and consequently the willingness to pay), crucially depends on the existence of all-weather road connectivity to ensure maintenance of supply lines and local transformers and managing the metering system. The “last mile” issue is also crucial in many areas still off-grid, where solar based lighting solutions through local mini-grids are constrained by barriers to physical access in the absence of a road or an accessible path.

Energy supply for cooking presents more challenges than for lighting. The Rajiv Gandhi Grameen LPG Vitaran Yojana (RGGLVY) –and its successor scheme the Pradhan Mantri Ujjwala Yojana (PMUY), aims to increase rural access to LPG through improvement in the supply chain and subsidized LPG for the poor. In order to address the issue of last mile reach of LPG in remote and difficult areas, an “LPG Suidha Kendra facility” will be created for local storage in outlying areas for improving delivery of services. Clearly the supply chain management is a crucial component of the initiative, and rural roads can help in ensuring reliability of the supply, which is an important consideration to the consumer, and in reducing the cost of transportation and storage which is important in improving the viability and sustainability of the programme.



Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

It is well understood that poor transportation infrastructure is an important barrier to the reallocation of labour out of agriculture and entrance into wage labour markets. The majority of self-employment and informality is in the agricultural sector. Once a community is provided a better road connection, households can experience income growth from both farm and non-farm sectors

⁸ The major components of DDUGJY are feeder separation; strengthening of sub-transmission and distribution network; metering at all levels (input points, feeders and distribution transformers); micro-grid and off-grid distribution network and rural electrification. The RGGVY focused mainly on rural electrification.

over time in multiple ways. The improvement of access to road and transport services will increase rural households’ socio-economic status in many ways:

- Less time is needed to be spent on commuting and so more time can be spent on work to earn wages or incomes.
- Enhanced labour mobility will increase job opportunities, and at better wages, more suitable for the skills possessed.
- The road connectivity can result in lower prices for freight and passenger services. This will lead to lower prices for products and consumer goods, higher personal mobility, and a general higher level of socioeconomic activities.
- Road improvements and better transport services will reduce inputs costs as well as transportation costs of bringing farm products to the market and increase the price realisations and farmers’ incomes.

Given the limitations of the natural resource base in agriculture, particularly in rain-fed and dryland areas, there is a need to diversify livelihood opportunities and create conditions that facilitate investment and technology flows into rural areas in the non-farm sector and enable the skilling of rural populations for taking advantage of new opportunities in production, transportation and marketing. Rural roads can facilitate these trends and connect rural production centres reliably and at more economic cost to urban areas. *Per contra*, rural roads are the natural pathways through which the investment and technology flows can conveniently be facilitated through supporting policies and strategies.





Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Rural roads, like other infrastructure are subject to various adverse impacts. In the case of roads, the transportation impact, impact of activities of the surrounding populations and impacts of climate change are the three most pronounced impacts. Climate change related extreme events such as floods, heavy rains, and storms may damage the road, shoulders and drains and even wash away the entire road, with loss of scarce road building materials. While increasing the embankment height may protect the road surface during floods, it may increase the duration of the ponding effect, further reducing the subgrade strength. Increasing the resilience of rural roads to flooding and extreme precipitation events may need multiple strategies including: planning for higher drainage requirements and better incorporation of natural drainage patterns in the area in the drainage plan for the road; considering overall inundation period as a design parameter for designing roads in flood prone areas.; tree plantation programmes along road alignments.; and R&D on use of locally available materials for use in areas where beyond a point it may not be economically feasible to preserve the roads against frequent extreme events.

Needless to say, rural roads are “lifelines “ in times of natural calamities and extreme events , to provide food and water and medical assistance and to improve the coping capacity of local communities. Disaster management strategies need to build responses keeping in view the availability and robustness of the rural roads network, and indeed, ensure strengthening of those segments that are essential for disaster response in highly vulnerable areas.



Reduce inequality within and among countries

While rural roads undoubtedly benefit impoverished communities and poor individuals, the greatest benefits of rural roads will go to those with the resources to invest in

the new opportunities available. Better transport reduces absolute poverty through lowering costs and increasing opportunities, but it may not significantly reduce income disparities and may in fact be increasing it. The major gainers in terms of improved prices and economic opportunities are generally those rural communities who are closer to the larger towns or markets, and the better off sections within these communities benefit more. The poor do benefit greatly from investments in rural roads and transportation services thereon (particularly longer rural roads) but the benefits are not sufficient to reduce the relative inequalities.

There is also a decline in traditional markets and occupations where the roads improved access to urban markets, and traditional goods and even some services may be substituted by other goods or mechanized services (such as kitchen utility items and washing machines) . Remoter, poorer communities may benefit substantially only if there is a local resource endowment that can be leveraged for income by using the new road connectivity. As a general strategy transport interventions are unlikely, on their own, to resolve the chronic problems of the poorest people, who may even be relatively marginalised by the changing economic circumstances. Roads reduce poverty and provide economic opportunities, but poverty elimination needs to be addressed in parallel through multiple strategies along with road investments. Some of these interventions are of course addressed through the SDGs.



Make cities and human settlements inclusive, safe, resilient and sustainable

Transport was not part of the Millennium Development Goals (MDGs) and as a result national and State level policies may not have fully developed the potential strong linkage between transport and economic development to advance the attainment of the MDGs. The SDGs in contrast comprise 17 goals and 169 targets; five of those targets directly involve transport, and achieving at least another six depend on it:

- *Target 3.6.* By 2020, halve the number of global deaths and injuries from road traffic accidents.
- *Target 7.3.* By 2030, double the global rate of improvement in energy efficiency.

- *Target 9.1.* Develop quality, reliable, sustainable, and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
- *Target 11.2.* By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities, and older persons.
- *Target 12.c.* Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.

But transport is also a critical enabler of achievement in other sectors' targets, such as agricultural productivity (Target 2.1), air pollution (3.9), access to safe drinking water (6.1.), sustainable cities (11.6), reduction of food loss (12.3), and climate change adaptation and mitigation (13.1).

Data from the Census of India shows that villages with population of less than 1,000 have sharply declined across almost all States and the number of villages with population of above 10,000 has risen. Though the perception is that there is a constant migration from rural to urban areas, currently the actual migration pattern is roughly as follows:

- 57 percent rural-rural,
- 22 percent rural-urban,



- 6 percent urban-rural, and
- 15 percent urban-urban

As more rural areas are now connected with all-weather roads and transportation services, overlaid with telecom connectivity, people can stay in a larger village even if it is further away from their agricultural land, and enjoy the benefits of more modern amenities, pucca houses, better transportation options etc. Concomitantly, there is a gradual rise of occupations based on non-agricultural income in these villages which because of their non-agricultural character are called "Census Towns", even though their governance continues to be Panchayat based. Spatial Plans to manage the future urbanisation and densification and to reflect the state government's economic, infrastructure and social development priorities and resource allocations is an urgent necessity. The purpose must be to bring in material resource and energy efficiency, facilitate poverty reduction and improve the sustainability of developmental processes.

It is also widely assumed that if there are good roads, market forces will lead to transport demand being met by private transport operators. Rural people also need public transport services to access markets, services and socio-economic opportunities, and the nature of services required often do not fit in neatly with the transportation solutions covered by national and State regulations. People travelling on rural transport services often need to carry heavy or bulky freight. As a result, most rural transport services are 'mixed', with passengers and small freight, in light trucks, mini buses or buses. Such mixed passenger-freight transport services are extremely important for poor people. More affluent people may have sufficient loads to use freight vehicles, but the poorer people need to transport their goods using 'mixed' passenger transport. Local transport planning must factor in this pattern to ensure optimum use by the poor of the road connectivity. Often operator margins are very low on roads in poor condition and where there is low transport demand. Operators respond by charging higher prices per passenger-kilometre, using very old vehicles, providing irregular services (waiting for a full load) and/or overloading vehicles. This severely discourages rural travel particularly rural women or older or poorer people; encouraging use of the road may need to also involve targeted subsidies to disadvantaged or weaker sections. Public transportation policies need to provide for local

variations based on local conditions and remoteness and population densities as well as the paying capacity.

The importance of addressing the transportation issue is already being realized. A new sub-scheme named “Aajeevika Grameen Express Yojana (AGEY)” as part of the National Rural Livelihoods Mission (DAY-NRLM) has been started recently. The SHG members are provided concessional finance to operate road transport service in backward areas. This will help to provide safe, affordable and community monitored rural transport services to connect remote villages with key services and amenities (such as access to markets, education and health) for the overall economic development of backward rural areas. This initiative is all the more important in States where for a variety of reasons, the State Transport Corporations are winding up or curtailing operations.



Ensure sustainable consumption and production patterns

Roads require substantial materials for their construction. While local paths and tracks often comprise of *in-situ* material compacted to acceptable standards and supplemented with other locally available materials, engineered roads where traffic is likely to be substantial require standardised material conforming to certain specifications. Crushed aggregates, sand, gravel, chips, bitumen etc are all required in substantial quantities. Water and energy are other inputs into the road making process. As such construction of engineered roads is quite materials and energy intensive, and substantial economies are possible by appropriately designing the roads using locally available materials or marginal materials not strictly conforming to classical specifications. Rural roads, because they bear less traffic and so have wider tolerances, are well suited to such innovative initiatives. A governance framework to fund such initiatives, including R&D for the process, is required in all States.

There is an urgent need for focused research on the energy and material use in rural road construction in order to promote cost-effectiveness as well as use-efficiency. 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. Some of the more important thrust areas for R&D work requiring immediate attention are:

- Evolving appropriate technologies for the construction and maintenance of low volume rural roads, both sealed and unsealed pavements
- Evolving low cost drainage and erosion control measures for low volume roads
- Identification of sources of locally available materials and waste materials (such as fly ash, mining waste, plastic waste not usable in other ways etc) 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.
- 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.

While the sustainability of construction practices for roads is in itself an important issue, the extent to which rural roads further the goal of sustainable production and consumption also needs detailed consideration. In principle, roads can help balance gaps between supply and demand; improve “circularity” of material flows; and reduce waste. Not only must public policies and regulatory systems be aligned in this direction, but private sector investments which may actually drive many



of these process must also be aligned to take advantage of the opportunities offered by the opening up of the rural hinterland, not merely as a new market but also as a segment for purposes of a distinct business process for promoting sustainable production and consumption patterns including more circularity.



Take urgent action to combat climate change and its impacts

Poor rural households are highly vulnerable to climate change impacts, having to cope with both domestic and production risks. Domestic shocks and stresses impact seriously on people's productive capacity as valuable assets are sold and money used to meet shocks such as ill-health or natural disasters. Drought, floods, pests, diseases and the market fluctuations are the main sources of production risks. Poor people's risk management strategies often trap them in low risk/low return activities, which restrict them from aiming for high growth, and this prevents them from building assets that can reduce their vulnerability in the long-term. All-weather good quality rural roads expand opportunities for livelihoods and reduce risks in multiple ways. In order for the roads to deliver on this characteristic, it is necessary that the roads themselves are resilient to climate change impacts, and also that the construction of the roads have as little adverse impacts as possible in terms of carbon footprint.

Keeping in view its development agenda, particularly the eradication of poverty coupled with its commitment to following the low carbon path to progress, India, in October 2015, declared its Intended Nationally Determined Contributions (INDC) for combating climate change, which in relation to the roads sector includes:

- Reducing emissions from the transportation sector.
- Promoting energy efficiency in the economy, notably in industry, transportation, buildings and appliances; and
- A Green Highways (Plantation & Maintenance) Policy to develop a 140,000 km long "tree-line" with plantation along both sides of national highways.

Rural road construction involves generation of GHGs at many points in the process, both on-site and off-site. There



is a need to develop an indicator of the carbon footprint of rural roads, and to develop policies and strategies to minimise the footprint and to "green" the process of road development. These measures need to be integrated with the INDC as part of the process of mitigating climate change impacts of the activity. For instance, the use of local and marginal materials and industrial waste and the use of appropriate mix of labour and machine inputs may constitute a significant initiative in "greening" the process of road construction and reducing the carbon footprint of the investment.

Roads are of course an essential component of the adaptation strategy with respect to climate change impacts; roads improve local community resilience and coping capacity, both with respect to catastrophic extreme events and with respect to ambient changes such as droughts. Risk and Vulnerability assessments to understand the nature of probable impacts can enable design improvements to improve the utility of the road by ensuring that the road itself is well adapted to withstand climate change impacts such as heavy rain, floods, landslides and avalanches. A well conducted risk and vulnerability assessment may in fact also bring out impact-mitigation strategies to increase the robustness of the road itself, and many of these impact-mitigation strategies such as afforestation of the upper reaches, watershed treatment, etc are likely to be well aligned with the SDGs as well.

It would be advisable that the rural road construction programme includes Risk and Vulnerability assessment in a more rigorous form than hitherto keeping in view the potential for climate change related impacts. Separately a network-level Risk and Vulnerability assessment must be

done in a systematic manner periodically and the outputs incorporated into the renovation, upgradation and maintenance plans. Concurrently the Asset Management strategic plan must factor in the climate change related risks to ensure that funding allocations are consistent. Needless to say, the Transect Walk (undertaken at planning stage) itself must include substantive discussion on the risk and vulnerability to climate change impacts.



Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Road projects generally improve economic and social condition of people, reduce travel time, lower cost of vehicle operation and cost of transport, and increase access to markets, jobs, and education and health services. However, people in the direct path of the 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 air and noise pollution, soil erosion, changes in streams/underground water, interference with animal and/or plant life and affecting the 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, particularly in case of rural roads aligned through sensitive areas such as forests, national parks, and protected areas. Where the same people are beneficially as well as adversely affected, very often they have to make difficult choices. In other cases, the adverse impacts can be less direct and longer term. In both situations, it is incumbent on the project authorities to ensure that all possible measures are being taken to mitigate the adverse impacts. Decisions need to be taken transparently, in an informed way and with the collaboration of local communities.

Generally rural roads follow existing tracks in use for a long time, the environment impact in most cases is incremental and such impact is likely to be predictable, and acceptable to the local community. However if the road construction leads to new range of activities such

as forest felling or mineral mining, clearly the issues are likely to be complex. Some of the impacts that need consideration at the time of finalising the detailed project reports are the construction and operational impacts with respect to:

- Biophysical environments
- Soil and water
- Air quality
- Flora and fauna
- Socio-economic environment
- Community life and economic activity
- Land uptake and resettlement
- Tribal population
- Aesthetics and landscape
- Noise (generally not a major problem on rural roads)
- Human health and safety

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 on land of road development is the elimination of its productive capacity. Unfortunately, the best sites for roads (flat and stable) also often 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. When the impact factors in the inevitable transformation (“ribbon development”) all along the right-of-way, the impact can be very large.

Activity-accelerated soil erosion, creation of borrow pits haphazardly, loss of productive soil, destabilization of slopes, dumping of waste and water flow diversion and contamination of soil are issues that need to be satisfactorily addressed during the construction phase. The practice, unfortunately still substantial, of unregulated activity during the road construction phase (whether for lightly engineered roads or for compacted earthen roads built using wage-employment funds such as MGNREGA) needs to be changed .

It needs to be ensured that the development of any road does not result in either contamination of existing water

bodies or cause hindrance in the natural flow of streams. The development of rural roads may affect the movement of water in the following ways, and mitigative and remedial measures must be planned and provided for:

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

In the case of rural roads, the main source of air pollutants is the exhaust from the vehicles during operation of the road facility; in the case of roads used for mining etc, dust may also be a significant pollutant. A poorly maintained road with rough surface results in higher fuel consumption and release of higher amount of air pollutants (vehicle exhaust as well as dust). It is therefore essential that rural roads receive regular maintenance so that the riding quality does not fall below acceptable limits.

Animal and plant life may get affected during the construction and operation of rural roads in all areas, in multiple ways. The road itself and embankment of road in particular acts as barriers to movement, propagation, and supply of water and nutrition, and adverse impacts need to be mitigated by suitable engineering and biotic measures. Drainage structures should be located at appropriate intervals, along with facility to provide unhindered passage for small wild and domestic animals.

For the long run, it would be necessary to not only understand the impact of the road in its construction phase, but also in its operations phase. An integrated Social and Environmental Assessment of the sub-network done periodically may be useful to identify areas to be addressed at the time of renovation, upgradation or maintenance. It can also enable identification of trade-offs that can be better managed.



Rural roads, particularly the last link, are essentially community assets. The choice of alignment, design, development of facilities on and around the alignment, fair treatment to all those affected by the construction and operation, including those who lose land or other assets or livelihoods on account of the road has to be integral to the process so as to give legitimacy to the development intention.



Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Roads have the potential to enhance the quality of public administration by improving access not only to the socio-economic services mentioned earlier but also governance related services such as police, fire services, disaster management, courts and the system of justice, and civil society organisations. It is important that public transportation and law and order and other service organisations take cognizance of the provision of road connectivity in planning their outreach services. The impact of a well-coordinated effort in this direction, coupled with a focused attention to building local day-to-day governance capacity such as Panchayats has seen remarkable results in some States and has the potential for replication in a variety of contexts.

The provision for a rural road is only the start of the process that helps reduce poverty. Provision of transport services, facilities and amenities along the alignment (including lighting in the case of some tracks), ensuring maintenance and road safety are some of the concerns that need to be constantly addressed to optimise on the investment and increase the pro-poor orientation of the infrastructure. The process of optimisation needs to be driven by the stakeholders, particularly the local Panchayat. It would be best if this is subjected to well-structured and rigorous social audit processes. Social Audit, if properly structured, is a very effective social accountability tool for not only bringing out issues of service delivery and quality, but also of inclusiveness and equity, and is a very potent pro-poor mechanism.

Recommendations

This paper attempts to use the SDGs as an analytical framework to understand the role and potential of the rural road network in not only poverty reduction but generally in sustainable development. Over the last decade and more, huge investments have been made in rural road construction all over the country. This is an opportunity to leverage rural roads to their full potential for the achievement of the SDGs. The analysis in this Paper indicates that in the rural areas of India, not only must those responsible for achieving each SDG leverage the potential of the road connectivity for the purpose at strategy and implementational stages, but the authorities responsible for rural roads must make institutional, policy and management improvements in order to ensure that rural roads have the best potential for the purpose. Implementation of the following main recommendations which have embedded facilitatory processes would seem to be the necessary first steps:

1. Need for a Nodal Planning institution and appropriate regulation

Given the huge potential of rural roads as enablers of the SDGs, States should bring together the diverse stakeholders of the sector (including the State coordinating agency for the SDGs) at a nodal point, including both the socio-economic service planning and the administrative service planning services. This could best take the form of a "Road and Transport Development Board". The functions of the Board could include the following:

- To develop a Vision and Perspective Plan for the entire road sector in the State;
- to coordinate Departmental Plans for different segments and hierarchies of the Network in accordance with such a Plan and Vision;
- To plan the development of rural areas based on the best utilisation of the road connectivity for urbanisation, agriculture and industry and livelihoods promotion, passenger transportation, access to socio-economic services and the achievement of the SDGs generally, etc.

- To strengthen the local community and governance institutions to play a proactive role in planning, maintenance, public transportation services, and road safety.

All the trends and patterns put together in this paper have long-term implications for incomes and new livelihood opportunities not merely for the farm and off-farm sector but also for a range of people who directly or indirectly depend on the rural road network, and constitute new classes of stakeholders in the network, including industry, service sector, those who access local labour markets, primary producers including mining and quarrying; as well as manufacturers of consumer durables and consumer products.

For the proper management of what is now emerging as a huge asset class, there is a dire need to integrate better with governance and planning systems for:

- District and local area planning
- Livelihood and poverty reduction programmes
- Socio-economic services such as schools, health, etc.
- Public transportation services
- Agriculture and industry related transportation
- Administrative services, etc.

With the present emphasis on rural roads for poverty reduction, and the realisation that this should encompass the entire road network to achieve the intended farm-to-





market connectivity in an economic rather than a physical sense, a scientific and coordinated approach to network planning, construction and asset management is slowly evolving. The importance of involving all stakeholders, including community and local governance institutions is also being better understood. The formation of State Road and Transport Development Boards explicitly recognising the poverty reduction and infrastructure multiplying role of the road network, and the role of local community and governance institutions can really help in realizing the potential embedded in the sector.

While roads other than National Highways are State subjects, there is an advantage in having a technically sound and reasonable uniform State level regulatory framework (based on a Central model Law) covering the non-National Highway sub-sector through a "Rural Road Management Act" which, *inter alia*:

- Can define functions and obligations of the State and local road authorities
- Ensures the creation and management of spatial data bases and services around the rural road network for planning and management purposes; and
- Governs regulation of rural roads, lays down funding mechanisms and requires instituting an asset management system.

The Central Road Fund Act 2000 (CRF Act 2000) empowers the Central Government to levy and collect by way of cess, a duty of excise and duty of customs on petrol and high speed diesel (HSD). There is a strong case to amend the CRF Act in order to enable the cess to be applied for maintenance of not only National Highways and State

Roads of economic importance as at present, but all roads including rural roads particularly through routes for which Gram Panchayat funding may not be available. It can even be argued that such rural roads too are roads of economic (and socio-economic) importance, particularly since they are key to achieving the SDGs. The amendment may be necessary notwithstanding the allocations made by the 14th Finance Commission to Gram Panchayats, because maintenance of rural roads by the Gram Panchayats will be confined to the Panchayat jurisdiction and will thus mainly comprise the smaller link routes rather than the larger through routes.

2. Long-term vision for sector-level road asset management

Asset management is the strategic and systemic process of operating, maintaining, upgrading, and expanding physical assets throughout their life cycle. It focuses on better decision making based on quality information, well defined objectives, and improved business and engineering procedures. The key principle is recognizing the economic value of assets, optimization of expenditure over the asset's life, and establishing the role of the road agency as a steward of the assets for purposes of management and optimization. Asset management strategies are well aligned with the poverty-reduction and other positive socio-economic outcomes for rural roads. A significant objective of asset management is to improve network efficiency. This may require consideration of the hierarchy of roads within a "transportation" framework, integration with other transport modes, and incorporation of imperatives of economic growth and strategic requirements.

The long-term vision should be that the rural road network would form a continuum from the arterial field track to the District or sub-District road, so as to realise the objective of "farm to market" connectivity, and to ensure reliable access to the socio-economic and administrative services mentioned earlier. Motorable roads, including those needing to be upgraded to all-weather standards due to traffic or socio-economic and administrative and "network efficiency" considerations should fall within the purview of the State Government, but other roads and tracks should remain at most of district level importance. In the latter type of roads, the Panchayati Raj Institutions (PRIs) would need to take ownership from the start.

There is a need for a comprehensive and well planned long term strategy to ensure sustainable routine maintenance of the rural roads network. Clearly, given the vastness of the area and the large lengths involved, routine maintenance capacity has to be developed on a mass scale, locally. The 14th Finance Commission has already recognised this by making substantial allocations for maintenance of community assets including roads. However, PRIs as the local governance mechanism cannot themselves be the maintenance agency; they can be the client and can supervise, but they usually lack the capacity to execute. Since rural roads are owned by various Departments, it would be best if “maintenance” is available as a paid service to all Departments, as well as the construction contractors (so that they can subcontract the post-construction paid maintenance for instance). This could take the form of training and skilling local educated youth to provide these services in small groups or micro-enterprises on an “approved rate” basis, with competition to ensure acceptable quality of service (similar to the practice among Utility agencies to train and empanel contractors for utility shifting on an “approved rate” basis). A growth path may also be charted out, so as to provide for growth of the micro-enterprises from Gram Panchayat level to Mandal/Block and even District level road maintenance management, and their formalisation as a society or similar organisation. Such enterprises may be facilitated in getting registered as subcontractors for maintenance purposes .

3. Ensuring land management and off-road development

Planned management of growth and development *along* the rural road is crucial as traffic and services develop and new opportunities arise. The rural road therefore needs to be seen as a “planned development” space, particularly along critical stretches near habitations, junctions, “road-heads”, bus stops etc. Integrated local land-use planning and leveraging the connectivity provided by the road to enhance socio-economic opportunities can improve the returns of the investment on the construction and subsequent maintenance manifold. These can include the siting of schools, public transport and goods transport parking or halting places, fair price shops, cooperatives, godowns, bank branches, Panchayat or other administrative and public buildings, allotment / leasing of space for petrol pumps, shops and commercial



establishments etc. Such planning needs to be done by the District/Block Panchayat and District administration under a framework/ policy of the State Government.

GIS applications are developing around land use, with outputs related to agriculture, soil-erosion, general rural development and land use 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 and its current condition is adequately reflected, so as to maximise the information for planning purposes.

4. A final word on the window of opportunity

For the first time in India there has been this focused effort to build good quality, well-maintained all-weather rural roads specifically to provide access and improve rural incomes. Like all assets, these roads too will in time erode in asset functionality and value, and will require upgradation and renovation at substantial cost. Good maintenance will reduce the rate of erosion, and must be part of the main strategy, but even well maintained roads have a finite life. It is necessary that the assets be leveraged to their maximum potential before the erosion becomes significant. That is the only way that rural India can rise to new levels and generate the surpluses to enable making of the additional investments needed for maintaining asset value of the network and sustaining the growth trajectory of the rural economy.

APPENDIX: THE SUSTAINABLE DEVELOPMENT GOALS



End poverty in all its forms everywhere



End hunger, achieve food security and improved nutrition and promote sustainable agriculture



Ensure healthy lives and promote well-being for all at all ages



Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all



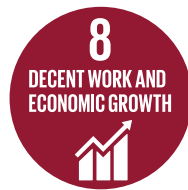
Achieve gender equality and empower all women and girls



Ensure availability and sustainable management of water and sanitation for all



Ensure access to affordable, reliable, sustainable and modern energy for all



Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all



Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation



Reduce inequality within and among countries



Make cities and human settlements inclusive, safe, resilient and sustainable



Ensure sustainable consumption and production patterns



Take urgent action to combat climate change and its impacts*



Conserve and sustainably use the oceans, seas and marine resources for sustainable development



Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss



Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels



Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

REFERENCES

1. Rural Roads Vision 2025, Ministry of Rural Development. Government of India (2007)
2. Rural Road Development in India: An assessment of distribution of PMGSY project benefits in three states by gender and ascribed social groups. World Bank (2014)
3. NBER Working Paper Series: Growth, Urbanisation and Poverty reduction in India : Gaurav Datt, Martin Ravallion, Rinku Murgai Working Paper 21983
4. Contribution of Rural Roads to Access to- and Participation in Markets: Theory and Results from Northern Ethiopia: Torbjørn Arethun, Bharat P. Bhatta . Sogn og Fjordane University College, Sogndal, Norway
5. Market Access and Structural Transformation: Evidence from Rural Roads in India. Sam Asher Paul Novosad (April 20, 2016)
6. Estimating the Long-term Impacts of Rural Roads: A Dynamic Panel Approach
Shahidur R. Khandker and Gayatri B. Koolwal
The World Bank Development Research Group; Agriculture and Rural Development Team (October 2011)
7. WB Connections: Devising the Right Indicators
Bernhard Ensink, Shokraneh Minovi, Roger Gorham, and Nancy Vandycke
8. Poverty and sustainable transport:How transport affects poor people with policy implications for poverty reduction: A literature review (October 2014)
Paul Starkey Consultant in integrated transport and John Hine Consultant in transport planning
9. Socio-economic Impacts of Rural Roads
World Bank March 28, 2002
10. Do Rural Roads Create Pathways out of Poverty? Evidence from India
Shilpa Aggarwal(March 2015)
11. Rural energy access and inequalities
The Energy and Resources Institute TERI-NFA Working Paper No. 4:
Aditya Ramji, Anmol Soni, Ritika Sehjpal, Saptarshi Das, Ritu Singh, (December 2012)



TERI Discussion Papers

Title	Authors	Division	Year
Benefit Sharing in the Mining Sector	Joyita Ghose	Integrated Policy Analysis	2018
Aligning India's Water Resource Policies with the SDGs	Girija K Bharat and Nathaniel B Dkhar	Natural Resources and Climate Change Programme	2018
Restructuring the Environmental Governance Architecture for India	S Vijay Kumar and Nidhi Srivastava	Resource Efficiency and Governance	2017
Why we need a New Mineral Exploration Policy for National Mineral Security	S Vijay Kumar and Swati Ganeshan	Resource Efficiency and Governance	2017
Faecal Sludge Management in Urban India: Policies, Practices and Possibilities	Dr S K Sarkar and Dr Girija Bharat	Natural Resources and Climate Change Programme	2016
Suggestions for an Appropriate Environmental Governance Architecture for India	S Vijay Kumar	Resource Efficiency and Governance	2016
Modelling Urban Carrying Capacity and Measuring Quality of Life using System Dynamics	Mihir Mathur and Kabir Sharma	Earth Science and Climate Change	2016
Moving Forward with a World-class Mineral Policy for National Mineral Security	S Vijay Kumar and Swati Ganeshan	Resource Efficiency and Governance	2015
Organic Agriculture: An option for fostering sustainable and inclusive agriculture development in India	Dr Shilpanjali Deshpande Sarma	Integrated Policy Analysis	2015
The Mineral Development and Regulation Framework in India	S Vijay Kumar and Nidhi Srivastava	Resource Efficiency and Governance	2015
What would India need for moving to a 100% renewable energy scenario by 2050?	Ritu Mathur, Atul Kumar, Saptarshi Das, Ilika Mohan, Manish Kumar Shrivastava, and Leena Srivastava	Integrated Policy analysis	2014
Perspectives on a Water Resource Policy for India	S Vijay Kumar and Dr Girija Bharat	Natural Resources and Climate Change Programme	2014

TERI publications, including Discussion Papers, can be accessed at: <http://www.teriin.org/publications>

About TERI

The Energy and Resources Institute (TERI) is an independent non-profit organization, with capabilities in research, policy, consultancy and implementation. TERI has multi-disciplinary expertise in the areas of energy, environment, climate change, resources, and sustainability.

With the vision of creating innovative solutions for a sustainable future, TERI's mission is to usher in transitions to a cleaner and more sustainable future through the conservation and efficient use of the earth's resources and develop innovative ways of minimizing waste and reusing resources.

TERI's work across sectors is focused on:

- Promoting efficient use of resources across sectors
- Increasing access and uptake of sustainable practices
- Reducing the adverse impact on environment and climate

TERI works with a diverse range of stakeholders across governments, both at the National and State levels, international agencies, and civil society organizations to help deliver research-based transformative solutions. Headquartered in New Delhi, TERI has regional centres and campuses in Bengaluru, Gurugram, Guwahati, Mumbai, Nainital, and Panaji.

Currently, TERI's work is structured around seven sectors namely:

- Agriculture
- Climate
- Energy
- Environment
- Habitat
- Health and Nutrition
- Resources

TERI brings out Discussion Papers on key contemporary issues in these sectors with multi-disciplinary and multi-sectoral implications for use by policy makers, legislators, researchers and practitioners. Discussion Papers are recommended for publication by a sub-committee of Distinguished Fellows at TERI. This Discussion Paper has been brought out by the Sustainable Habitat Division as a part of TERI's work on rural transportation. A list of recent Discussion Papers brought out by the Institute is given overleaf.

For more information, please visit: <http://www.teriin.org/>

