

# **The Nature of Rural Infrastructure: Problems and Prospects<sup>1</sup>**

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## **Abstract**

*This paper looks at rural infrastructure facilities in India, the lack of which is demonstrated to be an impediment to sustained economic development. We argue that problems of rural infrastructure provision are different from those of the urban, given the smaller size, density and per capita incomes of rural agglomerations. While privatisation is now being considered as the giver of increasing efficiency in the provision of urban infrastructure, this policy recommendation has to be modified in the case of rural infrastructure. Private investors will tend to shun rural areas, especially the ones remote or those that have low incomes or low population density, because of low expected rates of return. Thus, social equity might be endangered. It is necessary, therefore, to have a public-private partnership where subsidies or incentives provided by the government would help to direct private investment towards these disadvantaged areas.*

Rural infrastructure assumes great importance in India because of the country's predominantly rural nature, the crucial linkages of infrastructure to economic growth, poverty alleviation and human development, and the poor availability of rural infrastructure. The infrastructure sector in India is also in need of regulatory reform.

Given the low per capita income in rural areas, the immediate objective of the government is to provide universal access to the infrastructure services mentioned. Thus, the residents of every village should be able to access a common telephone. Each village should be able to connect to the electricity grid, have access to a road, and be close to a potable water source. However, universal access does not imply universal service, which suggests ensuring that each household consumes the infrastructure service. In other words, each household has an electricity connection, is physically and economically able to make phone calls, and use roads for motorised transport. Thus, universal service is something more than universal access.

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We now try to answer the question as to why issues concerning provisions of rural infrastructure services should be tackled in a manner different from those concerning urban infrastructure. We are of the opinion that this is because urban areas have characteristics vastly different from those of rural areas. We deal with three characteristics: population size, population density, and per capita income. The implications of these differences for rural infrastructure are then suggested.

Population density in rural areas is much lower than in urban areas. Urban population density as a multiple of rural population density varies from 3.79 in Kerala to 41.91 in Maharashtra (see Table I). For the country as a whole, the figure is 15.75. Rural population density is greater than 500 per square km in only three Indian states—Delhi, Kerala, and West Bengal. In 12 out of the seventeen states in Table I, it is less than 300 per square km. Such low density implies that one should think twice before setting up wired networks, because the cost per capita is bound to be very high. Thus, for example, in the case of power, it might be a good idea to use mini-generators instead of wired networks connected to the main grid. Similarly, in the case of telecom, mobile phone services might be more economical than landlines.

Though population density is a characteristic that demarcates rural areas from urban, there is a great deal of differentiation among rural areas themselves. Rural areas in Kerala and Delhi have high population densities of 603 and 1,190, respectively, and in these areas our recommendations for developing alternatives to wired networks do not hold.

**Table I: Urban and rural population density in Indian states in 1991**

<b>State</b>	<b>Population density (rural )</b>	<b>Population density (urban)</b>	<b>Urban population density as multiple of rural population density</b>
Kerala	603	2283	3.79
Bihar	441	3033	6.88
Orissa	179	1665	9.30

Delhi	1190	12361	10.39
Tamil Nadu	297	3089	10.40
West Bengal	576	6079	10.55
Assam	257	3003	11.68
Uttar Pradesh	386	4927	12.76
Punjab	292	4160	14.25
Haryana	287	4194	14.61
Madhya Pradesh	117	1940	16.58
Andhra Pradesh	180	3459	19.22
Gujarat	142	2773	19.53
Himachal Pradesh	85	1665	19.59
Karnataka	166	3257	19.62
Rajasthan	101	2070	20.50
Maharashtra	117	4904	41.91
India	214	3370	15.75

Source: Census of India, 1991

The other major difference between urban (towns) and rural agglomerations (villages) is size. The average town population as a multiple of the average village population varies from 4.55 in Kerala to 253.73 in Delhi. Kerala is an aberration in this respect, because in all other states considered in Table II this figure is greater than 20. The average population of an Indian village is 1,070 persons. For 14 out of the 17 states considered here, the average village population is less than 2,000 persons. When the population of an agglomeration is so small, the solutions to infrastructure problems are different. For example, setting up large water treatment plants, modern piped water supply, and sewerage networks are ruled out. Instead, it is necessary to have small water treatment plants, water supply through stand posts, and sanitised pit latrines. Again, our

recommendations do not hold for the large villages in Kerala (15,470 people) and Delhi (4,770 people).

**Table II: Average town and village size in Indian states (in 1991)**

<b>States</b>	<b>Average town population ('000s)</b>	<b>Average village population ('000s)</b>	<b>Town population/ Village population</b>
Kerala	70.46	15.47	4.55
Haryana	45.06	1.83	24.62
Tamil Nadu	73.37	2.83	25.93
Himachal Pradesh	8.16	0.28	29.14
Assam	28.6	0.8	35.75
Uttar Pradesh	39.32	0.99	39.72
Gujarat	63.32	1.5	42.21
Punjab	49.94	1.15	43.43
Andhra Pradesh	83.98	1.82	46.14
Karnataka	54.76	1.15	47.62
Bihar	53.81	1.11	48.48
Madhya Pradesh	35.42	0.71	49.89
Rajasthan	46.82	0.9	52.02
Orissa	35.59	0.584	60.94
West Bengal	116.25	1.3	89.42
Maharashtra	104.96	1.15	91.27
Delhi	1210.28	4.77	253.73
India	58.36	1.07	54.54

Source: Census of India, 1991

Another characteristic that distinguishes urban areas from rural is the average purchasing power of the people, with the average urban dweller being much wealthier than the rural. The excess of urban per capita income over rural per capita income varies from 22 per cent in Haryana to 180 per cent in Orissa. Only in three states is this figure less than 50 per cent. In 13 out of the 17 states listed in Table III, the level of rural per capita income is less than Rs 12,000. The low level of rural per capita income implies that in most rural areas, the pricing of infrastructure services cannot be structured so as to recover the entire capital and operating cost over the lifetime of the capital asset. Irrespective of whether the service is provided by the government, community or private sector, a subsidy has to be provided to the consumer. This can take place through direct or indirect means. Exceptions to this generalisation exist in the form of Punjab, Gujarat, and Haryana, which have per capita incomes greater than Rs 14,000. It must be remembered that Uttar Pradesh and Bihar are the only states that have urban per capita incomes less than this figure.

**Table III: Rural and urban per capita incomes**  
(in Rs, for 1999–2000)

States	PCY (Rural )	PCY (Urban )	% Difference
Orissa	5704	15993	180.38
West Bengal	8792	23892	171.75
Meghalaya	9284	20714	123.12
Madhya Pradesh	7079	14719	107.92
Maharashtra	11769	23747	101.78
Tamil Nadu	12888	24246	88.13
Himachal Pradesh	10816	19881	83.81
Uttar Pradesh	6738	12257	81.91
Bihar	6976	12404	77.81
Andhra Pradesh	11033	19143	73.51

Kerala	10342	17372	67.98
Karnataka	11300	18394	62.78
Goa	11017	17440	58.30
Gujarat	14574	22742	56.05
Assam	11109	17231	55.11
Rajasthan	10693	15850	48.23
Punjab	16540	21413	29.46
Haryana	14855	18134	22.07

Source: Indian Market Demographics Report

### **Rural infrastructure investments, economic growth, and poverty alleviation**

Better rural infrastructure has two effects: the promotion of economic growth and a decline in the incidence of absolute poverty. Jocelyn A Songco (2002), in a study, points out that rural infrastructure investments benefit the rural poor through increased incomes and improved consumption patterns (demonstrated in lower costs of basic goods, lower expenditures on energy because of new energy sources, greater uses of social services, etc.). Such benefits are often cited as rationale for more infrastructure investments. However, unless improvements in infrastructure are properly targeted, the non-poor might benefit more than the poor, and the gap between the two may widen. This realisation has led to changes in project design with greater attention to effective targeting (e.g. through revised subsidy schemes for rural electrification).

Some empirical and econometric studies illustrate a strong relationship between infrastructure and economic growth. A 1 per cent increase in infrastructure stock is associated with a 1 per cent increase in GDP across all countries, according to World Bank sources. Moving to specific sectoral studies, a study by Deichman *et al.* for Mexico shows that a 10 per cent increase in market access leads to an increase in labour

productivity by 6 per cent. Market access has an inverse relationship with travel time, which can be reduced through improvements in road networks. A very recent cross-country study on telecommunications has been by Lars Hendrik Roller and Leonard Waverman (2001). A distinctive feature of this study is their use of a two-way causal relationship between infrastructure spending and economic growth. Not only does higher infrastructure spending result in higher economic growth, the latter might lead to a more intensive use of infrastructure facilities, and therefore their rapid deterioration. This might call for more infrastructure spending. The main result of the paper is that economic product increases at an increasing rate with the density of the telecommunications network.

Let's turn to some surveys. Fifty per cent of poor Ecuadorian families see improvements in basic infrastructure provision as the way to alleviate poverty (*World Bank Survey*). A poor rural community in Nigeria considers that the lack of basic infrastructure services is the cause of their poverty. Broadly speaking, it can be said that rural infrastructure development has a five-fold impact on the economy, i.e.

- 1) creating better access to employment and providing further earning opportunities;
- 2) increasing production efficiency;
- 3) creating access to previously inaccessible commodities and services;
- 4) saving time, which can be better utilised in productive activities;
- 5) better health and physical conditions of the rural population.

The first and third channels correspond to better physical access facilitated by roads, etc. The second is due to improvements in technology and mechanisation, facilitated by electrification and telecommunications. The fourth corresponds to time saved on account of quicker physical access to employment opportunities, goods and services, and in collecting water due to the creation of drinking water sources. Sanitation and potable water facilities create good physical and health conditions. These five channels correspond to mechanisms through which incomes of the rural population can be raised and economic growth facilitated. Thus, the mechanisms through which the spread of rural

infrastructure leads to economic growth or a decline in poverty are the same. It is the targeting of the population that determines the consequences.

Songco (2002) gives plenty of empirical evidence in favour of the aforementioned linkages. For instance, the World Bank's operations evaluation department (OED) report of 1994 discussed Bank experiences in rural electrification (RE) projects in Asia and observed the following beneficial impacts:

- In India, the use of electric pumps in well irrigation was promoted in place of diesel pumps, and led to increased agricultural productivity through greater land use, less reliance on rainfall, and a switch to higher-yield crops. Diesel pumps continued to be used to supplement electric pumps; yet the new energy source was cited as the likely catalyst for the farmers' move to more productive irrigated farming.
- In India and Bangladesh, advances in irrigation due to rural electrification were shown to reduce significantly the incidence of absolute poverty.

For the past three decades, the government of Bangladesh has worked with partners—multilateral, bilateral, and private—and NGOs, to address the issue of extremely limited access to electricity in rural areas. The US Agency for International Development's (USAID's) evaluation of the Third Rural Electrification Project (co-financed by the World Bank and USAID) described the following benefits of electrification initiatives in Bangladesh:

- *Increased income.* Households with access to electricity because of the project had income 50 per cent more than households in control areas. Of this, 22 per cent has been attributed to electrification.
- *Lower poverty.* The percentage of the poor was 34 per cent in project areas, as against 41 per cent in control areas. The gap between the richest and the poorest households in project areas remained the same; however, the income of the poorest of the poor (lowest 10 per cent) in project areas was higher than the income of the poorest in control areas.



- *Increased agricultural productivity.* Beneficiaries felt the greatest economic impact resulted from the electrification of irrigation, which enabled greater land use for agricultural purposes and acted as a catalyst for more modern agricultural practices. Most farmers switched from diesel to electric pumps.
- *Increased off-farm income.* Electrified households had off-farm income, which was 33 per cent higher than that in control villages, and 66 per cent higher than that of non-electrified households in villages with access to electricity.
- *Increased savings.* Electrified households were able to save 30 per cent more money than control households, and had better access to credit, enabling a “virtuous cycle”.
- *Increased hours and rates of commercial activities.* Working hours increased from nine to 14 a day; turnover increased by 34 per cent. Electrified businesses employ more workers and pay higher wages than non-electrified businesses, showing that access to electricity by a particular household has the potential to have a multiplier effect.

Telecommunications, facilitated by electricity, have led to the formation of human capital in rural areas, thereby raising average human productivity. When population growth leads to more demand for food and traditional fuels, electricity-aided irrigation (such as electric pumps) reduces the overall cost of irrigation and permits a more intensive cultivation of land. It also helps to overcome shortages of other conventional fuels such as kerosene as well as provide better lighting. Thus, any further deterioration in the living standards of the poor is prevented for sure, and possibilities for improvement are opened up.

In certain rural areas, however, electrification is not a feasible or foreseeable option. Solar energy is one alternative that has provided pro-poor benefits. Countries that have incorporated this solar energy option in their rural energy strategy include China, Indonesia, Sri Lanka, Kenya, Mexico, and Brazil. India too is trying to harness the sun’s energy for street lighting, solar lanterns, photovoltaic domestic system, etc.

**Box I: Solar energy in rural areas: Perceived benefits**

Rural consumers feel that solar energy:

- Provides higher quality light;

- Is safer; no risk of indoor air pollution, accidental fires, or battery leakages;
- Is more convenient, and requires limited to no future purchases of equipment or fuel;
- Is more reliable and is not dependent on access to fuel;
- Carries with it a sense of progress and higher social standing for beneficiaries.

Also, because of the traditional uses of solar energy, given its limitations (low levels of generation preclude industrial use), women and children may benefit the most. Women in the Dominican Republic and the Philippines are able to do housework in the evenings and spend their days out of home in productive activities. In the Philippines, women do not have to spend as much time acquiring necessary fuels and consequently have more time to participate in income-generating cooperatives. Women also feel that solar electrification allows them to provide better care for their children, particularly in responding to needs during the night. Children can read at night, listen to the radio, or watch television.

*Source: Best Practices for Photovoltaic Household Electrification Programs: Lessons from Experiences in Selected Countries, World Bank Technical Paper No. 324, 1996.*

Investment in the water and sanitation sector, too, has positive effects on the economy. A mid-term evaluation of a rural irrigation project in Northern Thailand—sponsored by the International Fund for Agricultural Development (IFAD, a United Nations agency)—noted that beneficiaries saw a 26 per cent rise in household income from the construction and rehabilitation of small dams, weirs, and canals. Farmers felt the project impact was clearly positive, as they would be able to increase productivity through land use during the dry season. An OED sector study of irrigation projects recognised that the promotion of higher-value crops, increased agricultural productivity, higher demand for labour, and greater opportunity for income-generation directly served to improve the welfare of rural communities. A UNICEF report highlighted the benefits (economic and non-economic) from investment in improved sanitation:

- fewer deaths and cases of sickness;
- savings in health costs;

- higher worker productivity;
- better learning capacities of school children;
- increased school attendance, especially by girls;
- strengthened tourism;
- heightened personal dignity and national pride.

Rural water supply projects create new business opportunities, which in turn stimulate incomes of the rural poor. In some project areas, a small proportion of the project beneficiaries in Northern Thailand started *new enterprises* as a result of access to water. Restaurants and laundries were opened, agriculture and animal husbandry activities initiated, and alcoholic and non-alcoholic beverages manufactured and sold. Again, complementary initiatives such as training for small businesses and advising and access to credit may enhance the economic benefits resulting from water projects and enable a greater percentage of households to participate in these initiatives.

#### **Box II: Hits and misses in Bihar Plateau**

The government of Bihar invested approximately \$30 million from its own budget, and received approximately \$120 million in World Bank funding for a rural infrastructure project that closed in 2000 (two years after the expected closing date).

**Objectives:** The project aimed to alleviate rural poverty (this is explicitly stated in project objectives) by increasing production and market access; strengthening local capacities (e.g. in planning, coordination, etc.); involving project beneficiaries; and incorporating environmentally sustainable activities.

**Impacts:** The project succeeded in increasing the area of irrigated land available for farming, which should increase incomes. Improved rural roads and the construction and maintenance of bridges provide greater market accessibility. Provisions of drinking water to significantly more households have minimised water-borne diseases; and the experience of implementing the project has strengthened local capacities.

An OED review of the project noted comments in regard to the following:

- **Design:** A participatory planning approach was not evident from the start. This resulted in a limited sense of ownership by the project beneficiaries, and arguably the limited local commitment did little to move the project along during a slow start-up phase. Systems for assessing the capacity of local organisations to manage the project were not incorporated into the project design. Consequently, inaccurate projections were made regarding the time required to complete the project. The OED assessed the project design as overly ambitious and complex.
- **Implementation:** Much of the construction was rushed through and took place in the later stages of the project, with potential implications for the quality of construction. The OED recommended a study to assess the physical and financial sustainability of the project's works. Again, participatory involvement throughout project implementation was fairly weak, notable since this was an explicit goal of the project.
- **Lessons:** Three lessons were identified by the OED in regard to involvement and monitoring systems. First, it is important to carefully gauge the "readiness for implementation" to avoid initial start-up delays and ensure that a given project is appropriate for a given community or region. Second, monitoring systems are essential throughout the course of project implementation. Finally, local actors (e.g. project beneficiaries) must be involved from the start to enable ownership and ensure project support and appropriateness.

Ultimately, the project achieved notable success; yet the review suggested that more could have been achieved with better planning and more extensive beneficiary participation.

*Sources: Bihar Plateau, OED Evaluation Summary, 2001; Rural Infrastructure from a World Bank Perspective—A Knowledge Management Framework, Pouliquen, 1999.*

Investments can and often result in lower costs of goods and services consumed. Beneficiaries of rural road rehabilitation projects in Kon Tum and Dac Lac Provinces in

the Central Highlands region of Vietnam noted that the costs of goods in their village decreased to the same price as goods sold in the commune centre following the upgrading of roads to year-round access gravel or asphalt roads. An OED evaluation of World Bank-supported rural road rehabilitation in Ghana found that rural sellers profited from higher prices, because they were able to sell their goods directly, rather than through middlemen. Shopkeepers noted that bringing goods to the village was less expensive and their sales had risen.

### **Box III: Rural transport impacts in Ghana**

A 1999 OED report on three transport projects in Ghana discussed the targeted pro-poor outcomes that had been achieved, and successes were noted at different levels: rural communities, capacity building, and physical infrastructure. The three projects were designed with the short- to medium-term goal of rehabilitation. Roads were in severely poor condition largely because of the lack of attention to the transport sector in the 1970s and 1980s, a time of political instability in Ghana. The long-term goals focus more on road management and financing.

**Design in brief:** The three projects lasted about 10 years, 1987–1998, and included road rehabilitation; transport improvements; and the promotion of intermediate means of rural transport, railway equipment, and software components [e.g. training for staff of the department of feeder roads (DFR) and provision of technical assistance]. Objectives included promoting the commercial management of roads and increasing the efficiency of the transport sector. Pro-poor objectives included the promotion of low-cost technology for rural transport, reduced transport costs, and improvement of women’s self-development (particularly in the design of the second project).

**Impact on rural communities:** Villagers’ benefited from the implementation of the projects, in the following ways:

- Greater access to motorised transport improved mobility, both for personal and commercial travel, and was offered at a cheaper cost.

- Transport in times of health emergencies was cheaper and easier to use.
- Investments in feeder roads brought increased agricultural productivity to rural areas, greater market accessibility, and increased mobility of the rural poor.

**Impact on local capacities:** Government agencies benefited from increased learning and capacity, and local industries were developed and promoted. The Ghana Highway Authority and the DFR, key actors involved in the three projects on the side of the Ghanaian government, noted improved expenditure and work programmes (e.g. the latter included road maintenance designs promoting women's employment) following collaboration with the World Bank. The design of the second project explicitly provided institutional support for local NGOs. Local consultancies and construction firms emerged to meet the demand for these services.

**Impact on physical infrastructure:** The projects were most successful in mending a portion of the rural roads in Ghana before it was "too late". However, an assessment in 1997 showed that 58 per cent of the road network was still classified as "poor". The World Bank and the Ghanaian government have set targets for investments in this sector: 70 per cent of the network was to be made "good", and 20 per cent "fair". Railway investments were the only component of the projects that failed to meet intended objectives.

*Source: Précis No. 199, OED, 1999.*

In Morocco, a highway project supported by the World Bank included a rural road rehabilitation component. An OED evaluation noted the following improvements and benefits:

- land use for fruit and vegetable crops increased 40 per cent, and small farms' use of agricultural extension services increased fourfold.
- agricultural diversification in favour of high-value crops (e.g. perishability was no longer a constraint), initiation of complementary components of the project (e.g.

irrigation equipment and improved seeds), and increased investments in livestock raised farmers' productivity and incomes.

- off-farm employment opportunities increased by a factor of six.

These advances are particularly striking when compared with observations in control areas. Control areas were characterised by the production of lower-value cereal crops and little change in farming technologies, and off-farm employment increased by only a factor of three over the 10-year study period.

Rural poor in Morocco benefited directly (e.g. higher agricultural productivity) or indirectly (e.g. time savings or lower costs for goods and services).

Indirect benefits of rural water projects have been that households have more disposable income or higher earnings. These are on account getting more time to work, time saved from closer access to water (e.g. in Paraguay), and decreased expenses on healthcare resulting from better health facilities. Beneficiaries in Sri Lanka noted up to 30 hours were saved per month; those in Karnataka, India, noted an average of 90 hours saved per month. The density of population increased in Kerala and Paraguay, with implications of opportunities for development.

Following a rural water supply project in Paraguay, households had more disposable income due to a lower cost of water. Poor households, who used to purchase water from vendors (this expense represented 12 per cent of household income), later spent only 4 per cent. In Kerala, India, land values increased five times following rural water supply improvements.

Coming to obstacles, in rural electrification, they can include high connection costs, limited or no access to credit, or loan terms that dissuade the poor from borrowing. Limited skills may prevent villagers from maximising the benefits of electrification, pointing to the value of relevant skills. Cottage industries or small business initiatives may have limited benefits for the poor, particularly if goods produced face low demand

or a saturated market. Micro-enterprise advisory services and pro-poor credit opportunities can promote off-farm employment and the diversification of production into more profitable areas.

- Next we examine the aggregate impact of the stocks of rural infrastructure on rural poverty and economic development in India. We consider four different kinds of rural infrastructure listed in Table IV, and construct indices of deprivation relating to them. The definitions and sources of the indices of deprivation are also given in Table IV.

**Table IV: Infrastructure deprivation indices**

<b>Sector</b>	<b>Definition</b>	<b>Source</b>
Roads	% of villages that are unconnected (in 1997)	Basic Roads Statistics (98-99)
Power	% of households that are unconnected (in 2000-01)	Survey data *
Telecom	% of households without DELs ( in 2001-02)	Survey data
Water	% of population not covered by safe drinking water (in 2001-02)	Ministry of Rural Development, Annual Report

Notes: a) \*: “Survey data” refers to data collected by networking organisations for the India Rural Infrastructure Report.

Before we conduct our exercise it would be valid to review the situation of rural economic development and poverty in various Indian states.

**Table V: Rural per capita incomes (99-2000)**

	<b>Per capita income</b>	<b>Rank</b>
Punjab	16540	1
Haryana	14855	2
Gujarat	14574	3
Tamil Nadu	12888	4



Maharashtra	11769	5
Karnataka	11300	6
Assam	11109	7
Andhra Pradesh	11033	8
Goa	11017	9
Himachal Pradesh	10816	10
Rajasthan	10693	11
Kerala	10342	12
Meghalaya	9284	13
West Bengal	8792	14
Madhya Pradesh	7079	15
Bihar	6976	16
Uttar Pradesh	6738	17
Orissa	5704	18

Source: Market Demographics Report, 2002

Punjab has the highest per capita income, followed by Haryana and Gujarat. Bihar, Orissa, and Uttar Pradesh are the bottom three. In Punjab, rural poverty is the lowest. Thus, highest economic development coincides with lowest poverty. However, there is no perfect negative correlation between rankings in terms of poverty and those in terms of per capita income. For example, Kerala is ranked 12th in terms of per capita income but is second in the poverty ranking.

**Table VI: Rural Poverty in Indian states (1999-2000)**

State	Rural poverty	Rank
Punjab	5.9	1
Kerala	12.6	2
Haryana	12.7	3
Andhra Pradesh	14.9	4
Gujarat	15.4	5
Himachal Pradesh	18.9	6

Rajasthan	19.6	7
Tamil Nadu	19.9	8
Karnataka	25.7	9
Maharashtra	29.2	10
Uttar Pradesh	33.7	11
Madhya Pradesh	36.4	12
West Bengal	37.1	13
Assam	44.1	14
Orissa	47.3	15
Bihar	49.2	16

Source: Angus Deaton's corrections of NSS 55<sup>th</sup> Round Estimates

Next we deal with the issue of correlation between infrastructure, poverty, and economic development. Given the fact that Assam's per capita income seems a bit too high, we deal with two series: one including Assam, and the other excluding Assam.

**Table VI: Correlations of per capita Income with infrastructure deficiency indices**

<b>Deprivation Indices</b>	<b>Correlation (with Assam)</b>	<b>Correlation (without Assam)</b>	<b>Rank correlation (with Assam)</b>	<b>Rank correlation (without Assam)</b>
Roads	-.68	-.68	.612	.605
Telecom	-.44	-.45	.457	.488
Power	-.75	-.83	.635	.755
Water	-.14	-.15	-.028	-.026
Overall	-.77	-.80	.597	.659

Source: Derived from data mentioned in sources of Tables I and II

It is seen that the deprivation measure corresponding to electricity has the strongest negative correlation with per capita income, followed by those for roads and telecom. The deprivation index for water has an extremely weak negative correlation with per

capita income. This only implies that a scarcity of water leads rural people to pursue alternative modes of development that yield substantial rates of return, without relying heavily on proximity to drinking water sources. As far as the rank correlations are concerned, the results are similar. The correlations of course are positive [as the states are ranked (from 1 downwards) in an ascending order of deprivation], except for water, which shows a weak negative correlation.

**Table VIII: Correlations Of Rural Poverty With Different Infrastructure Deficiency Indices**

<b>Deprivation indices</b>	<b>Correlation (with Assam)</b>	<b>Correlation (without Assam)</b>	<b>Rank correlation (with Assam)</b>	<b>Rank correlation (without Assam)</b>
Roads	.615	.683	.635	.690
Telecom	.655	.649	.724	.513
Power	.925	.914	.94	.914
Water	.034	-.044	-.079	-.192
Overall	.832	.831	.799	.719

Source: Derived from data mentioned in sources of Tables I and II

The correlation of rural poverty with infrastructure deprivation is positive (except in the case of water) and is the highest for power, followed by roads/telecom. Again, the correlation in the case of water is either very weakly positive (data including Assam) or negative (data excluding Assam). The results from rank correlations are very similar with positive and significant magnitudes in the case of power, roads, and telecom, and negative correlation in the case of water.

One needs to be very careful in interpreting the large and positive correlations of rural poverty with infrastructure deficiency indicators in the power and the telecom sectors. A smaller value of the deficiency indicator might be an outcome rather than a cause of lower rural poverty. This is definitely true when we are talking about household

connections. This prompted us to consider the correlation between rural poverty and the percentage of villages having electricity/telecom facilities. The usefulness of this exercise lies in the fact that the percentage of villages having electricity or telecom facilities can be considered largely independent of demand factors. It is seen that the correlation of rural poverty in 1999-2000 with the percentage of villages that were electrified in 1991 is  $-0.824$ . For telecom facilities, we consider the correlation of rural poverty with the percentage of villages that did not have telecom facilities in 1999-2000. The correlation in this case is  $0.75$ . These two findings help us to confirm that greater access to power and telecom facilities leads to less poverty.

The advancement of the rural parts assumes further importance in the context of a developing country such as India, where 71 per cent of its one billion-plus population reside in the rural areas. S N Mishra and Sweta Mishra (2001) point out that until recently, there had been an overemphasis on the development of heavy industries, sophisticated technologies, and newer superstructure in order. But before generating the momentum needed for development, a number of maladies came to affect the body of economic system. Benefits did not reach and penetrate large sections of the community. The rich became richer and the poor poorer. The character and content of this process of economic development resulted in creating a spatial dichotomy, i.e. rural and urban, in a most conspicuous manner. This went against the constitutional objectives of economic policy, which aimed at establishing an egalitarian society.

In view of the above, there is serious thinking on the part of policy planners and implementing agencies that strengthening the network of rural infrastructure facilities is a must. This is why in 1996, the United Front government, under the common minimum needs programme, gave top-most importance to the development of rural infrastructure. It is highly essential to shift development focus to rural areas. The government from time to time announces special schemes for development of rural infrastructure. However, their implementation leaves much to be desired. In fact, a major hindrance has been a lack of reliable power, telecommunications, water, sanitation, and transport services. On average, 89 per cent of rural households do not own telephones, and 52 per cent of households do

not have domestic power connections. The average brownout in India is three hours in the non-monsoon months, and 17 hours during the monsoon. Twenty per cent of rural habitations have partial or no access to safe drinking water supply. The average distance from a village to an all-weather road is 2 km, and 52 per cent of the people living away from the main village do not have access to all-weather roads.

- Yatish Mishra (2001) says that though the telecom sector has witnessed substantial growth in the last decade, the spread of telecommunications on a per capita basis has been slow, in comparison with other developing countries. In contrast with the urban areas, where costs of service are lower and returns assured, investments in rural areas represent higher risks and lower returns. This is, in fact, one of the main reasons for the poor penetration of telecommunications in rural India—less than 0.2 per hundred inhabitants. One of the objectives of the New Telecom Policy-99 was to provide reliable telecom facility to all villages by 2002, but out of 6,07,491 villages only 3,74,566 villages had village public telephones in February 2000 (Mid-term appraisal of the Ninth Plan, Planning Commission, New Delhi 2002). But the All-India rural teledensity is only 1.278, compared to an overall teledensity of 66.13 for the US, 14.26 for the world, and 2.2 for the whole of India. The NTP-99 also proposes to increase rural teledensity to four by 2010.
- According to Malick and Murthy (2001), the power sector holds the key to all developmental efforts, and it is in this area that India has encountered the biggest setbacks. Power requirements in the country have reached gigantic proportions. Because of funds shortages, there is hardly any effort to upgrade old power stations, leave alone conceiving and implementing new projects. The dismal state of the power sector is evident from the fact that in rural India, power is available only for an average of 14 hours per day and 20 days a month. S N Mishra and Sweta Mishra (2001) define rural roads as those roads that connect villages. They constitute other district roads and village roads in the hierarchy of the system of roads. The other district roads are feeder roads.

Rural road development in India has suffered mainly due to a piecemeal approach. One must ensure that the selected centres of growth with large populations are linked properly with other villages. Hence, the issue of the development of a road network has to be taken up within the framework of an integrated area development plan.

In India, rural roads cannot be accessed by 52 per cent of the rural population. The demand for rural roads is increasing, as indicated by the demand for vehicles. Between 1992-93 and 1995-96 the number of scooters per 1,000 households increased from 15.5 to 19.2, i.e. a 24 per cent increase. The number of bicycles per 1,000 households increased from 474.9 to 529, which means an increase of 11.5 per cent (India Market Demographics Report, 1998).

Compared to this, the increase in rural road length over 1990–97 was 15 per cent. Note that the growth in the use of scooters over such a period would be expected to be 56 per cent and that in bicycles about 28.5 per cent.

- The state of the water and sanitation sector is equally dismal. The average distance of a household to a drinking water source is 0.7 km, and only 27 per cent of households have latrines. Around 19 per cent of the population do not have access to clean drinking water.

Until now, we have considered economic development as measured by per capita income (or the command over commodities) and the alleviation of deficiency in individual incomes as the central objective of government policy. However, Sen (1987) and later the *Human Development Reports* say that the development of human capabilities is more important than mere material development. These human capabilities can include life expectancy, literacy, low infant mortality, mobility, etc. The importance of infrastructure like road transport and provisions of sanitation and safe drinking water is obviously important for such capabilities. Thus, the development of rural infrastructure is important, irrespective of whether our objective is “economic development” or “human development”.

### **The need for reforms in rural infrastructure**

We now discuss some works on reforms in infrastructure in general. According to a World Bank Report by Alexander and Estache (1999), at the heart of the market reforms that have swept both the developed and developing world is the reform of the infrastructure service provision industries.

While the link between improved provisions of infrastructure services and greater economic growth has not been universally accepted, it is clear that reforms aimed at creating competition where possible. A strong, independent, economic regulation of natural monopolies is able to establish an environment conducive to:

- Private sector participation;
- Incentives for companies to strive for efficiency savings that can ultimately be passed on to consumers; and
- Greater provisions of services (such as a faster rollout of infrastructure or innovative solutions to service delivery for customers not connected to an existing network).

When policymakers determine which form of infrastructure restructuring to undertake or how to design a regulatory agency, it is important that the right decisions are taken. A key element of any decision-making process should be a review of the evidence on the impact of the various types of reforms.

The need for policy reforms is brought out by a study by Carsten Fink *et al.* (2002). The study has been carried out for the telecommunications industry. The econometric results show that privatisation, competition, and the introduction of an independent regulator lead to an increase in teledensity by 8 per cent and an increase in labour productivity by 21 per cent. However, the increase in teledensity is larger in the case of a simultaneous introduction of privatisation and competition than where the latter follows the former with a time lag. Autonomous developments such as improvements in telecommunications technology and increase in the level of public investment are also found to be important positive determinants of performance. The important question is what kind of policies encourage such technological developments.

It seems that the qualitative nature of the results emerging from this study should be preserved in other infrastructure sectors. The quantitative magnitude of the results should vary significantly from one sector to another. However, this is just speculation and should be verified by studies in infrastructure sectors other than telecommunications.

Fink, Mattoo, and Rathindran (2002) claim that private ownership is likely to lead to greater internal efficiency for a variety of reasons, ranging from lower costs of monitoring, more precise and measurable targets, and greater flexibility to devise incentive contracts.

There is ample empirical evidence to support the assertion that an effective reform of infrastructure leads to greater economic growth. Consider the process of privatisation and its impact on the economy, for two countries—Argentina and Chile.

The privatisation process in Argentina had far-reaching implications for the economy as a whole. The starting point is the impact of the reforms on industry, which has been summarised in Table I.

**Table IX: Changes in performance  
between 1993 and 1995 (%)**



<b>Sector</b>	<b>Electricity</b>	<b>Electricity</b>	<b>Gas</b>	<b>Water</b>	<b>Telecoms.</b>
Industry	Generation	Distribution	Distribution	Distribution	
First year of private operation	1992	1992	1992	1993	1990
<b>Efficiency gains</b> (measured as reductions in intermediate input purchases as a share of total sales value)	19.51	6.26	8.84	4.86	11.28
<b>Labor productivity gains</b> (measured as GWh/staff for electricity, 000m <sup>3</sup> /staff for gas, population served/staff for water and lines in service/staff for telecoms)	23.1	17.59	4.79	-27.58	21.25
<b>Increases in Investment</b> (concession contracts for gas and actual investments for the other sectors)	8.65	n.a.	4.56	75.97	28.10
<b>Improvements in quality</b> (measured as reductions in losses: net of consumption by transmission/production for electricity and gas, water unaccounted for/production for water, lines in repair/lines in service for telecoms)	n.a.	10.00	27.80	6.12	4.56
<b>Changes in real average tariffs</b> (defined as total sales value by a physical indicator of production)	n.a.	-9.5	-0.5	5.5	-4.9

Source: Table 4.1 Changes in performance between 1993 and 1995, Chisari, Estache and Romero 1997.

The table illustrates the gains, which can be achieved through the channels highlighted above:

- save for the water sector, tariffs decreased in every sector;
- losses in the process of transmission, distribution, theft, etc. were significantly lower;
- all sectors for which data were available recorded a significant increase in investment;
- there were labour productivity gains in every sector apart from water;
- the shares of intermediate inputs in total sales decreased in every sector.

Table II summarises the impact of a general equilibrium calculation on the levels and distribution of gains across income classes from the efficiency and quality improvements due to the privatisation process and those that could be achieved from effective regulation.

**Table X: Annual gains from private operation of public utilities**

<i>Income class</i>	<i>Savings from operational gains (A) (in millions of 1993 US\$)</i>	<i>Savings from effective regulation (B) (in millions of 1993 US\$)</i>	<i>(A)/income class expenditure on utilities</i>	<i>(B)/income class expenditure on utilities</i>
1 (poorest)	197	138	29%	20%
2	259	142	31%	17%
3	373	121	37%	12%
4	403	214	32%	17%
5 (richest)	1047	302	59%	17%
<b>Total</b>	<b>2279</b>	<b>915</b>	<b>41%</b>	<b>16%</b>

*Notes: (A) is the 'fixed-price' model, in which the gains accrue to the private operators while (B) reflects the difference between the fixed and flexible price models, i.e. the maximum impact that an effective regulator could have.*

In Chile, three companies were considered—Chile Telecom (responsible for 95 per cent of local telecommunications), Chilgener, and Enersis (a major electricity-generating company and the distribution company for the capital). In all three cases there were overall net benefits to the country through the privatisation process. These are shown in Table III.

**Table XI: Impact of privatisation in Chile**

<i>Company</i>	<i>Primary sources of benefit</i>	<i>Main groups benefiting</i>
Chilgener	Productivity	Buyers (excluding workers) Foreigners
Enersis	Output diversification Price changes	Buyers Consumers
Chile Telecom	Output diversification Investment	Consumers Foreigners Government

The primary lesson that can be drawn from this evidence is that if the right incentives are established for a sector or company, significant increases in productivity can be achieved. Furthermore, the private sector can provide the bulk of the required investment in a sector such as electricity that traditionally was considered a public sector domain.

The effectiveness of any reform programme depends as much on the details of the reforms as it does on the general principles that are followed. However, *how* each of

these reforms is applied has an equally, if not more, important impact on the overall effectiveness of the reforms in fostering growth in the economy. There are instances where even well intentioned reforms in infrastructure sectors can have less than the desired impact on the economy and in some cases even a negative impact.

For instance, if we consider Chile, evidence from the electricity distribution and telecommunications industries shows that where competition has been allowed to flourish, rates of return are lower than in those industries and segments where monopolies have been retained. Tables IV and V provide some evidence on this issue.

**Table XII: Annual rate of return on equity for Chilean firms, 1995-97**

<i>Sector and Industry</i>	<i>Rate of return (%)</i>
Electricity distribution (regulated)	30
Electricity generation (competitive)	12
Basic telephony (regulated)	18
Long distance (competitive)	6.5

*Source:* Table 8.1, Chile: Recent Policy Lessons and Emerging Challenges (1999)

*Note:* Some difference will depend on the risk faced by the industry, but this is unlikely to differ by such a great degree. For information on the different levels of risk faced by different industries (and under different regulatory regimes) see Alexander, Mayer and Weeds (1996).

**Table XIII: User's prices for selected years in Chile**

<i>Price</i>	<i>1988</i>	<i>1997</i>	<i>% change</i>
Electricity distribution price (KW/h) (in current U.S.\$)	9.44	12.00	27.1
Average household telephone bill (in constant Ch\$ of June 1998)	7,773	11,403	46.7

*Source:* Table 8.1, Chile: Recent Policy Lessons and Emerging Challenges (1999)

The continued existence of monopolies is due to the fact that the market has not been fully developed as a competitive one. In the case of telecommunications, the 1982 law established that open competition should exist in all segments of the telecommunications market, but no actions were taken to break up the two powerful monopolies that existed at that time (one covering local and the other national and international traffic). Furthermore, since a competitive philosophy had been adopted, no price regulation was proposed. The law was amended late in the 1980s after the authority determined that the industry was still dominated by the original monopoly providers. Pricing rules were then successfully implemented. Even by 1994, the five new entrants in the local telephony market had achieved only 2 per cent of the market.

So, stating that competition is to occur is by itself not enough. A proper implementation of policies is required, involving both the encouragement of new entrants and also the control (whether through sectoral economic regulation or competition policy) of existing operators. It is especially important that governments are aware of the potential problems with respect to conduct regulation. No government, in either the developed or developing countries, has been able to foresee every pitfall and so no perfect model of reform exists. Countries in South America that have led the reforms process, such as Argentina and Chile, have had a mixture of successes and failures, but even with these problems the reforms process has been able to have an important impact on the performance of the economy. What is important, however, is accepting that these sorts of problems will be encountered and then ensuring that sufficient flexibility is established to deal with the problems effectively and fairly. It should be acknowledged that reforms are an ongoing process and that governments should see initial major reforms as the start of a process that can yield great benefits to an economy.

However, there are things that governments can do to limit their exposure to the conduct regulation risks. These include the introduction of:

- the greatest degree of competition that is possible (although the cost-benefit trade-off should always be considered); thus, exclusivity agreements with any infrastructure provider, as seen in many countries, should be avoided.
- rules to ensure that vertical and horizontal ownership issues that make conducting regulation even more difficult are limited (or hopefully non-existent);
- rules to ensure that all the information that the regulatory office is likely to need is available in a timely, consistent and accurate format.
- cross-subsidisation should be avoided because the section of the population, which is supposed to subsidise the rest, often takes recourse to avenues other than using the infrastructure. Subsidies must be targeted towards the poorer consumers but must be financed by government tax revenues or an infrastructure development fund.

Until now the discussion in this section has focused on reforms in infrastructure in general. The recommendations of Carsten Fink *et al.*, Alexander and Estache, and Fink Mattoo and Ravindran need to be modified/qualified when we talk about reforms in rural infrastructure. While private sector participation might enhance efficiency and increase competition, it is possible that the private sector might limit its activities to those economic and geographical sectors that provide it with high rates of return. Many rural areas exhibit a low population density and small agglomeration size. Many others are remote. These characteristics imply that the profitability of traditionally supplied infrastructure services may be low. As a result, these areas might be neglected by the private sector. Clearly, a public-private partnership, where the public sector subsidises the private sector in these areas so as to compensate for a lower rate of return, is needed. In other words, the government's incentives are tailored so as to promote regionally equitable rural infrastructure development.

However, even the suggested public-private partnerships will enhance competition, given that the efficiency of the private firms is one of the criteria used to enter into such partnerships. Competition can be expected to bring productive, allocative, and dynamic efficiency. **Productive efficiency** requires that production be undertaken using the lowest-cost technology. **Allocative efficiency** requires that the market price for a product is equal to the cost of the marginal unit of production. When allocative inefficiency becomes locked into the industry, it has profound implications for the **dynamic efficiency** of the market, which requires that new investments be made when the cost of producing from the marginal source of production exceeds the cost of producing from the new investment. In this way, old, obsolete or inefficient production is supplanted by new cheaper production. While competition is, in theory, not necessary to achieve full efficiency, competition sharpens the incentives for productive efficiency and productivity improvements, and acts as a spur to innovation in the provision of new services and lower-cost methods of production.

Regulatory regimes can be set up to mimic competition when this is absent from the market, although this is likely to be an unsatisfactory alternative because of problems

with imperfect information. Furthermore, the costs of acquiring and analysing data will ultimately have to be paid by the consumer. However, in general, governments have differed in their willingness to concede control to the market, and most have a penchant for gradualism. Competition has been introduced, but the number of firms has been fixed by policy; privatisation is often partial and there are limits to foreign participation; “autonomous” regulators have been created but are rarely fully independent.

In India, infrastructure services are rendered predominantly by public sector enterprises. Changing rural demographics, technological advancements in these sectors, and a global shift in the role of the state have altered the manner in which these services can be best provided. It has become necessary to explore how effective public monopolies are in these sectors, in which areas they should give way to private providers and community-based initiatives, and where combined provisions would work best. New providers need to be encouraged through financial and non-financial incentives. The shift from the monopoly provision of these services by state enterprises to a market-oriented system with economic tariffs and community-based, private and multiple players will call for changes in regulation and perhaps even in the laws. Given the geographical expanse of the domain, a decentralised regulator could be effective and the role of local bodies such as the newly empowered panchayati raj institutions in local governance and regulation needs to be explored.

### **Types of reforms**

There are several aspects of reforms that need to be considered. These include:

- *Industry structure.* Structural reforms primarily concerned with the introduction of competition into a sector or the removal of barriers to entry so that contestability is a real option;
- *Operation.* Conduct reforms, whereby a natural monopoly is constrained by rules covering areas such as quality, pricing and access. The key to the successful implementation and enforcement of these rules is an effective regulatory system that ideally requires the establishment of an independent agency;

- *Ownership.* Reforms are often associated with a change in the ownership of previously state-owned enterprises to some form of private sector ownership.
- The nature of public–private partnership
- *Decentralisation in allocation mechanisms.* These often play an important role in enhancing the influence of economic forces and the participation of stakeholders in the infrastructure sector. This is certainly true for the water sector, as is revealed by a study.
- *Change in regulations.* Regulations can often have an adverse impact on welfare. For example, regulations aimed at controlling prices and entry into markets are likely to reduce the average standard of living (Guasch and Hahn 1997). There are certain principles that should be followed in changing or introducing new regulations:
  - (a) The choice of regulation should be based on cost-benefit analysis.
  - (b) Any regulatory policy should have a clear economic rationale.
  - (c) Evaluations of the regulation should be done by an independent agency that considers the economy-wide impact and not by a sector-specific agency.
  - (d) Regulations should be simple and subject to careful scrutiny. These improve accessibility to the public (transparency) and diminish the likelihood of capture by political groups.

While changing regulations, the objectives and instruments of regulation should be kept in mind. Our discussion is based on the work done by Galal and Nauriyal (1995). Given the scarcity of public funds for investment in any infrastructure area, regulation has three objectives: to attract high private sector investments, to assure reasonable rates of return to producers, and provide improvements in consumer satisfaction. Common regulatory tools are pricing rules, the degree of competition allowed, and conflict-resolution mechanisms.

Common pricing rules are of three kinds: rate of return pricing, benchmark pricing, and price cap regulation. Under the rate of return pricing, the firm is assured of a stipulated fair rate of return on its cost. This allows the firm to inflate its costs and gains, at the expense of the consumer. Under benchmark pricing, a benchmark is set (say, the cost of

an efficient firm) and the firm is assured a stipulated rate of return on the benchmark. This forces the firm to reduce its costs in order to maximise its profit. Under price cap regulations, the price increase is given by the increase in the retail price index minus an X factor reflecting technological or other change. The ad hoc manner of setting the X factor reduces the attractiveness of this pricing rule. From the above discussion, it seems that benchmark pricing is the best pricing rule. This is supported by the fact that Chile, a successful model of telecommunication reforms, has adopted benchmark pricing and countries adopting other pricing rules have not done as well. We now turn to conflict-resolution mechanisms. When there is a conflict between different parties (firm, consumer and government), a resolution of the conflict is necessary to prevent losses to parties. The sureness of neutral resolution of a conflict with rules for conflict resolution spelt out in detail beforehand makes the infrastructure contract(s) more attractive and secure to all contracting parties. Again, this is brought about by the success of Chile's conflict-resolution mechanism in the telecommunications sector. In order to assure a neutral resolution of conflicts, an independent regulatory agency should be set up with quasi-judicial powers. Another crucial aspect of regulation is the amount of competition to be allowed. Competition in an area replaces the need for price regulation because it promotes costs as well as tariff minimisation that is compatible with an acceptable rate of return. However, the existence of economies of scale in certain infrastructure areas implies that the decision to allow competition within a certain area would depend upon the size of the consumer base and the potential scale on which the various firms can operate.

Apart from the above-mentioned instruments, provisions should be included in the regulation to ensure a good performance. This is done by having clauses that say that the licence will be revoked if the firm does not meet stated targets.

Finally, it is also important to place the reform of the utility and infrastructure companies in the context of broader institutional reforms. Some of the successes of the utility and infrastructure reform may be diluted if other broader reforms have not occurred. The impact of labour shedding, created by providing the private operators with incentives to



achieve the lowest cost of production, is a good example. If the labour market still faces rigidities and consequently is unable to handle the labour that is released from the utility and infrastructure companies, some of the benefits of the sector reform will be lost.

## **Conclusion**

In view of the massive investments required to sustain rising economic growth and fiscal stringency in many countries, these are looking for additional sources of financing infrastructure. This is certainly true of rural infrastructure in India. Inadequate state funds have prevented the government from providing the promised full coverage. The state governments, because of the precarious nature of the state finances, have largely ignored even the maintenance of the existing infrastructure. On the other hand, economic growth in rural areas has pushed up demand for infrastructure by creating a burgeoning middle class and a significant drop in people below the poverty line. It is essential, therefore, to allow private players in infrastructure, given the important linkages of infrastructure to economic growth and poverty alleviation. However, a public-private partnership, in which the public sector controls the direction of private investment through appropriate incentives/subsidies, seems to be superior to unfettered private activity because the former is socially equitable.

The concept of universal access to infrastructure needs to be changed from time to time. For example, universal access in telecommunications might involve community access at first, followed by institutional access, and then household access. Similar changing concepts of universal access are seen in roads and other sectors. Given the complementarities among different types of infrastructure, their expansion in the pursuit of the goal of universal access should be coordinated.

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