Assessing the Impact of Transport and Energy Infrastructure on Poverty Reduction

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ABBREVIATIONS

ADB	Asian Development Bank
ANM	primary health center nurse (India)
BOOT	build, own, operate, transfer
CASS	Chinese Academy of Social Sciences
DFID	Department for International Development (UK)
DMC	developing member country
DRI	domestic research institute
EGAT	Electricity Generating Authority of Thailand
ESCAP	(United Nations) Economic and Social Council for Asia and the Pacific
GDP	gross domestic product
GEB	Gujarat Electricity Board
GSRTC	Gujarat State Road Transport Corporation
IFPRI	International Food Policy Research Institute
IFRTD	International Forum for Rural Transport and Development
ILO	International Labour Organisation
IMT	intermediate means of transport
IPP	independent power producer
IRAP	Integrated Rural Accessibility Planning
JBIC	Japan Bank for International Cooperation
Lao PDR	Lao People's Democratic Republic
LPG	liquefied petroleum gas
MDG	Millennium Development Goal
NCAER	National Council for Applied Economic Research (India)
NGO	nongovernment organization
NMT	nonmotorized transport
OECD	Organisation for Economic Co-operation and Development
PPIAF	Public-Private Infrastructure Advisory Facility
PPP	purchasing power parity
PRC	People's Republic of China
PRS	Poverty Reduction Strategy
PRSP	Poverty Reduction Strategy Paper
PV	photovoltaic
R&D	research and development
RETA	regional technical assisstance
RIPA	Roads Improvement for Poverty Alleviation (PRC)
RRMIMP II	Rural Roads and Markets Improvement Project II
RRP	report and recommendation of the President
SEB	State Electricity Board (India)
SPP	small power producer
SRT	State Railway of Thailand
TA	technical assistance

TDRI	Thailand Development Research Institute
TVE	town and village enterprise (PRC)
UNDP	United Nations Development Programme

CURRENCY EQUIVALENTS

In this study, amounts in People's Republic of China yuan (CNY) are converted into US dollars ($) at the rate of CNY8.3 = $1.0.
Amounts in Thai baht (B) are converted into US dollars at the rate of B42 = $1.0.
Amounts in Indian rupees (Rs) are converted into US dollars at the rate of Rs46.5 = $1.0.
In this study, "$" refers to US dollars.

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Electricity fills this classroom in Jamnagar, Gujarat with light and fresh air.

FOREWORD

When it adopted poverty reduction as its overarching goal in 1999, ADB initiated a process of reviewing its operations to identify how best to adapt them for greatest possible poverty reduction impact.

This was quite a challenge for the transport and energy sectors, which have traditionally been among ADB's areas of strength. Intuitively, their influence on poverty reduction seemed obvious. However, empirically, the available evidence was still quite weak. We therefore needed to gather empirical evidence on a systematic basis to understand how these sectors exert their impacts on poverty reduction, both directly and indirectly. This would then serve as valuable feedback to the designers of future projects and programs.

To begin filling this gap in knowledge, ADB initiated a regional technical assistance project on *Assessing the Impact of Transport and Energy Infrastructure on Poverty Reduction*. We carried out this technical assistance in close collaboration with our partners from the United Kingdom's Department for International Development, the Japan Bank for International Cooperation, and the World Bank, each of which shared our need to know more about this subject. The high quality of work produced is a reflection of the combined efforts and strengths of this development partnership, and demonstrates our shared commitment to the international agenda for harmonization of development support.

This book presents the findings of the technical assistance. Above all, it shows how transport and energy infrastructure contributes to poverty reduction, and why these contributions are important. One new aspect that emerges is that, in addition to their impacts on income dimensions of poverty, transport and energy have significant impacts on nonincome dimensions such as health, education, personal security, and community participation. The book also recommends a series of policy and operational-level refinements for increasing the poverty reduction impact.

With the publication of this book we have taken a step toward improved understanding of this complex subject, but there is still a long way to go. It is my hope that the book will help give momentum to further efforts to close the knowledge gap. I look forward to it being widely used by developing country governments, development partners, professionals, academics, and in civil society.

Haruhiko Kuroda
President
Asian Development Bank

In many parts of Thailand today, private transport is not reserved for adults.

SUMMARY

Introduction

In response to shared concerns about the lack of knowledge about how transport and energy investments contribute to poverty reduction, the Asian Development Bank (ADB), in collaboration with the Department for International Development of the United Kingdom, the Japan Bank for International Cooperation, and the World Bank, undertook a regional technical assistance (RETA) project, *Assessing the Impact of Transport and Energy Infrastructure on Poverty Reduction*. The objectives of the RETA, a study based on a literature and project review and on field research in three Asian countries, were to enhance current understanding of how transport and energy infrastructure contribute to poverty reduction, to fill knowledge gaps, and to identify lessons learned and good practices. The RETA also aimed to help build capacity in developing member country (DMC) research institutions to design and conduct policy-relevant research on poverty and infrastructure.

The RETA was implemented in three stages. Stage 1 assessed the current understanding of how transport and energy infrastructure impacts on poverty reduction, identified knowledge gaps, and developed proposals for supplementing this knowledge by conducting country case studies. In Stage 2, domestic research institutions carried out field research and data analysis to prepare country case studies in the People's Republic of China (PRC), Thailand, and India. Stage 3 analyzed and compared the findings of the three country studies to identify policy and operational implications as well as priorities for future research.

Literature Review

In the literature on transport-poverty and energy-poverty linkages, direct, empirical evidence is relatively scarce. This is because transport and energy, like other infrastructure investments, are intermediate goods: they make possible other activities that increase the productivity and enhance the welfare of poor people, and they contribute to economic growth that may expand the economic opportunities available to the poor and provide additional resources for poverty reduction. However, the linkage is not a necessary one: other political, socioeconomic, and cultural factors are likely to be important in determining the poverty impact.

Past studies often lacked a reliable methodology. Most existing studies are of uncertain value because they do not present systematic "before and after" data on poverty or evaluate complementary actions that affect the impact of transport investments, and do not track the effects on poverty long enough. Nevertheless, many people in developing countries believe that transport improvements do alleviate poverty.

Most of the existing work on transport and poverty reduction has concerned roads, particularly rural roads. This bias is logical, since roads represent the transport mode most often used by the poor and rural areas are where most poor people live. Not much research has been done on the poverty reduction impact of national or provincial highways, other transport modes, or urban transport. While much past work focused on infrastructure impacts on agricultural production, more recent studies have looked at the impact on nonfarm activities in the rural economy. Studies have generally treated increased access to social and economic services as a benefit, without examining whether this actually enhances the welfare of the rural poor. Recent themes have included the differentiation of gender roles in transport and the impacts of transport infrastructure development on the physical and social environment.

Few empirical studies have attempted to measure the poverty reduction impacts of energy infrastructure investments. Quantifying the value of electricity to the poor is difficult, except as it relates to food storage, irrigation, agricultural processing, and small-scale industry. Previ-

ous studies have shown that high initial investment costs, including electricity connection charges, prevent poor people from gaining access to more efficient and affordable energy types.

Aggregate expenditure on roads and electricity is linked to rural poverty reduction. A few studies have looked at the composite effects of investments in different sectors on poverty reduction, particularly in rural areas. These studies are helpful in assessing the relative importance of different types of investments and their appropriate sequencing and timing for optimal impact. Of particular interest is a set of studies by the International Food Policy Research Institute (IFPRI), which uses an econometric model to compare the poverty-reducing effect of public investment in different sectors. These include IFPRI's initial studies on the PRC and India, and a further study of Thailand that ADB commissioned as part of this RETA. The studies provide evidence that investments in infrastructure, education, and agriculture work together to improve rural productivity and reduce rural poverty. Because of their additional effects on both farm and nonfarm employment, investments in roads may often have the greatest impact on rural poverty reduction, especially where road density and quality remain relatively low. Investments in irrigation and power may also influence agricultural productivity, but usually have a smaller effect on poverty reduction.

Project Review

Previous transport and energy projects of ADB and the World Bank struggled to show a direct link between project activities and poverty reduction. A review was conducted of the 30 ADB and 36 World Bank projects in transport and energy approved between 1993 and 2001 that had identified poverty reduction as a primary or secondary objective. Most are still being implemented. These included projects that targeted a particular area where most people were poor, and projects integrated within multisector rural development programs. Although the project reports described expected impacts on poverty, they were usually unable to demonstrate a direct link between project activities and poverty reduction, or to provide quantitative indicators to monitor poverty reduction outcomes.

Research Design

The literature and project reviews were used to develop a universe of hypotheses—a "propositional inventory"—about the poverty impacts of transport and energy investments. These hypotheses linked transport and energy investments with poverty reduction outcomes in terms of income and expenditure impacts, impacts on farm productivity and nonfarm employment, access to services, access to information, access to common resources, safety, security, and social participation. Some hypotheses had been the subject of empirical research, often with conflicting findings. Others were proposed on theoretical grounds, but had never been empirically tested. The propositional inventory was used as a tool for determining gaps in current knowledge that might be addressed through field research. It also served as a yardstick for comparing progress made by the RETA against the overall challenge of improving knowledge on the poverty reduction impact of transport and energy investments.

Drawing on the propositional inventory, the following key gaps in current knowledge were identified, with a view to including them within the design of the field research wherever possible:

- impacts of sector policy change,
- impacts of changes in service provision,
- impacts of transport modes other than roads,
- impacts of energy sources other than electricity,
- impacts of transport and energy projects on the urban poor,
- constraints on access by the poor to improved transport and energy services,
- gender differences in the impacts of transport and energy investments,
- environmental consequences of transport and energy investments, and
- governance and institutional issues.

The main focus of the field research was to trace out the causal chain of effects that, in a given context, leads from a transport or energy intervention to a poverty reduction outcome. The broad conceptual framework for the field research proposed transport or energy interventions as the independent variables, macroeconomic and sociocultural factors as contextual variables, sector policies and situational characteristics as intervening variables, and poverty reduction outcomes as dependent variables. The interaction of multiple factors has been articulated in the studies by IFPRI.

To improve the prospects of insightful findings about how transport and energy infrastructure affects poverty reduction, the selection of sites for the field work was

based on countries with relative macroeconomic and political stability over the last 10–15 years, where it was to be expected that infrastructure interventions would have had more chance of realizing their potential impacts. The countries selected for field work were the PRC (Shaanxi Province), Thailand, and India (Gujarat State). The range of transport and energy case studies examined is summarized in Table S.1.

Table S.1. Transport and Energy Case Studies by Country

Case	PRC	India	Thailand
Secondary/rural Road	■	■	■
Railway	■		
Long-Distance Travel			■
Bus/rail Stations	■		
Private Port		■	
Rural Electrification	■	■	■
Urban Slum Electrification			■
Complementary Credit, Training	■		

Source: Authors' summary.

People's Republic of China Country Study

The PRC study examined the use of transport and energy services by poor and nonpoor households in selected poor counties in two prefectures of Shaanxi Province, Yulin in the north and Shangluo in the south. The study used household data from the Shaanxi provincial database for poverty monitoring, and from field surveys conducted in four counties. The team used four different definitions of poverty: (i) a measure of income-based poverty based on the official poverty line, equivalent to about 66% of the international "$1-a-day" standard; (ii) poverty based on incomes of less than $1 a day; (iii) poverty based on consumption expenditures of less than $1 a day; and (iv) poverty in value of household assets.

A probit model was used to estimate the impacts of transport and energy infrastructure, in conjunction with other factors, on poverty reduction. The findings suggest that both road and rail investments do contribute to poverty reduction. Whether a village had road access or not in 1998 had no observable effect on household poverty for the extreme poor (those below the national poverty line), although it had the expected effect for the poor defined in other ways. This may mean that the extreme poor could not take advantage of village road access to escape from poverty. Only if the households have reached some income or asset accumulation threshold can village roads contribute to poverty reduction. Access to electricity in 1998 had the expected impact on poverty only in the case of poverty defined by the value of assets. This suggests that farmers increased their ownership of electrical appliances (especially television sets) after gaining access to electricity, but that they did not use electricity much for income-generating activities.

The field survey database included additional measures of the quality of transport and energy infrastructure. Linking the results to those found using the provincial database, it emerges that when transport and energy infrastructure was of poor quality, it did not contribute much to poverty reduction. Higher densities of roads and stronger electricity systems have a greater impact on poverty than simply providing basic access, since the reliability and quality of transport or energy services are important.

The findings from the statistical analysis, together with the results of participatory village discussions and key informant interviews, were combined to assess the impacts of five different interventions: rural road improvements, road construction, railway construction, rural electrification, and roads and electrification combined with access to technical services and credit. Better performance in poverty reduction in villages with road access was attributed to two main factors: easy access to credit and technical training, and direct effects of road access on transaction costs and time. Smoother and faster motorized road transport also facilitated a shift to high-value perishable products. Households, both poor and nonpoor, substantially increased the share of their income coming from off-farm employment over this period. Village road access did not seem to have made a significant difference in this respect.

Households with access to electricity performed better than those without electricity in terms of income and consumption growth. The value of assets, however, grew faster among the households without electricity. Poor households with electricity, especially the poorest, showed faster rates of income growth than poor households without electricity. In poverty reduction, however, access to electricity did not show any benefits. The main reason for the contrast between impacts on income growth and impacts on poverty reduction is that households with electricity increased their income from both farm and non-

farm activities more than households without electricity. Households without electricity, and in particular the poor among them, increased their income more from off-farm employment. However, little significance can be attributed to these differences, because of the small size of the nonelectrified sample.

Railway construction in two counties had a greater immediate impact on income than on poverty. In 1993, per capita incomes of farmers in Zhen'an and Zhashui were the lowest in the prefecture and the incidence of poverty was very high (80–90%). After railway construction, the counties had the prefecture's highest annual per capita growth rates for gross domestic product and household income, but poverty incidence was still higher than in most other counties in the prefecture. The study found that the poor benefited as much as the nonpoor from employment opportunities generated by railway construction and increased demand for local products and services. Railway construction also had a demonstration effect: local people employed gained confidence, skills, and experience that enabled them to then seek other employment outside their villages.

The PRC country study showed that transport and energy infrastructure contributes to poverty reduction, not only by directly improving the living conditions of the poor, but also by diversifying income and employment sources and helping improve the productivity of poor households. Infrastructure also helps improve health care and education and enhances the contact and communication of the poor with the outside world. However, the team found that the positive impacts of transport and energy investments on the poor were constrained by existing policies and institutional arrangements.

Thailand Country Study

The Thailand study examined the poverty reduction effects of (i) rural transport improvements, (ii) rural electrification, (iii) urban electrification, and (iv) long-distance transport by road and rail. The three rural sites covered Nakhon Ratchasima and Buri Ram provinces in the Northeast Region and Nakhon Si Thammarat Province in the Southern Region. The two urban sites were in Nakhon Ratchasima City and Bangkok.

Three different definitions of poverty were used. The first was income-based or "objective" poverty. Using national urban and rural poverty lines, respondents were divided into "poor," "ultra poor," and "nonpoor" groups. Second, the study examined how people's perceptions about poverty affect their perceptions about infrastructure improvements. To do so, it introduced the notion of "subjective poverty," or poverty status as reported by key informants (village and community leaders). Third, the study measured "relative poverty" through self-reports. This was found to correspond closely with subjective poverty, indicating that people accurately perceive their own status and that of other people, and do so in relation to local rather than national norms.

The basis for defining transport change was the recorded change in travel time, by the most convenient means, from each village to the district center. Changes in travel time could reflect road improvements, transport service improvements, and/or changing modes of transport, including increased private vehicle ownership. Changes in energy status were measured by the percentage of households in each village connected to electricity in 1990 and 1999. The team carried out an econometric analysis using village-level data from the national rural survey database, combined with household-level data from field interviews; and used household interviews, village-level information and key informant interviews, participatory focus groups, and supplemental secondary data analysis.

The findings of the Thailand country study suggest that many benefits of improving transport and electricity services to poor communities are widely shared, even if households are not equal in their ability to access such services directly. The benefits of communal improvements such as street lighting and village water supply, as well as those such as greater access by teachers, health care providers, security services, and nongovernment organizations (NGOs), are accessible to all. In fact, such benefits probably make a greater difference to the poorer households in the community, since the nonpoor have other options for obtaining these services. Poor households also welcomed improved opportunities to access common resources. Even if the poor do not change their own produce marketing behavior as a result of road improvements, they benefit from increased competition among buyers and traders coming into the community. The benefits are not only lower prices and greater variety of goods, but also more secure supply under conditions to which the poor are particularly vulnerable; furthermore, if poor households rely on wage work for their incomes, road improvements allow them to seek work over a wider area, and electricity offers a greater range of employment opportunities.

Perhaps surprisingly, transport and electricity improvements had not induced a significant change in the employment patterns of most poor households. Farmers remained farmers; urban laborers or petty traders remained in their

occupations. However, transport and electricity improvements had clearly helped many people increase their productivity. Farmers shifted from subsistence crops to higher value crops and livestock; urban workers were able to reach wider markets and work longer hours. About half the rural households studied, and less than half the urban households, felt that their incomes had increased as a result of transport and energy improvements. Income impacts were less widely felt among the poor and least among the very poor, although the differences between income groups were not very great. One area of special concern was the small minority, usually very poor, that had experienced a decline in income.

Positive impacts on education and health are likely to promote income poverty reduction over the longer term, perhaps not measurable within the time span of the present study. It is therefore encouraging to note that the rural poor benefited even more than the nonpoor from improved access to education, and the urban poor benefited even more than the nonpoor from improved access to health care. The findings are particularly significant in girls' education, which is clearly facilitated by safer road travel and better lighting at home and in the community. The same conditions facilitate greater social participation by both men and women, helping build social capital both within and between communities.

The Thailand country study confirmed that transport and energy improvements induce additional expenditure by both poor and nonpoor households, some of which might be seen as a pure consumption expense (tourism, television) but much of which can be seen as a form of investment (work-seeking travel, travel to participate in family or community activities, using lighting and household appliances to extend working hours or facilitate studying). Study respondents strongly rejected the hypothesis that roads or electricity had anything to do with indebtedness.

Long-distance travel was common among both urban and rural households. Poor households were more likely to engage in work-related long-distance travel, whereas nonpoor households were more likely to make long trips for social or personal purposes. Road transport was generally the preferred mode, as it was more convenient and faster. Time savings were important to the poor as well as the nonpoor. Rail transport was used by a relatively small minority of long-distance travelers, mainly because costs were low and when origin and destination were conveniently served by railway stations. For this reason, poor households are more likely than others to travel by train to and from Bangkok.

The team concluded that the most important research result was the finding that poor people place a high value on improved access to transport and electricity. This finding was confirmed both by the econometric analysis and by the subjective evaluation provided by local people.

India Country Study

The India study was carried out in the state of Gujarat. Three districts were initially selected for the study: Jamnagar, which achieved very significant poverty reduction over the study period; Bharuch, where poverty was relatively low, both at the beginning and the end of the period; and Panchmahal, the only district in the state with persistently high poverty. Kuchchh District, where significant poverty reduction also took place, was added to the sample to include a private port project (Mundra port) in the study.

The study used the national definition of poverty in India, equivalent to a per capita income of about $88. By this measure, about 60% of all sample households were poor.

The study's two main objectives were to (i) evaluate the impact of transport and energy interventions on poverty reduction at the community, household, and individual levels; and (ii) identify the direct and indirect mechanisms through which this impact on poverty was produced. To achieve these objectives, the study used village-level information and interviews with key informants from service agencies, household interviews with questionnaires, limited participatory focus group discussions, and supplementary secondary data analysis.

At the community level, changes were measured over the 5 years from 1998 to 2002. Since all the villages were electrified before 1997, changes over this period may be largely attributable to recent district road improvements. However, they might also represent delayed effects of village electrification. Since there were no "without-service" villages in the sample, the study could only measure changes that occurred after both electrification and road improvement took place. Consequently, it was not possible to separate transport effects from energy effects at the village level. At the household level, the analysis found significant differences in income between electrified and nonelectrified households, as well as between households that are close to and far from improved roads. The differences were greater for electrification than for road access.

To clarify these findings, the India team used a probit model to predict the probability of a household being poor. The model showed that access to roads and electricity

were significantly (negatively) related to poverty status only in Panchmahal (the district where poverty was still high). In Kuchchh, the relationship between access to electricity and poverty status was significantly negative, but no significant relationship emerged for road access. In other districts, neither service was significantly related to poverty. Distance to improved roads also had no relationship to poverty status. However, per capita expenditures on energy were significantly (positively) related to poverty status in all districts, and per capita expenditures on transport were significantly (positively) related to poverty status in all districts except Jamnagar. These results suggest that it is not mere access to these services that leads to poverty reduction, but rather the use of the services, as measured by expenditures.

The impacts of the private port at Mundra in Kuchchh were different from the impacts of road and electricity improvements. Although these impacts were also covered by the household survey, open-ended discussions with focus groups in two sample villages were particularly valuable in understanding port impacts. In general, the villagers felt that they had not benefited from the construction of the port in their area. The indirect benefits of the port had accrued mainly to landowners and homeowners, as well as to those who could invest in commerce and trade. The port had brought about some negative impacts, which were felt mainly by the poorer households depending on wage labor for their income. Since many landowners had sold their agricultural land and salt farms to the port or the factories, fewer job opportunities existed for wage laborers. The growth in commerce and trade had increased the prices of some essential commodities, putting further pressure on the limited resources of the poor. Instead of employing local labor, the port and associated industries were using labor contractors who brought workers from outside the district and even from outside the state. The origins of these workers indicate that they might have been poorer than the local people. Thus, although port employment had little impact on poverty in its immediate vicinity, it may have been having a positive impact on poverty on a state and national scale.

The overall finding was that improvements in roads, ports, and energy infrastructure had significant effects on poverty at the household, village, and community levels. Impacts that accrued to both the poor and nonpoor included growth in existing economic activities and emergence of new employment opportunities. Others were improved access to health care and education facilities, and improved availability of news and information. The study also found that the poor gain improved access to common property resources, increased personal security, and enhanced participation in social bonding, building social capital, and social participation.

Findings on Propositional Inventory

The country studies provided new evidence to support or disprove the hypotheses in the propositional inventory. This is summarized in Table S.2.

For rural transport improvements, the country studies supported hypotheses concerning decrease of transport costs for the poor, access by poor people to health care and education services, and access to common property resources, and their improved personal security and participation in the community. As regards the income generation hypotheses, the studies supported the idea that transport generates farm and nonfarm incomes, but found that this did not disproportionately accrue to the poor.

For rural energy improvements, the main hypotheses supported were those concerning improved quality of education and health care for the poor, and increased information flow to the poor. Hypotheses of reduced energy costs for the poor and decreased pressure on woodlands were rejected. Findings on most other energy hypotheses, including impacts on farm and nonfarm incomes of the poor, were mixed or inconclusive.

For both rural transport and energy improvements, the studies supported the part of the hypothesis on wage employment concerning increased employment and wage rates, but again found that these did not accrue disproportionately to the poor.

The aggregate impact hypothesis that transport improvement significantly affects poverty reduction was supported, as was the hypothesis that transport and energy improvements taken together have a greater poverty reduction effect than their individual effects. However, findings were inconclusive on the hypothesis that energy improvement significantly affects poverty reduction.

The findings on urban transport and energy improvements refer only to Thailand. Among the hypotheses supported were those stating that urban transport improvement facilitates health care and education service delivery to the poor, and affects poor people's health and safety risks and community participation (mostly positively).

Table S.2. Summary of Findings on Propositional Inventory

No.	Hypothesis	Evidence from Studies			Observations
		PRC	India	Thailand	
Rural Transport Improvements					
1.	decrease costs to the poor for personal travel and goods transport.	■	■	■	Much of the gain from improvement reflected in time savings.
2.	generate farm income that disproportionately accrues to the poor.	x	x	x	Farm income increases accrue to nonpoor as well as poor.
3.	promote the development of nonfarm activities in rural areas that generate income disproportionately accruing to the poor.	x	x	x	In PRC construction employment was substantial, but nonpoor received greater share.
4.	increase the range of opportunities for wage employment and thereby raise the price of labor in rural areas, generating income that disproportionately accrues to the poor.	□	□	□	Increased employment opportunities and higher wages in India and Thailand, employment migration in the PRC; not disproportionately to poor.
5.	increase the availability and accessibility of education and health care services in rural areas, resulting in greater participation in these programs by the poor.	■	■	■	Frequency and quality of services affected, as well as service take-up and school attendance.
6.	increase the access of the poor to natural capital, especially common property resources (land, water, vegetation, wildlife).	••	■	■	
7.	increase the personal security of poor people in rural areas.	••	■	■	Being less isolated helps reduce the vulnerability of the poor.
8.	facilitate the delivery of emergency relief to the poor in case of natural disaster.	••	□	••	Not explicitly studied, but some evidence from Gujarat earthquake.
9.	have a positive effect on participation of the poor in (a) local organizations (bonding social capital), (b) activities outside the rural community (bridging social capital), and (c) local political processes and management structures.	■	■	■	Although findings were generally positive, in some cases exposure to outside world weakened internal social bonds and made people more critical of village life.
Rural Electrification Improvements					
10.	reduce energy costs for the rural poor.	x	x	x	Unit costs reduced but spending rose due to electricity bills and cost of appliances.
11.	increase farm productivity that generates income increases disproportionately accruing to the poor.	□	x	x	In the PRC poor households with electricity had most income growth; in India and Thailand, fewer poor households reported income growth, and often due to nonfarm activities.
12.	promote the development of nonfarm activities that generate income disproportionately accruing to the poor.	□	••	□	Growth of nonfarm activities confirmed, but nonpoor at least as likely as poor to gain.
13.	improve the quality of education and health care services in rural areas, resulting in greater benefits of these programs for the poor.	■	■	■	Lighting helps for doing homework and reduces eyestrain, electricity helps operation of service facilities.
14.	increase the flow of information to the poor.	■	■	■	Reading, radio, and television increased flow.
15.	by decreasing pressure on woodlands, protect the access of the poor to natural capital.	x	x	x	Few used electricity for cooking or heating, so biomass still widely used.
16.	increase the personal security of poor people in rural areas.	••	□	■	Household and street lighting considered important in Thailand.
17.	have a positive effect on participation of the poor (a) in local organizations (bonding social capital), (b) in activities outside the rural community (bridging social capital), and (c) in local political processes and management of community resources.	x	□	■	Effects were generally less than for rural transport improvement.
Aggregate Impacts					
18.	Transport improvements, all other things being equal, have a significant effect on poverty reduction.	■	□	■	Poverty levels in the PRC and Thailand were inversely related to per capita transport spending.

Table S.2. Summary of Findings on Propositional Inventory (*continued*)

No.	Hypothesis	Evidence from Studies: PRC	India	Thailand	Observations
19.	Energy improvements, all other things being equal, have a significant effect on poverty reduction.	x	■	□	In India strong links to income poverty reduction were noted; in Thailand, to nonincome dimensions.
20.	Transport and energy improvements, taken together, have a significant effect on poverty that is greater than the sum of their individual effects.	••	■	••	In India transport improvements tended to reduce inequality, but rural electrification tended to increase it.
Urban Transport Improvements					
21.	reduce transport costs for the poor.	••	••	x	
22.	facilitate the delivery of health care and education services to the urban poor.	••	••	■	Especially travel to school and health centers, and access to information.
23.	reduce (increase) health and safety risks for the poor.	••	••	■	Effects mostly positive, especially improved security; some negative effects, e.g., air pollution, road accidents.
24.	increase (reduce) opportunities for employment for the poor in (a) transport services, (b) commerce and industry, (c) the informal sector.	••	••	□	Substantial occupational change in response to road improvements, but more for nonpoor than poor.
25.	positively (negatively) affect the participation of the poor (a) in community organizations (bonding social capital), (b) in activities outside their neighborhoods (bridging social capital), and (c) in local political processes and management structures.	••	••	■	Due to greater convenience in traveling inside and outside the community.
Urban Energy Improvements					
26.	access to electricity reduces (increases) energy costs for the urban poor.	••	••	□	Household spending generally increased, but some poor households reported decreases.
27.	energy reforms increase the access of the urban poor to modern energy services.	••	••	••	Not explicitly tested, but Thailand study suggests need to give more attention to
28.	access to electricity improves the quality of health care and education services, resulting in greater benefits of these services to the urban poor.	••	••	□	connecting urban poor.
29.	access to electricity reduces (increases) health and safety risks for the urban poor.	••	••	□	Positive effects of street and home lighting, but poor may lack access.
30.	access to electricity increases (reduces) opportunities for employment of the urban poor in (a) energy services, (b) commerce and industry, and (c) the informal sector.	••	••	x	Effects likely for nonpoor, but not significant for the poor.
31.	access to electricity positively (negatively) affects the participation of the urban poor (a) in community organizations (bonding social capital), (b) in activities outside their own neighborhoods (bridging social capital), and (c) in political processes.	••	••	x	Effects reported by the nonpoor, but less by the poor.

■ = Confirmed, □ = Partly Confirmed, **x** = Not Confirmed, •• = Not Examined.
Source: Study findings.

Conclusions

General

Transport and energy infrastructure investments have benefited the poor as well as the nonpoor. Contextual factors in the country influenced this finding. Differences in some of these contextual factors may explain why similar poverty reduction results have not always been obtained in other Asian countries or in other parts of the world.

The evidence is not sufficient to reject the null hypothesis that the poor and the nonpoor benefit proportionately. Transport and energy infrastructure is, and is seen to be, a public good, the benefits of which are available to all. Poor people welcome such investments, even if they are not immediately able to take advantage of them. Reduced transport costs are reflected in the prices of their products and of the goods they purchase, as well as in the increased presence of traders and service providers in their communities. Poor people share equally in the qualitative benefits of improved access to health and education services, increased safety and security, and access to information. Transport and energy improvements are less likely, in the short run, to benefit the poorest of the poor, whose efforts are often handicapped by factors associated with chronic poverty; they are more likely to benefit poor households near the poverty line that may be able to escape poverty through their own initiative.

Poverty is not so much a village as a household characteristic. Within well-off communities, some households are still poor, and even in disadvantaged communities not all households are poor. Bringing transport and electricity to a community creates opportunities that benefit relatively richer households and enable some of the poorer households to move out of poverty. Even for those households that remain poor, welfare may be improved by some of the secondary impacts of transport and electricity investments at the community level. Particularly with respect to electricity, however, better-off households may be in a better position than the poor to make the complementary investments needed to turn an infrastructure investment into an opportunity to increase household incomes. Consequently, though everyone in a village may in fact be better off as a result of such investments, the perception may still be one of growing social inequality.

Transport and energy infrastructure creates opportunities to increase the productivity of the poor. For some households, these opportunities can become powerful drivers of an escape from poverty. Transport improvements were seen as having the most significant impacts on the incomes of the poor, mainly through increasing opportunities for employment in nonfarm enterprises. The impacts of electricity seemed less likely to benefit the poor in the short term.

Whether transport and energy investments bring economic benefits depends on the assets (natural, physical, human, social, and financial) that people can mobilize to take advantage of these opportunities. However, transport and energy investments are also important in making nonfarm income-generating opportunities available to landless poor households.

Whether transport and energy infrastructure brings benefits to the poor also depends on the quality of services provided. The responsiveness of transport and energy services to the needs of the poor is partly a function of public policy and partly of political culture and institutional governance. In transport, all three countries studied have relatively open transport service sectors offering a wide variety of options tailored to the needs of different users. Competition is keen, resulting in prices that may be close to marginal costs, so that the benefits of road improvements are likely to be passed on to the transport service consumer.

Time savings are of great importance to the poor, implicitly valued at much more than their opportunity cost of labor. Other studies have shown that the poor, especially women, are significantly time-deprived. Transport improvements generate time savings for the poor (and others) that are reflected in more time spent on farm or household work or on participation in health care, education, or other community activities. Time savings are particularly important in expanding the radius within which off-farm urban and rural employment opportunities are accessible to the poor. Energy improvements can also contribute to productivity if they are used together with time-saving appliances. Improved lighting can also extend the productive working hours of both men and women.

Infrastructure and service improvements that decrease risk and increase security, at both personal and community levels, are important for the poor and near-poor. Access to emergency health care services, though needed only rarely, is greatly valued by the poor, as is the ability to deliver emergency relief in cases of natural disaster and law enforcement in remote communities.

For some of the poorest of the poor, village improvements in transport and energy infrastructure may produce net negative effects on welfare. These include people whose livelihoods depend on activities that may be displaced by

transport or energy improvements and producers of local goods and services that cannot stand up to market competition. Project designers should, therefore, identify such potentially "economically displaced" poor people and include project components to help them develop alternative means of earning a living.

Improvement of transport or energy may have less immediate impact on chronic poverty. The three country studies examined the characteristics of households that had not reported income benefits from transport or energy improvements. The evidence suggested that such households fit the profile of the chronic poor, with relatively high rates of disability and chronic disease, low educational levels, and high dependency ratios. For such households, improved access to health care and education services may be the most important short-term benefit of transport and energy investments, paving the way for improved incomes in the more distant future.

Private Sector Development

The differences between the public and the private sector in delivering infrastructure services to poor households are not significant; the poor do not value low-cost, publicly provided services that fail to meet minimum standards of convenience, safety, and reliability and will shift to higher-cost, higher-quality, privately provided services if they have the option. Greater market competition seems to result in more choices and better prices that help to maximize the benefits reaching the poor. However, meeting the needs of the poor may mean delivering services at less than their true costs. If meeting these needs is a public priority, some form of subsidy may be required.

Gender Concerns

The study provided little hard evidence on intrahousehold inequities in access to transport and energy services, but does show that women, particularly poor women, are often put at risk by the lack of or poor quality of transport and energy services. Reliable transport seems particularly important in encouraging parents to allow girls to continue their education, and in enabling women to participate in social and economic activities, outside the village. Community lighting—street lights and illumination in communal facilities—has a positive impact on women's (as well as men's) safety, security, and social participation. Lighting and television/radio in the home lengthen the time available for productive work and enable women and girls to study and access information that might otherwise be unavailable to them.

Environmental Impacts

The poor are relatively unconcerned about the potential negative environmental impacts of transport or energy infrastructure. Air quality was the main environmental concern expressed by both poor and nonpoor respondents; no one mentioned negative impacts due to poor road design. Traffic accidents are a concern, but views are divided as to whether road improvements reduce such accidents or, by inducing traffic growth and higher speeds, increase them. Most survey respondents did not see degradation of natural resources due to increased access as a negative impact, but rather were happy with the greater opportunities to appropriate a portion of those resources for themselves. The majority view seems to be that, on balance, rural road improvements are environmentally beneficial. In urban areas, both poor and nonpoor residents are more conscious of the negative impacts of transport improvements on air quality, but are relatively insensitive to safety issues.

Policy and Operational Implications

This study's recommendations, at several levels, apply not only to national policymakers, but also to projects and programs designed by development partners, and include the following:

Investment in transport and energy infrastructure should continue until national networks ensure that all people have access to quality services. If investment stops before the national networks are complete, it will be the poorest who are left unserved. At the same time, the importance of service quality underlines the need for maintaining existing infrastructure networks and capacity expansion as needed to serve the demands of a growing economy.

The development community should continue to support transport and energy infrastructure and related services. These have a role to play in poverty reduction programs. While not all the poor will necessarily benefit from such interventions, a significant number will do so. Many nonincome benefits associated with transport and energy investments are equally available to the poor and nonpoor

at the community level and may be especially important for the poor.

Area targeting should be used to reach remaining pockets of poverty that suffer from a lack of transport and energy infrastructure. Area-wide, cross-sector investment planning should capture synergies among transport, energy, and other forms of support for poverty reduction. In particular, infrastructure investments should be coordinated with social sector investments focused on enabling the poor to take advantage of the opportunities provided. However, once the basic networks are in place, less scope will exist for area targeting and it will have diminishing returns for poverty reduction.

The area targeting approach will not suffice to eliminate poverty. In addition to targeting the remaining geographical "poverty pockets," this study shows that access to services varies significantly within villages and even, to a certain extent, within households. Some poor households that had characteristics of chronic poverty were not able to benefit economically from transport and energy improvements. Policies are needed that will ensure equitable access within communities; address gender, age-specific, and other barriers to the use of services; and encourage decentralized, demand-responsive management by local authorities. This may require household-level or individual targeting of support, such as subsidized transport and electrical connections.

Use of labor-based construction methods can increase the poverty reduction impact. These methods help poor families supplement their incomes on a temporary basis during the construction period. More important, perhaps, they introduce poor people, such as remote rural residents, to the labor market and give them some of the skills needed to seek more productive employment elsewhere.

Technology choices should be part of the decision-making process through which projects are designed and approved. In countries where labor is still relatively cheap, labor-intensive methods may be appropriate for road construction. Alternative energy sources such as coal, charcoal, solar cells, or mini-hydro may provide more satisfactory service than grid electricity. When national networks are well developed and well managed, however, they are almost certain to provide more cost-effective support to rural communities than solutions based on local labor and local resources.

Significant and sustained poverty reduction from an income perspective depends on enhancing the productivity of individuals and households through complementary investments, either public or private. The investments include not only local transport and energy infrastructure directly serving poor areas, but also the primary and secondary infrastructure networks into which these need to connect, as well as investment in health care, education, extension services, credit, and other productivity-enhancing activities.

The overall approach of examining the poverty impacts of transport and energy interventions within a wider conceptual framework of contextual and situational influences is transferable from case to case. However, the types and extent of impacts are case-specific; thus, it is unlikely that simple benchmarks can be developed for measuring the poverty reduction impacts of transport and energy projects.

The wider policy framework has a vital role to play in ensuring that transport and energy investments are, in practice, pro-poor. First, it must ensure that the poor can actually benefit from such investments. Then, it must provide safeguards to protect against adverse impacts and to reduce risks that the nonpoor will capture most of the benefits. Lastly, it should ensure that savings from efficiency gains in infrastructure management are redirected to support other programs designed to enhance the productivity and the welfare of the poor.

Transport and energy investments impact upon the income and nonincome dimensions of poverty. The case studies strongly confirmed that transport and energy investments are agents of economic growth that contribute to poverty reduction by raising incomes. They also confirmed the important role of transport and energy in alleviating nonincome dimensions of poverty, including health care, education, empowerment, opportunity, security, and freedom, thus helping raise poor people's incomes over the longer term. Thus, investment in transport and energy infrastructure and services not only promotes growth, but also supports education, health care, and other aspects of social development. Such interventions are therefore also important for achieving the Millennium Development Goals.

The selection and design of transport and energy projects can be more pro-poor. The transport case studies found that reducing the distance to the highway and improving road quality contributed to income poverty reduction for roughly half of poor households: road connectivity was a necessary condition for poverty reduction. Identification of poor areas that suffer from low road density and poor road quality, and examination of the supporting framework of policies and programs, are therefore important starting points in formulating pro-poor road projects.

The main contribution of new railways development to poverty reduction was found to be through supporting general economic growth. Small areas of high growth also developed around towns served by railway stations. The PRC study found that household poverty reduction was correlated with railway improvement within a 5-kilometer (km) radius of railway stations, but not beyond this zone. Future railway interventions could try to extend these influence areas by including feeder roads to link surrounding communities to new railway stations.

The electricity case studies identified connection fees, tariffs, and quality of service as critical issues affecting the willingness and ability of poor people to take advantage of existing infrastructure. Analysis of how to maximize connections and tariff affordability for the poor should be a critical issue in formulating energy projects.

The case studies found that in poor and disadvantaged rural areas, poverty reduction impacts were greater if both transport and energy were improved, or if transport and/or energy investments were accompanied by other pro-poor interventions, such as provision of small-scale credit and technical training. In formulating future rural transport and energy interventions, the adequacy of complementary programs should be assessed and, where inadequate, provided within the scope of the project, or developed on a multisector basis.

Safeguards should be built in for those who may suffer negative effects. A small minority of poor households may suffer negative impacts if their livelihoods are displaced as a result of transport and energy interventions. Project planners should consider this possibility, identify the groups concerned, consult with them, and include specific, targeted remedial measures in the project—most likely assistance in finding more productive occupations—to ensure that, on balance, they are not made worse off.

The study has shown that poor households care relatively little about the environmental impacts of transport and energy infrastructure. Even road safety seems not to be a high-priority concern.

The trend toward requiring increasingly elaborate project monitoring frameworks may need to be refined. Generally, ex ante analysis of the poverty reduction impact of projects is highly speculative. Moreover, transport and energy interventions contribute to poverty reduction over an extended period, perhaps as much as 20 years. Attempts to measure impacts over a shorter period are likely to confuse short-term effects with long-term impacts and produce misleading findings. It might be better to do ex ante poverty analysis of the sector rather than the project level, focusing on identifying and understanding the broad impact channels and critical situational factors. It would also be useful to initiate long-term monitoring studies to track the effects and impacts of a small sample of transport and energy projects over a period of 10–20 years.

Priorities for Future Research

Infrastructure and pro-poor growth. Until now, the debate on infrastructure investment and pro-poor growth has focused on the impacts that can lead to reduction in income poverty. Research is also needed to examine the impacts that can reduce the nonincome dimensions of poverty.

Link between system-wide transport improvements and poverty reduction. This study has not directly addressed the poverty reduction impact of system-wide improvements designed to alleviate congestion, increase average speeds, and provide more efficient transport services on a larger scale. Research is needed on the mechanisms by which transport cost savings that accrue in the first instance to vehicle owners or operators are passed on to intermediate users (shippers, merchants, service providers) and end users (travelers, producers, consumers), the degree to which regulation affects this pass-through, and the effects of subsidies.

Large projects. The literature review and case studies identified considerable methodological difficulties in examining the poverty reduction impacts of large transport and energy projects, such as expressways or electricity grids. Since large projects account for a substantial portion of investment spending in these sectors, research is needed into methods and models to improve understanding of their poverty reduction impacts.

Maximize the poverty impact of large infrastructure. Large infrastructure investments such as limited-access highways, railways, ports, and airports are expected to stimulate economic growth in the areas they serve. The extent to which the poor will participate in the benefits of such projects depends on their ability to access the infrastructure and related services (for example, secondary roads linking communities to major highways), and on their ability to take advantage of resulting employment opportunities (skills, credit, etc.). Research using case studies might identify the factors—such as a combination of transport and energy infrastructure with investment in education and telecommunications—favoring the partici-

pation of the poor in infrastructure-induced economic growth, as well as the barriers to their participation.

Negative side effects of transport on the poor. This study has indicated a relatively low level of concern among the poor about the potential risks of road transport. Yet it is commonly alleged that the poor are most likely to be victims of road accidents and vehicular pollution. Research on the real incidence of these negative side effects may help clarify views on this subject, raise awareness, and prepare for policy change if needed.

Barriers to poor people's participation in energy projects. This study strongly suggests that participation by the poor in the benefits of energy projects could and should be increased. Research could examine regulatory barriers and issues of high up-front costs, and explore the potential for well-designed, targeted subsidies or credit programs to cover up-front costs.

Implications of energy sector "unbundling" for the poor. This study did not address the question of policy changes that involve "unbundling" energy sector services and encouraging greater participation by the private sector. Research in other parts of the world, particularly Latin America, has suggested that such policy change may be beneficial to the poor, even if short-term costs are increased. However, it is also feared that the private sector may raise prices beyond the reach of the poor, and insist on the need for continuing subsidies. This is a fertile area for future research in the context of ongoing sector policy change in the DMCs.

Service provision. The field research for this study focused on infrastructure projects, treating service provision as an intervening variable. Although some changes in service provision are clearly related to infrastructure changes (for example, the proliferation of motorized vehicles on recently paved roads), others may be independent of such change. An interesting aspect of this question is the extent to which the poor invest in or otherwise obtain access to assets, such as vehicles, equipment, and appliances, to become direct users of the infrastructure provided, or share in the benefits by using others' equipment, e.g., transporting crops in a neighbor's truck, watching television in a neighbor's home. Further research could focus more closely on such changes in the poor's asset base and the extent to which the poor can "own" new services in this way. Improved quantity and quality of services at the community level can directly affect the poor, even if they are not direct users of these services: reduced transport costs can lower prices in local markets and increase the reliability of supply; street lighting and electricity in community facilities bring benefits the poor can appreciate.

Infrastructure and urban poverty. This study touched only lightly on infrastructure impacts on the urban poor. The nature of poverty is different in urban areas: many goods that are "free" in rural areas, such as water, fuels, and building materials, have to be paid for in cities; wage employment is critical to quality of urban life; and many urban poor depend on the informal economy to make a living. Future research could examine more closely the ways in which the effects, both benefits and costs, of transportation and energy investments in urban areas reach the urban poor. The study also showed that transport and energy projects play a part in improving communication and information flow between rural and urban areas. The full extent of these rural-urban linkages and their effects on the poor, both rural and urban, remain to be further explored.

Institutional issues. By focusing on the end user, this study paid little attention to the institutional and governance issues that influence the effects of transport and energy investments on the poor. In addition to the general concerns of maximizing efficiency and quality in service delivery, research is needed on how to make regulatory institutions and service providers (public or private) more responsive to the needs of the poor, including decentralization of regulatory and management responsibility to local authorities, necessary safeguards for equitable participation by the poor, and the possible role of NGOs.

Gender issues. This study found that transport and energy improvements create new opportunities for women as well as for men. However, the extent to which women can take advantage of these opportunities is influenced by economic, social, and cultural factors. Research is needed to investigate these gender aspects of transport and energy infrastructure impacts, distinguishing between men and women, and poor and nonpoor.

A paved road cuts across Thailand's Northeast Region.

Chapter 1

INTRODUCTION

Background

Concern about poverty and economic inequity has long driven the international development agenda. However, this concern has taken different forms over time. In the aftermath of World War II, the concern was for the economic consequences of the war and for ensuring rapid recovery in the defeated countries, to avoid a repetition of the social phenomena that gave rise to the war in Europe and Asia. The success of postwar reconstruction efforts in Europe and Japan led the international community to turn its attention to the poorer countries of the "Third World," where poverty was more deeply rooted. In the 1960s, development investments often focused on large infrastructure projects designed to promote the economic growth of poor countries, such as ports, bridges, and power plants. In the 1970s, however, it was recognized that such investments did not necessarily bring benefits to the majority of people—mostly poor—in those countries. In particular, they promoted the development of urban areas and industries, while failing to address the needs of the generally poor rural population. Consequently, attempts to address poverty in the 1970s and early 1980s became more focused on rural development.

Subsequent studies (Chambers 1983; Cernea 1985) showed that rural development programs were difficult to implement successfully and often failed to reach the poorer parts of the rural population. Following the publication of the first United Nations Development Programme (UNDP) *Human Development Report* in 1990, the focus of poverty alleviation efforts shifted to the development of human capital by improving education and health care services, complemented by structural and institutional change to alleviate the indirect burdens of debt and inflation on the poor. More recently, these concerns have extended to the physical, social, and cultural environment of the poor. Meanwhile, resource constraints have encouraged the withdrawal of the State from economic activities and greater involvement of the private sector in delivering services needed for development. These concerns have led some members of the development assistance community to question the value of public infrastructure investments in promoting sustainable development and poverty reduction.

Since the 1970s and the identification of poverty with the rural population of the developing world, theory and research on the impact of transport investments on poverty have focused on their role in promoting increased agricultural production and improving the incomes of farm households. In energy, they have focused on the "energy transition" from traditional to modern fuels. A considerable research effort has been devoted to understanding these changes. Only recently, however, have researchers begun to look specifically at the nature of poverty in both urban and rural areas, to disaggregate beneficiary populations into poor and nonpoor groups, and to study the intrahousehold distribution of benefits (e.g., gender-specific effects).

Throughout this evolution, transport and energy infrastructure has remained a priority concern for the clients of development finance institutions, and a major conduit for the flow of funds from the developed to the developing world. Recent research on the perceptions of poverty by poor people around the world also shows that they experience lack of access to transport and energy infrastructure as a process of social exclusion (Box 1.1). Consequently, the international development assistance community has recognized the need to learn more about how different types of transport and energy infrastructure investments can help reduce poverty in developing countries.

In response to shared concerns about the limited knowledge base linking infrastructure investment to poverty reduction, the Asian Development Bank (ADB), in collaboration with the World Bank, Japan Bank for International Cooperation (JBIC), and United Kingdom's Department for International Development (DFID), undertook a regional technical assistance project (RETA 5947). The purpose of this RETA was to assess the impact of selected transport and energy infrastructure investments on poverty reduction, based on field research

Box 1.1. Perceptions of the Poor about Transport and Energy

Many poor communities... are isolated by distance, bad road conditions, lack of or broken bridges, and inadequate transport. In both rural and urban areas, these conditions make it difficult for people to get their goods to market and themselves to places of work, to handle health emergencies, to send children to schools, to obtain public services, and to keep in touch with events and influence decisions.

> *A community without roads does not have a way out.*
>
> —A poor man, Juncal, Ecuador

> *If we get the road we would get everything else, community center, employment, post office, water, telephones.*
>
> —A young woman, Little Bay, Jamaica

Energy scarcity emerges as especially acute for poor people in the urban areas of the cold-weather climates of Eastern Europe and Central Asia… As in so many domains, so with energy scarcity: the poor and vulnerable suffer, and finally the children.

> *Finding firewood for cooking is the problem. Very soon we may have to go to the town to buy firewood.*
>
> —A woman, Viyalagoda, Sri Lanka

> *Gas heating is a great joy for us.*
>
> —A poor elderly man, Takhtakupyr, Uzbekistan

Source: Narayan et al. 2000. pp. 75–80.

in three Asian countries. Its objectives were to enhance current understanding of how transport and energy infrastructure and services contribute to poverty reduction, to fill knowledge gaps, and to identify lessons learned and good practices to be taken into account in future development assistance operations. The RETA was also intended to help formulate the infrastructure components of national or regional poverty reduction strategies in ADB's developing member countries (DMCs). Finally, it aimed to help build capacity in DMC research institutions to design and conduct policy-relevant research on poverty and infrastructure.

Methodology

The scope of work for the study was set forth in an ADB technical assistance paper, approved in October 2000 (ADB 2000a). A Steering Committee for the study was set up, involving representatives of the four development partner institutions, as well as key decision makers and interested staff from ADB. In Stage 1, an international consultant team consisting of a poverty specialist, a transport specialist, and an energy specialist, supported by an ADB research assistant, and in consultation with staff of the four collaborating institutions, conducted a review of relevant literature and project experience, to identify knowledge gaps and prepare proposals for field research. In Stage 2, teams from domestic research institutions undertook field work and data analysis in three ADB DMCs. The three teams came together at the beginning and end of Stage 2 in technical workshops, held in the participating countries, to coordinate the study methodology and to share the field work findings across the three countries. In Stage 3, the results of the three country studies were compared to identify new knowledge gained and the policy and operational implications to be drawn from it, as well as priorities for future research.

Before starting the study, the consultant team identified some key issues.

- The impact of any physical investment on poverty is highly dependent on the policy context. Thus, the study needed to take into account variations in policy context as well as actual infrastructure investment. These variations include both macroeconomic and social policy, as well as sector policy issues.
- The impact of infrastructure investment on poverty is mediated by the provision of efficient, reliable services to the poor. Thus, the study should consider not only improvements in infrastructure but also in transport and/or energy services, as well as the targeting of such services to the poor.

- Improvements at the margin of an infrastructure network can have a positive impact on the poor only if the network itself functions well. Thus, if access to services by the poor has already been provided, improvements in the cost-effectiveness of service provision on the network as a whole may have a greater poverty impact than additional infrastructure investment.
- Transport and energy investments meet different but complementary needs for the poor. In some circumstances, a substitution effect may apply (e.g., information flow); at other times, synergy may occur (e.g., electricity for schools and clinics can enhance the effectiveness of services provided via improved road access). In still other ways, their effects may be entirely separate. Similarly, the contributions of transport and energy investments to poverty reduction are likely to be different in urban and rural areas.

Literature and Project Review

The study team identified research on the impact of transportation and energy infrastructure on poverty reduction through a search of bibliographic databases. It searched the Econ Lit database (in a CD-ROM from ADB's Library), containing reports and articles from various economic journals, for relevant studies. The World Bank website, mainly the infrastructure and poverty sections, also yielded substantive results. The staff of ADB's divisions responsible for transport and energy operations provided suggestions on additional studies that could be useful for the RETA. In addition, the study coordinator and sector specialists on the international study team identified relevant publications. DFID and JBIC representatives on the Steering Committee also made suggestions, as well as the RETA's peer reviewers and participants in review workshops. The results of the review reported in the RETA Interim Report (ADB 2001a) were updated after the field work was completed in 2003.

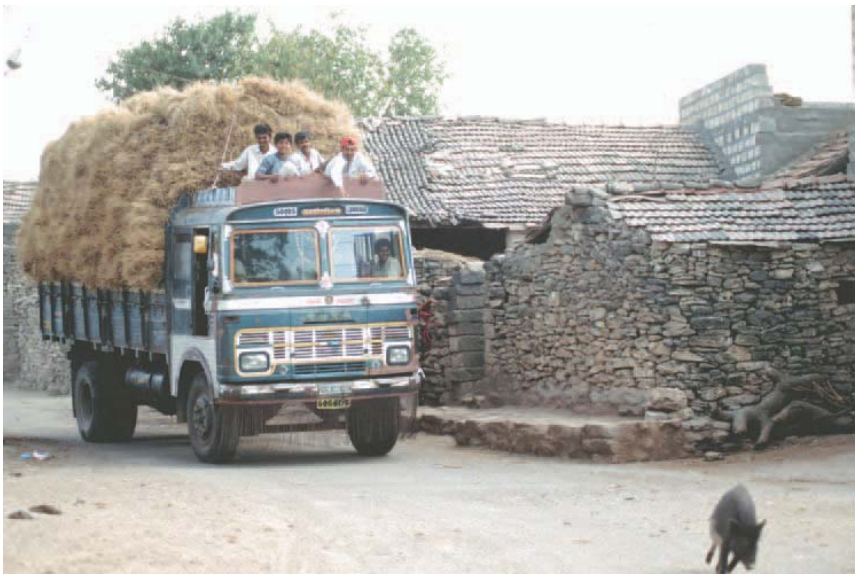
The study team also carried out a review of ADB transport and energy projects between 1993 and 2000 that indicated poverty as a primary or secondary objective, and of World Bank poverty-oriented transport and energy projects approved between 1994 and 2000. The objective of the review was to identify the technical approaches used and expected outcomes for poverty reduction, with particular attention to any plans for monitoring poverty impacts and any relevant evaluation results. The study team reviewed project summaries and appraisals for these projects, together with selected projects carried out by DFID and JBIC.

The findings of the literature review are summarized briefly in Chapter 2 and more fully in the Appendix. A complete list of the studies reviewed is given in the Bibliography. The findings of the project review are reported in Chapter 3. The literature and project review helped identify the research hypotheses and to evaluate the available evidence concerning the impacts of transport and energy infrastructure investments on poverty reduction in developing countries. This information formed the basis for a knowledge gap analysis and the formulation of proposals for the field research, described in Chapter 4.

Country Case Studies

During Stage 1, suitable countries and regions within countries, as well as qualified domestic research institutions in those countries, were identified, with the approval of the RETA Steering Committee. Proposed country team leaders participated in the review workshop on the RETA

A truck transports crops to market in Jamnagar, in India's Gujarat State.



Interim Report, held in November 2001. The research institutions were then invited to submit proposals in which they would identify the specific transport and energy investments to be studied and the research hypotheses they believed to be most appropriate for pursuing the policy dialogue in their countries. They were also asked to constitute national steering committees and to plan for national workshops in which the findings of their country studies could be discussed and disseminated. These proposals formed the basis for a Study Methodology Workshop held in Bangkok, Thailand, in January 2002.

The three country teams examined the full range of research hypotheses identified in Stage 1, regarding rural transport and energy improvements (generally, rural roads and rural electrification). They gave less attention to urban transport and energy investments, although the Thailand team did carry out urban case studies. Apart from rural road improvements, the teams variously looked at rail, port, and major road improvements. All three country studies used a combination of quantitative and qualitative methods, and performed secondary data analysis for the purpose of selecting sample communities and households, as well as for comparison to the results of field surveys. Each team collected data from community-level key informants as well as from selected sample households. Community discussions and group interviews also yielded data. The three teams shared preliminary results in a workshop held in Vadodara, Gujarat State, India, in July 2003. National seminars were also held in all three countries between April and October 2003.

Comparative Analysis and Conclusions

A RETA draft final report was reviewed in a workshop held at ADB in Manila in October 2003. Based on this review, the RETA Steering Committee concluded that additional analysis was needed to further explore the results of the country studies and to further develop the policy and operational implications of the research. This work was completed by April 2004 and is reflected in this final report. Chapters 1–4 summarize the current state of knowledge about transport and energy investments and their impacts on poverty. Chapters 5–7 describe the country contexts and case studies. Chapters 8–10 present the findings of the RETA, its policy and operational implications, and priorities for future research. Data sources are detailed in the Bibliography.

Transport and energy enable other activities to bring about poverty reduction. Policies and approaches to operations should seek to realize the full potential of this enabling influence.

Chapter 2

LITERATURE REVIEW SYNOPSIS

Introduction

After the literature review was completed in 2001, ADB, as part of an overall review of its 5-year-old Poverty Reduction Strategy (PRS) (ADB 2004a), reviewed and analyzed large amounts of data and published literature on poverty in Asia and the Pacific, the roles of growth and social development and of infrastructure in poverty reduction, the impact of the PRS on country-level operations and project designs, and the monitoring and evaluation of the strategy, poverty assessment reports, and country strategies and programs. The PRS Review incorporates and updates the review carried out for this study.

Poverty

Having adopted poverty reduction as the primary goal of its development activity (ADB 1999a), ADB is pursuing poverty reduction in Asia and the Pacific in the context of its four other strategic objectives: promoting economic growth, human development, and sound environmental management; and improving the status of women. ADB subscribes to the Millennium Development Goals (MDGs) established in the 1990s by the countries of the international development community, including a 50% reduction by the year 2015 in the proportion of the world's population living in extreme poverty.[1] Much progress has already been made, and despite occasional setbacks as the region's economy becomes more closely linked to the global economy, it is expected that these ambitious goals can be achieved (ADB 1999b).

Progress in poverty reduction is vulnerable to external economic shocks, such as the East Asian financial crisis or the sudden liberalization of transitional economies in the Central Asian republics, and to the uncertainties and security concerns that have adversely affected the global economy, and hence the region, since the late 1990s. Such shocks can, at least temporarily, push nonpoor households back below the poverty line. Progress in poverty reduction is also closely linked to progress in controlling population growth, in preventing and responding to natural disasters, and in controlling interpersonal, civil, and international conflict. ADB's strategy for assisting its member countries in poverty reduction rests on three pillars: promoting pro-poor, sustainable economic growth, social development, and good governance. All three objectives may be pursued through transport and energy projects.

The PRS Review arrived at several findings that will affect the PRS and how it is carried out. Among them:

- Implementation of the PRS has led to a sharper focus on poverty in ADB's policy dialogue with DMCs.
- Significant changes have occurred in project design in terms of pro-poor targeting and monitoring.
- In 2000–2003, ADB increased the share of transport and energy within total ADB lending and technical assistance operations.
- It is recommended that ADB focus on sectors and subsectors that particularly help the poor—e.g., on infrastructure sectors; the areas of focus should include rural roads, rural electrification, small and medium-sized enterprises, water supply, and sanitation.

Definition of Poverty

ADB defines poverty as "a deprivation of essential assets and opportunities to which every human is entitled" (ADB 1999b). In practice, ADB country strategies and programs are based on the definitions of poverty that are used by its member countries.

[1] Extreme poverty has been defined as per capita consumption valued at less than $1 a day in 1993 purchasing power parity prices.

The concept of measurable, income- or asset-based poverty can be further specified in terms of *extent* (percentage of the population below the poverty line), *depth* (mean distance of poverty incomes from the poverty line), and *severity* (square of the mean distance below the poverty line). In addition, measures of absolute deprivation (for example, incomes insufficient for adequate caloric intake) can be complemented with measures of relative deprivation or social inequity (e.g., the Gini coefficient). In the Asian context, where significant progress has been made in absolute poverty reduction, social inequity is now perceived to be an increasingly important dimension of the poverty problem.

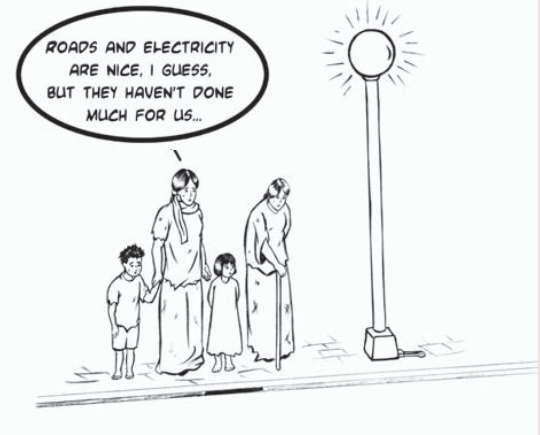
The ADB definition fits well with work on poverty and human development carried out by UNDP over the past decade. UNDP defined a "human development index" combining measures of longevity, literacy, and infant mortality, complementing the income-oriented measures used by the World Bank. More recently, UNDP has added a stronger emphasis on improved governance and participation by the poor as key factors in overcoming poverty (UNDP 2000).

The World Bank has also recognized the changing thinking about poverty. Its current view of poverty, based partly on the results of extensive consultations with poor people around the world, is given in the 2000/2001 *World Development Report* (World Bank 2001). Its three pillars of poverty reduction are *promoting opportunity* (access to resources, services, and productive employment), *enhancing security* (reducing vulnerability to shocks), and *facilitating empowerment* (increasing the participation of poor people in decision making).

Recently, development analysts have started to distinguish among transient poverty, structural poverty, and chronic poverty (Hulme and Shepherd 2003). Transient poverty is often the result of sudden shocks such as wars, financial crises, or natural disasters; seasonal changes; or life cycle events, that occasionally push people living near the poverty line back across it. Chronic poverty may be due to any of several disabling factors at the individual or household level, including dependency (children and the aged); gender, caste or indigenous minority status; and physical or mental disability. The determinants of transient poverty are different from those of chronic poverty (Jalan and Ravallion 2000). Consequently, chronic poverty requires different treatment (e.g., targeted services, social safety nets, direct income transfers). Structural poverty, by contrast, is basically due to lack of opportunity: it is often due to disconnection, often geographical, from the wider economy and society (Datt and Ravallion 2002, Jalan and Ravallion 2002). The provision of infrastructure and services is critical to overcoming structural poverty.

Poverty in Asia and the Pacific[2]

Poverty reduction cannot be achieved globally without significant progress in Asia, which still accounts for about two thirds of the world's poor. Generally, the countries of Asia and the Pacific have made significant progress in poverty reduction over the past 20–30 years, with development strategies that promote broad-based economic growth; major infrastructure investments; private, employment-generating investment; and the green revolution in agriculture. Growth provided fiscal resources that were redirected toward social programs, including major investments in education and health care services, and in social safety nets.



Chronic poverty may be due to any of several disabling factors at the household level, including very young or old people, disability, and caste or minority status.

In the past poverty has been largely rural, and rural areas remain poorer than urban areas, but rural-urban migration, a solution to structural poverty whose effects are still not well understood, has changed the situation. Urban poverty has not figured largely in the assessment of poverty in Asia and the Pacific. However, Asia's urban centers contain pockets of severe poverty and, as rural-urban migration is likely to continue, urban poverty is likely to grow. Future strategies for reducing poverty will have to anticipate a shift in relative importance from rural

[2] This section is largely based on an unpublished paper prepared by Cynthia C. Cook for ADB in 2001 (Cook 2001).

to urban poverty and develop ways of addressing these problems. Strategies to reduce poverty will also have to consider the needs of children, the elderly, and disabled persons in poor households.

Poverty Reduction in Development Projects

Few projects explicitly designed to address poverty reduction were approved before 1995, and most of these are still being implemented. International and other development finance institutions have developed guidance for staff and clients on how to take poverty reduction into account in project and program analysis (ADB 2001, World Bank 1999). However, empirical research measuring the poverty-reducing impact of development projects is still rather limited. Early efforts to incorporate concern over the distributional effects of development projects in project appraisal were generally unsuccessful (Little and Mirrlees 1974, Squire and van der Tak 1975, Powers 1989). ADB's *Guidelines for the Economic Analysis of Projects* (ADB 1997) requires an analysis of the distribution of project effects (costs and benefits) among different groups, and a calculation of the proportion of net benefits going to the poor (the poverty impact ratio). An *ex ante* review of recent projects in the transport sector concluded, however, that staff and clients have been moderately successful in mainstreaming poverty concerns in project formulation (Hansen 2000).

Infrastructure projects carry a particular risk of impoverishing, or further impoverishing, people affected by relocation associated with major construction projects. Both ADB and the World Bank, as well as other development finance institutions, have strong policies determining the requirements for resettlement of people so affected and internalizing the consequent costs in project cost-benefit analysis. ADB has also prepared guidance for staff on identifying these risks and planning appropriate mitigation measures to include in projects (ADB 1998).

Poverty and the Private Sector[3]

The resources needed to fuel sustained growth far exceed the resource mobilization capacity of governments and international institutions. Private capital flows are already far more significant, and the private sector is often a more efficient and effective manager of investments, particularly profit-making ventures, than government. Thus, the active involvement of the private sector is essential for successful poverty reduction, especially in infrastructure (Box 2.1). A study of current private sector involvement in providing infrastructure for the poor shows that over 80% of low-income countries have some type of private participation in infrastructure. In the lowest-income countries, the public sector is still responsible for most infrastructure investment, although even here, private sector involvement is growing rapidly (Houskamp and Tynan 2000).

Box 2.1. Role of the Private Sector in Poverty Reduction

> The private sector, the engine of growth, can also play a direct role in poverty reduction. It can participate in physical and social infrastructure, including provision of basic services that will benefit the poor… As the role of the private sector expands, that of the government should shift from owner and producer to facilitator and regulator… Governments must also monitor the social impacts of privatization to see that retrenchment, redeployment, or compensation programs are appropriate... For poorer areas, public investment is generally necessary (p. 9).
>
> The contribution of the private sector to poverty reduction will be enhanced through enterprise development, expansion of infrastructure and other public services, and improvement of corporate governance and responsibility… Private operators could be enabled to increase their participation in providing infrastructure and public services and in projects targeting the poor. Regulatory reform will, however, need to precede sector-specific approaches such as privatization, contracting out, and public-private partnerships (pp. 23–24).

Source: ADB 1999.

Ehrhardt (2000), summarizing the key structural issues that governments should consider when planning to introduce private participation in network utility industries, recommends regulatory reform to allow new providers to compete with incumbents or fill previously unserved market niches. According to Smith (2000), a pro-poor regulatory strategy would focus on deregulation, eliminating barriers to entry, reducing the scope and intensity of price controls, and being more pragmatic in attempts to control service quality.

[3] A useful symposium on this subject is *Infrastructure for Development: Private Solutions and the Poor*, Proceedings of an international conference held in London and sponsored by Public-Private Infrastructure Advisory Facility (PPIAF), DFID, and the World Bank, 31 May–2 June 2000 (PPIAF, DFID, and World Bank 2000). Several studies cited in this review are reprinted in Brook and Irwin (2003).

Legally established monopolies in infrastructure services such as transport and energy, with provisions for cross-subsidies between different categories of users, are often justified as a form of "protection" for the poor. However, recent research has shown that the intended benefits of such regulation rarely reach the poor. Restructuring and privatizing public enterprises to promote competition may be a more effective way to accomplish this objective.

Pro-Poor Growth

In recent years, considerable work on the nature of "pro-poor growth" and the role of infrastructure investments has shown that particularly in Asia, economic growth and poverty reduction have followed expanding access to global markets, which in turn depends on expanding transport and logistic infrastructure at the national level (Carruthers and Bajpai 2002). Other types of public investments (e.g., education) are also needed to enable the poor to take full advantage of these opportunities.

In India's Gujarat State, where this bus is loading passengers, the growth of good roads averages about 700 kilometers per year.

The importance of linkages between farm and nonfarm growth in the rural economy for the welfare of the poor has been known for some time (e.g., Hazell and Haggblade 1993). Recent research suggests that the positive impacts of infrastructure investments on poverty reduction, even in rural areas, may be achieved more efficiently by expanding opportunities in the nonfarm sector than by increasing agricultural output.

The World Bank recently completed a wide-ranging literature review on how increased access to infrastructure services impacts on poverty reduction in four sectors—energy, water and sanitation, transportation, and information and communication (Brenneman and Kerf 2002). The report concludes that the impacts are similar in all regions, but are better documented in regions where physical infrastructure is still largely lacking (e.g., Africa) than in regions where access problems are due more to affordability and quality issues (e.g., Asia).

Transport

Most of the early empirical work linking transport investments to poverty reduction defined poverty in terms of a region or a rural economy, without disaggregating to the village or household level (Box 2.2). Current studies are limited to the roads subsector and suffer from many methodological problems. The *PRSP Sourcebook* section on transport investments (Gannon et al. n.d.) suggests that transport investments will have the greatest impact on poor people when other sector interventions are also in place, and stresses the need to address both infrastructure and services in transport policy, establish public accountability for poverty outcomes, and promote broad public participation in planning and action to meet transport needs.

Transport Needs of the Rural Poor

Transport planning in developing countries does not take adequate account of the needs and requirements of the rural poor (Barwell et al. 1985). These are largely for the movement of small loads over relatively short distances. Much available transport is inappropriate to local-level transport tasks; "intermediate means of transport" (IMTs) between walking and motor vehicles are required, including human-powered vehicles such as wheelbarrows, handcarts and bicycles; animal-drawn carts and sledges; mopeds and motorcycles; and boats. Rural transport could be greatly improved by grading and straightening footpaths, strengthening bridges, and making paths passable by IMTs. Nonmotorized transport should be incorporated into project design (Guitink, Holste and Lebo 1994).

Box 2.2. Early Evidence on Rural Road Impacts

- Roads lead to agricultural production increases. Larger, wealthier farmers are able to benefit most.
- Subsistence farming yields to commercial farming. Production of crops that are perishable and/or are transport-intensive generally increases the most.
- Rural roads expand the use of new tools, machines, inputs, and modes of transportation. Wealthier producers benefit most.
- Rural roads encourage the establishment of government services and private cooperatives. The major beneficiaries appear to be the larger farmers.
- Agroindustrial, industrial, and commercial enterprises increase along the road corridor. Such expansion can hurt local cottage industries.
- Rural roads stimulate short-term employment, especially if they are built using labor-based technologies. They also contribute to wider employment opportunities in the medium and long term. However, workers engaged in traditional modes of transportation may be displaced.
- Road improvements lead to higher land values and more intensive land use. These benefits may be captured by wealthy outsiders and/or a local elite.
- Transport cost savings are available to all, but the new modes of transportation may be out of the economic reach of the poor.
- Marketing activities increase and new marketing patterns arise with road improvements. The largest beneficiaries are large cash crop producers and those close to markets.
- Rural roads increase the availability and use of consumer goods, social travel, and recreational activities. The consequences for the poor are mixed.
- Rural roads increase access to health and education services, but the benefit of these services to the poor is not always evident. Other barriers remain. Also, roads may serve as the vectors of new diseases and/or new cultural values disrupting the community.
- Roads have mainly negative effects on ethnic minority groups but mainly positive effects on women.
- Farm-to-market roads have relatively little impact on rural-urban migration, but rural arterial roads may accelerate migration to urban areas.
- Rural roads accelerate deforestation through the expansion of agricultural land and the increased commercial exploitation of forest resources. Intensified production may lead to soil degradation and erosion as well as pollution from fertilizers and pesticides. Poor road design may lead to flooding and other types of environmental damage.

Source: Devres, Incorporated 1980.

Transport Needs of the Urban Poor

Relatively less attention has been paid to the transport needs of the urban poor, although it is a growing category in Asian towns and cities. Researchers have tended to neglect the frequent short pedestrian trips of the urban poor in favor of longer trips by public transport (Kranton 1991). The poor travel mainly to school or work; travel to work can be long, time-consuming, and prohibitively costly, especially for poor households clustered on the urban periphery. Men in urban areas make more and longer trips than women (Allport 2000). Although walking is the only mode of transport used by at least half of the urban population and accounts for 80% to 90% of all trips among the poor, the urban infrastructure makes little accommodation for pedestrian movements. The dispersion of the urban poor makes it difficult to meet their transport needs with geographically targeted interventions.

Rural Transport Improvements

Cook (1983) showed that a significant share of all travel in rural areas, but probably less than half, is work-related. Other reasons for traveling include seeking health care or education services, or participating in social, political, or religious activities. Changes in personal mobility resulting from rural road improvements may have far more profound effects on rural development than changes in commodity transport. The appropriate design of projects intended to serve mobility needs may be different from those designed to promote commodity transport.

Employment in labor-intensive rural road construction can provide direct, immediate benefits to poor people and can also generate additional benefits through the multiplier effect (an estimated 1.5 to 2.8) of expenditures in the rural economy. Labor-intensive methods also often make use of locally available construction materials. Where labor-intensive methods have been used, the benefits, which can be wage-targeted to the poor and include work for women, are clear (Edmonds and Howe 1980). Labor-intensive works can be constructed at costs 25–30% less than those of comparable capital-intensive methods (Keddeman 1998). Unfortunately, labor-based construction methods are infrequently used despite their known benefits, and the immediate benefits of wage employment are not usually sustained over time.

In a recent project aimed at empirically evaluating the impact of rural road improvements on the rural economy and the life of rural people, Levy (1996) found that in

Repairing and redesigning bridges like this one in Zhen'an County, Shaanxi Province, People's Republic of China, would be a great help to the rural poor.

addition to reducing vehicle operating costs, the project succeeded in eliminating frequent road closures during bad weather. Reduced vehicle operating costs were reflected in lower prices for goods and passenger transport, resulting in traffic growth on project roads. Ownership of motor vehicles and the supply of passenger transport services increased significantly. Access time to service centers was cut by at least 50%, due partly to better road transport and partly to the location of new facilities in the study areas. Agricultural production patterns changed dramatically as farmers shifted from low-value, less perishable food grains to high-value fruits and vegetables produced for export markets. In Bahia State, Brazil (World Bank 1997), new feeder roads initially benefited primarily the large farmers already living in the project areas, but they also stimulated in-migration and brought improved living conditions for the population as a whole, including small farmers and landless farm workers. The share of landholdings under 50 hectares (ha) increased substantially over the study period.

Research sponsored by DFID has shown that reductions in transport costs, achievable through improved asset management and a better interface with the private sector, can have a significant impact in rural areas as elasticity of demand is high (30% increase in demand with a 10% cost reduction) (John Howe, personal communication). A study of the impact of rural roads on poverty reduction in Indonesia, Philippines, and Sri Lanka (ADB 2002) concluded that the poor and the very poor benefited substantially from social impacts through improved access to state services. Lack of maintenance of improved roads was a constraint, however, leading to a rapid decline in the benefit stream and reduced incentives for the poor to take the risks of changing their livelihood strategies. In Bangladesh, ADB found that providing all-weather access for rural residents on small roads with improved earthworks, bridges, and culverts, and assuring their regular maintenance, has a strong impact on reducing poverty (ADB 2000e, The Louis Berger Group, Inc. 2002).

A carefully designed study of the welfare impacts of rural roads in Viet Nam, now nearing completion, notes a decline in two- and three-wheel motorcycle services, suggesting that passengers are substituting cheaper alternatives (including accompanied freight transport) that were not available before road rehabilitation (Van de Walle and Cratty 2002). Significantly, time savings were highest for the poor. This finding may reflect a poorer initial condition of roads in the poorer communes served by the project.

An ex post study of the poverty impact of the ADB-financed Jamuna Bridge in Bangladesh showed that the bridge has substantially reduced poverty in the region that it serves, dramatically reduced transport costs, facilitated energy supply to the region, and improved the environment for private industrial investment (The Louis Berger Group, Inc. 2003). New economic activities developed in the vicinity of the bridge and along access roads. While the results show that landowning nonpoor rural households and rich urban households captured a greater share of the benefits than the poor, the benefits to the poor were nevertheless large enough to reduce (by 20–40%) the number of rural households in poverty.

Urban Transport Improvements

It is less clear how to use transport as an effective policy instrument to help the urban poor. Direct interventions targeting the transport needs of the urban poor are more difficult to implement, and may be less effective, than those targeting the rural poor. Transport subsidies are widely used to help the poor, but it is difficult to limit them to the poor: they are vulnerable to misuse and to capture by wealthier residents; they also weaken transit operators' incentives for cost control, create opportunities for rent-seeking, and eventually become financially unsustainable.

In rail and urban rail investments, even subsidized fares are often beyond the means of the poor. Graduated fares benefit the poor who take short journeys, while market flat fares are advantageous to commuters over longer distances (Allport 2000).

In a major DFID-sponsored study of sustainable livelihoods, mobility, and access needs in Uganda and Zimbabwe, which had a focus on rural-urban linkages, it was found that agricultural activities were important even for urban households. It also showed a high degree of residential mobility between urban and rural areas. Not surprisingly, journeys to work and school were the main travel purposes, followed by social visits. Long-distance travel in both countries was predominantly social in nature, including travel for funerals, weddings, and rituals.

Rail Transport

Rail transport, which is rarely affordable by the poor, has declined as investment has poured into roads. Where rail is used extensively by the poor, fares are heavily subsidized, either by public revenues or by other railway users. In these circumstances, the railway is often expected to make up a shortfall in passenger revenues by cross-subsidizing from freight traffic. With rail already at a disadvantage compared to road transport operators, this is a recipe for the demise of rail services.

Ports and Waterways

Water transport, including river transport and coastal shipping, remains important for poor people to meet travel and transport needs, as well as earn income. Some places in the developing world, such as parts of Indonesia and the Pacific Islands, are still so remote that water transport remains the major means of access. In other cases, such as Bangladesh, a dense waterway network complements the road system to ensure all-weather access for rural communities.

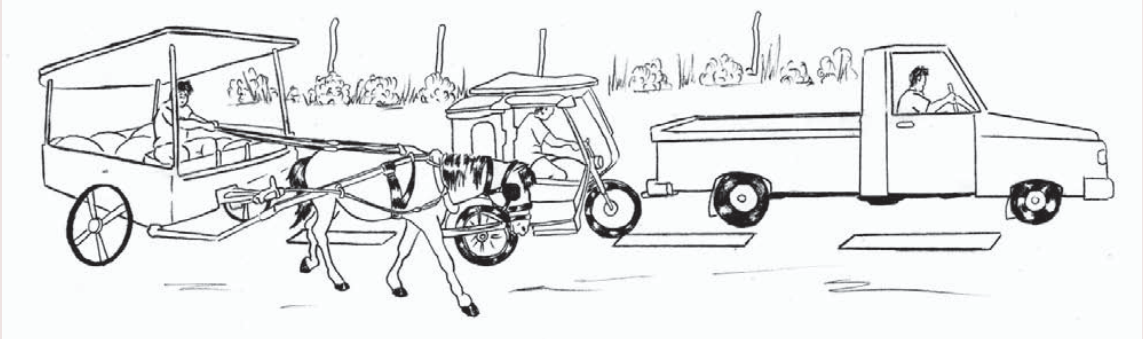
Aviation

Aviation, a high-technology mode, offers few employment opportunities for the poor. Nevertheless, the poor may share in the benefits that spring from airports and air services. Air access to remote areas, such as scattered island archipelagos, makes services more readily available and can be a lifeline in emergencies. Access by air can also be a prerequisite for tourism, which may employ unskilled poor people and give them a chance to develop skills and improve their livelihoods.

Gender Impacts

As of 2001, little research focusing on the gender distribution of impacts of transportation and energy investments had been published, but considerable work on this topic has since been completed. The general theme of this research, in both transport and energy, has been the need to move away from a gender perspective that focuses on enhancing women's capacity for productive work to one that addresses the equity dimensions of gender relations, and pursues the economic, social, and political empowerment of women. Based on the assumption that women are by definition disadvantaged and vulnerable, they have also helped identify political, institutional, social, and cultural barriers preventing women from capturing the benefits of infrastructure interventions. A study in Uganda on access to bicycles (Malmberg Calvo 1994) found that women were denied access to bicycles for both economic and social reasons. Similarly in Tamil Nadu, India (Rao 2002a), while women may gain access to a bicycle, they rarely control its use, as men's or boys' needs take prece-

Everywhere, animal-powered transport was being replaced with, first, three-wheeled, then four-wheeled motor vehicles.



dence. In Bihar, access to bicycles by men shifted the burden of transporting forest products from hilly areas for sale, but the change also shifted control over the resulting income to men (Rao 2002b). Research by International Forum for Rural Transport and Development, however, found evidence of cultural change in the face of changing economic realities, though the effects tend generally to increase rather than reduce women's workloads (Box 2.3).

An urban case study in Ahmedabad, India (Shresthova, Barve, and Chokshi 2002) looked at the role of transport in the lives and livelihoods of six women employed in the informal sector. More than half the respondents estimated that they spent between 2 and 8 hours every day to meet their work-related travel needs, and nearly 30% of their cash income on travel and transport, including 13% on work-related travel expenses. In Kolkata (Mukherjee 2002), women from periurban areas commuting to jobs as maids, vendors, industrial workers, and office workers, are away from home an average of 12 hours a day; 5–6 of those hours are spent traveling and waiting for transport.

In Bangladesh (Matin et al. 2002), women are treated discourteously on buses, so they prefer to use the less "public," but more expensive, rickshaws or rickshaw vans. Road improvements provide poor women with more income-generating opportunities, both in road construction and maintenance and in gaining access to other forms of employment. Transport improvements indirectly benefit women by making it possible to deliver services in rural communities, where women can access them more easily.

Policy Change and Sector Reform

To meet poverty reduction objectives, it will be necessary to revisit transport sector policies and to build the capacity of transport sector institutions. While investments in pro-poor growth must still meet economic efficiency criteria, targeted investments aimed directly at poverty reduction can be evaluated using cost-effectiveness criteria. To ensure that transport policies and institutions are responsive to the needs of the poor, it is necessary to provide for their participation at all stages of transport planning, decision making, and implementation (World Bank n.d.). In many instances the obstacle to mobility is not lack of infrastructure, but rather the lack of affordable and appropriate vehicles. Commercialization and privatization of state-owned transport enterprises may result in higher prices for services that previously were affordable to the poor, and may bring about labor redundancy. Public policy will need to anticipate these possible adverse consequences and provide safety nets.

Impact Assessment Methods

Before 1990, most conventional cost-benefit models used to evaluate rural transportation impacts focused almost exclusively on agricultural production, and failed to account for the values placed by rural people on such intangibles as time, energy, health care, security, social interaction, and spiritual intercession (Cook and Cook 1990). In particular, failure to account for the value of time has led to an underestimation of the benefits of passenger travel (including pedestrians) and nonagricultural commodity traffic. Dissatisfaction with conventional cost-benefit analysis as a way of evaluating ex ante poverty impacts has led some to experiment with alternative methods of assessing the incidence of rural road project benefits. Studies in Nepal (Jacoby 1998) estimate a nonparametric model and show that as a hypothetical road extends

Box 2.3. Women's Transport Needs

Women's transport needs are different from men's, and the transport responsibilities of women and men are quite separate. The triple burden of women—reproductive, productive and community-managing work—determines their transport activities and needs. Women are time- and energy-impoverished from meeting transport needs and are generally less mobile than men in the same socioeconomic group. Also, women are much less likely to have access to and use transport technology than men. Existing transport infrastructure, services, and technology may be inappropriate for women (e.g., bicycle design). Women have less money and face more cultural constraints.

Women's transport activities are much less visible in transport planning. Infrastructure and transport services oriented to the needs of women could drastically reduce women's workload and free up time and energy for other productive and reproductive tasks. Transport planners need to consult with men and women to address the intrahousehold division of labor, multiple transport needs, and cultural attitudes and norms. Furthermore, planners need to implement targeted schemes, such as providing credit for appropriate intermediate means of transport, and to develop and enforce regulations to ensure women's safety, especially while walking or on public transport.

Source: Hanmer et al. 2000.

Since women are often treated discourteously on public buses, they may prefer to use transport such as this Indian "taxi" just for them.

farther from the existing network (up to 8 hours' walking distance), benefits become progressively more targeted at the poor. The Integrated Rural Accessibility Planning developed by the International Labour Organization in the Philippines in 1990 and since used in Cambodia, Indonesia, and the Lao People's Democratic Republic, is based on quantifying village access to activities and services.

New methods that consider poverty in ex-ante project evaluation have been proposed. ADB has prepared technical guidance for its staff on the analytic and operational issues that need to be addressed in project preparation (ADB 2003a) and best practices for improving the poverty orientation of transport projects (ADB 2003b).

A suggested method to estimate the poverty reduction impact of rehabilitating major roads combines the results of classical road feasibility studies with data obtained from small sample surveys of road users (Gajewski, Luppino, and Fujimura 2002). This approach is based on ADB's *Guidelines for the Economic Analysis of Projects*, which calls for estimating the proportion of the net benefits to each beneficiary group that will be passed through to the nonpoor, the poor, and the very poor, in order to calculate a poverty impact ratio. The participatory approach also helps identify nonmonetary benefits and costs perceived by the poor, and the policy and institutional changes, as well as complementary investments, that could enhance poverty reduction impacts. ADB tested the approach in Tajikistan with ADB technical assistance for poverty analysis of a road rehabilitation project (ADB 1999c). The World Bank has developed detailed guidance for staff on the socioeconomic impact assessment of rural road projects (Grootaert 2002). Van de Walle (2000a), assessing current methods of evaluating rural road investments, including recent proposals to incorporate poverty reduction and equity concerns, finds a cost-effective approach to project selection appropriate, because rural road programs often operate under budget constraints and in an environment where economic efficiency is not the sole policy goal.

A recent DFID-sponsored study on the valuation of transport-related time savings by the poor in Bangladesh (I. T. Transport Ltd. 2002) shows that the poor, especially poor women, are more time-constrained than the nonpoor. Under conditions of time poverty, travel time represents a real opportunity cost to the poor. Consequently, the value of travel time savings to them is high.

Energy

Relatively few empirical studies have measured the impacts of energy infrastructure investments. While the provision of energy infrastructure alone is no longer expected to precipitate economic growth and reduce poverty (ESMAP 2000), the availability of modern energy, together with other enabling factors, can accelerate changes in economic welfare.

ADB's energy sector strategy seeks to increase the availability of energy in a least-cost and environment-friendly manner and to improve access to energy, particularly for the poor (ADB 2000b). The World Bank's *PRSP Sourcebook* (World Bank n.d.) identifies five goals for energy development that could have positive effects on poverty: (i) expanding access to modern energy, (ii) improving the reliability of energy supply, (iii) ensuring fiscal sustainability, (iv) improving sector governance and regulation, and (v) reducing health and environmental costs. The poor place a high value on modern energy services, and to the extent that they are available and affordable, are willing to pay the full cost. Lack of a reliable energy supply tends to discourage households from making necessary investments for an energy transition, and requires businesses to invest in costly backup facilities or to obtain alternative supplies at higher prices. Brook (2000) notes that the ways energy policies are set and energy services are delivered also provide indirect benefits to the poor: a more efficient, sustainable energy sector contributes to

national productivity, employment, and earnings; a more competitive and transparent energy sector provides fewer opportunities and incentives for corruption; decreased reliance on government subsidies frees fiscal resources; and a sector that is net contributor to the tax base can boost fiscal resources. DFID's position paper *Energy for the Poor* (DFID 2002a) argues for greater effectiveness in energy sector management, improved performance through privatization and regulatory reform, and expanded access and targeted subsidies for the poor.

Energy Needs of the Poor

Poor people, like others, are rational consumers who will naturally seek to maximize their economic welfare by using a mix of available traditional and modern, or commercial, energy resources (Barnes and Floor 1996; Foster and Tré 2000). People use different energy resources depending on availability, affordability, efficiency, and reliability. Rural electrification is unlikely to change poorer people's use of biomass for cooking. Without access to modern fuels, poor people in developing countries depend on biomass for their energy needs. Burning biomass such as wood, charcoal, dung, or straw exposes them to high levels of dust and soot, directly affecting their health, life expectancy, and quality of life (Lamech and O'Sullivan n.d.).

Energy in the Rural Community

Poor people in rural areas do not use electricity to meet many of their household energy needs, but electricity can help meet other needs of the poor through community services, such as potable water pumping, education, medical services, and security. Quantifying the value of these services, however, is difficult (ESMAP 2002a). The economic impacts of other modern energy services—such as refrigeration to improve and extend food storage, water pumping for irrigation, agricultural processing, and small-scale industries—are more readily measured. While rural electrification projects rarely support themselves financially, they can be justified by the external benefits rural populations receive from improved access to information, education, economic opportunities, health care services and improved security (Sanghvi and Barnes 2001).

The high cost per consumer is the main difficulty in expanding rural electricity services (Webb and Derbyshire 2000). An approach characterized by alternative market structures and institutional arrangements, including alternative forms of ownership, and/or the use of alternative technologies for energy production, is needed. For example, some benefits of modern energy may be achieved through the application of alternative technologies in the use of traditional biomass, such as modern stoves and smoke management (chimneys) (World Energy Conference and FAO 1999).

A recently completed study in the Philippines (ESMAP 2002a) found that willingness to pay for energy services is as high as the cost of providing grid electricity in rural areas. Indeed, many households without electricity are using more expensive and risky alternatives, such as kerosene lamps and auto batteries. When grid electricity lowers costs, energy consumption increases dramatically. Similarly, an ADB-financed study in Tajikistan (The Louis Berger Group, Inc. 2003b) found that poor households pay about as much as nonpoor for access to electricity, while the supply they receive, especially in rural areas, is much less reliable. Electricity services would have to be greatly improved before people could be expected to pay higher tariffs or comply with stronger collection efforts.

Energy in Urban Areas

Most Asian cities are already served by grid electricity. The challenge is to help the urban poor gain access to these services at affordable rates (ESMAP 2001). The low cost of extending urban electrification to the poor should make such programs economically justifiable, but the authors do not address the issue of property ownership: because many of the urban and periurban poor are squatters, obtaining a legal connection is very difficult or impossible. Even where the utility does not seek proof of ownership, other institutions might.

DFID's energy research program includes a number of completed and ongoing projects aimed at addressing poverty-energy linkages in urban areas.[4] One energy research project (DFID 2000c) focuses on the strategies the poor adopt to cope with rising energy costs: shifting down the energy ladder (e.g., from kerosene to fuelwood), reducing their energy consumption, reducing other expenditures. These strategies have a strong negative effect on the assets of the poor. Another (DFID 2000d) demonstrates that the shift from traditional to modern fuels also entails a shift from traditional (manual) transport to modern (mechanized) transport.

[4] The following project descriptions are taken from materials available on the DFID Knowledge and Research Energy website. Available: http://www. DFID-kar-energy.org.uk.

Energy for Commercial and Industrial Development

The availability of reliable modern energy is important in selecting a location for a new enterprise. Where access to modern energy is not available, the probability of new enterprises locating there is low.

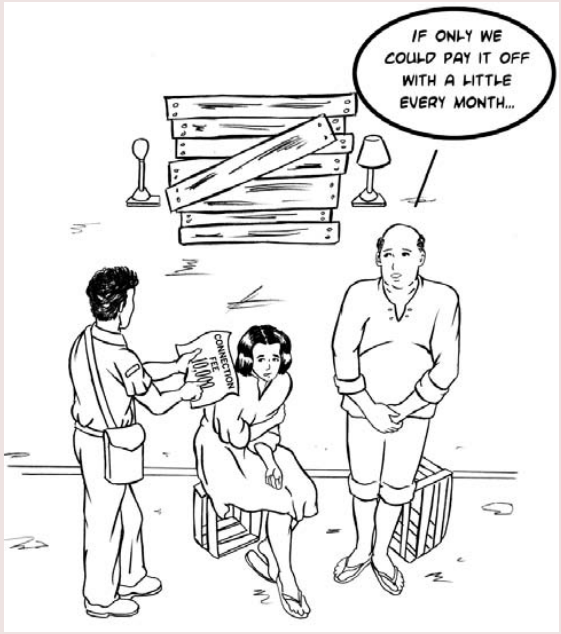
Expanding commercial energy provision is supposed to lead to social benefits (Lamech and O'Sullivan n.d.), but little evidence is available on the degree to which claimed benefits, from rural electrification in particular, are realized. World Bank studies in Asia suggest that investments in rural electrification are only economically justified where a dynamic agricultural or rural industrial sector already exists (World Bank 1994). Rural electrification can support rural economic growth but not initiate it. The driving force behind expanding commercial energy services is, however, largely political, and therefore the pressure for expansion is unlikely to diminish.

Gender Impacts

Gender bias, deriving from role expectations requiring women to provide and manage household energy, while also contributing their energy to the accomplishment of household and agricultural tasks, is evident in energy poverty, although little quantitative data are available (Annecke 2002). Programs promoting energy development for economic growth have not addressed these needs of poor women.

A set of case studies on energy and gender issues carried out by UNDP (Kairlsson and Misana 2001) show a strong emphasis on linking energy services to the creation of income-generating opportunities for women and facilitating their participation in community decision making. However, where grid-based electricity cannot be supplied to rural communities economically, alternative technologies also require some sort of financial subsidy to be affordable to poor people.

Many poor people could afford the monthly charges for electricity, but high up-front connection costs put the service out of reach.



Policy Change and Sector Reform

Despite the fact that it is difficult to devise and even more difficult to implement subsidy programs that are affordable, help poor people, and don't distort the market system, it is likely that subsidies will remain a part of pro-poor energy policies in developing countries for some time (Barnes and Halpern 2000). Thus, energy subsidies should be directed at encouraging access to service, rather than covering the operating costs of providing services. Electricity is known to have the highest connection costs of all forms of modern energy—an insurmountable obstacle to the poor. One solution has been to allow the option of paying for the connection and other equipment costs over time as an additional charge on their electricity bill. Such an approach may still not be sufficient for the poorest consumers. In the past, ADB has generally opposed energy subsidies in principle, but its most recent energy policy (ADB 2000c) recognizes that subsidies focused on poverty reduction may be an interim necessity. Other forms of modern energy (liquefied petroleum gas [LPG], kerosene) also require new appliances, so it will be important to establish a consistent policy for all forms of modern energy (Barnes and Halpern 2000). Efforts should also be made to ensure that all alternatives are priced consistently, so that economically rational use and consumption rates may be expected (Barnes and Floor 1996).

Villagran (2000) states that power sector reform programs should aim at improving access to electricity for potential consumers regardless of their distance

from the grid, because grid electricity is the least-cost, highest-quality solution. Governments should allow customers and service companies to make the technology decisions and avoid blocking the development of markets for alternative fuels through price subsidies and quantity controls.

Private Sector Involvement

As most countries seek to restructure their energy supply systems, debate has been renewed over whether private sector involvement in service provision is likely to improve access by the poor (see Albouy and Nadifi [1999] for a review of the evidence). A preliminary assessment of the impacts of utility privatization and sector regulation in Argentina (Chisari, Estache, and Romero 1999) shows that economic gains are significant and that all income groups will benefit, but that effective sector regulation would produce significantly greater benefits for lower-income groups. Estache, Gomez-Lobo, and Leipziger (2000) conclude that the relation between "privatization" and the poor is complex and in general ambiguous, and more research on this matter is needed.

Community Participation

It has been widely suggested that, if alternatives are adequately explained to the community, and the community is given the right to make the ultimate decision, an infrastructure intervention is more likely to be successful (ESMAP 2002b). Energy infrastructure must be paid for, and different energy options will have different costs and benefits, so the community must fully understand the implications of each option, and may not necessarily select electrification as its option.

Impact Assessment Methods

Foster and Tré (2000) discuss the feasibility of measuring the impact of energy sector interventions on the poor. Indicators should consider a household's full portfolio of energy sources, basic needs, economic benefits, and social benefits. Much of this information can be obtained from living standards measurement surveys or other income and expenditure surveys commonly carried out in developing countries.

Additional research sponsored by DFID has developed a tool kit for the selection of appropriate combinations of energy services to meet the needs of poor communities on a sustainable basis (DFID 2004). Combined with information on current energy expenditures and aspirations for the future, the tool kit helps assess the affordability of different options for different members of the community. Alternative scenarios then support community-based decision making. The goal is to encourage the development of more inclusive approaches to energy supply.

Transport and Energy

Only a relatively few studies have looked at the composite effects of infrastructure investments (together, in many cases, with investments in the social sectors) on economic growth and poverty reduction. These studies are particularly valuable in assessing the relative importance of different types of investments and their appropriate sequencing and timing for optimal impact. Most studies have included both transport and energy investments in this definition, although some have looked only at utilities (e.g., Houskamp 2000, and Komives, Whittington, and Wu 2000). In addition to transport and energy, the physical infrastructure "bundle" usually includes water, sewer, and telecommunications systems, and sometimes irrigation.

Taking a dynamic approach to poverty, in a study evaluating the role of infrastructure in reducing both transient and structural poverty, Sawada (2000) concludes that infrastructure, including roads and irrigation, has a role to play in relation to both types of poverty. In addition to increasing economic opportunities to reduce structural poverty, infrastructure helps minimize the risks of agricultural production, which are the main cause of transient poverty in Asia. Pouliquen (1999) stresses the role of rural infrastructure projects in building social capital at the community level, but points out that this does not necessarily result in poverty reduction. Greater community participation, together with more decentralized administration, may help empower the poor, but only to the extent that the poor participate effectively in local decision making.

A comprehensive review of the literature on rural electrification, with an emphasis on poverty reduction, showed that poor beneficiaries perceived important noneconomic benefits even when the investment had little impact on their agricultural productivity, and emphasizes the importance of complementary investments in equipment, services, and credit to enable the poor to access the benefits that improved infrastructure provides (Songco 2002).

A study carried out in India by the International Food Policy Research Institute (IFPRI) (Fan, Hazell, and Thorat 1999) found that investment in rural roads, followed by agricultural research and development (R&D), had the greatest effect in reducing poverty. Rural roads were second only to agricultural R&D in explaining increases in agricultural productivity. Investments in education followed in third place for poverty reduction.

The IFPRI model illustrates the multiple linkages between road expenditures and poverty reduction (Box 2.4, p. 22). Investment in roads acts on three major variables: total factor productivity in agriculture (because of cost savings in transport of inputs and outputs); agricultural wages (because of structural transformations in agriculture placing a greater premium on wage labor); and nonagricultural employment (due to the employment-generating impact of road works, the stimulus to nonfarm commercial and industrial activities, and greater efficiencies in the rural labor market). An interesting byproduct of this research is the ability to estimate the time lag for investments to have their maximum impact on poverty: those determined by the model are 7 years for roads and power, 8 years for irrigation, 10 years for health care, 11 years for education, and 13 years for agricultural R&D. In a similar study by IFPRI in the People's Republic of China (PRC) (Fan, Zhang, and Zhang 1999), education expenditures had the greatest impact on poverty reduction, followed by rural telephones, agricultural R&D, and then roads and power, having approximately equal effects.

Recent research on poverty reduction in the Philippines, based on data from 73 rural provinces, found that road infrastructure endowments were by far the strongest predictor of successful poverty reduction. The model also included changes in access to electricity, but this did not prove to be a significant determinant of poverty reduction (Balisacan 2001). A second study (Balisacan and Pernia 2002) found that electricity does not have a significant effect, either alone or in combination with education.

ADB's Economics and Development Resource Center looked at public expenditures in the 25 provinces of Indonesia from 1976 to 1996 (Kwon 2000). The rate of decline in poverty was found to be most sensitive to road investments, followed by education, agriculture, and irrigation.

A study on water and electricity service provision in Peru, looking explicitly at the question of whether synergies can be obtained by "bundling" infrastructure services (Grootaert and Oh 2001), showed not only that access to basic services was a key determinant of growth in per capita consumption, but also that the impact of each service increased as new services were added. Water and electricity were the most widely available and most likely to occur in combination; the combination of water and electricity increased incomes by much more than either service alone or the simple addition of the two separate effects.

Additional research on irrigation and poverty carried out by the International Water Management Institute in India, Philippines, Thailand, and Viet Nam (Bhattarai, Sakhitavadivel, and Hussain 2002) showed that poverty levels are generally lower in irrigated areas than in unirrigated areas, even though the bulk of the irrigation benefits may be captured in the first instance by the nonpoor. It emphasizes the importance of multiplier effects in spreading the benefits to the poor through increased farm and nonfarm employment.

Box 2.4. The IFPRI Model

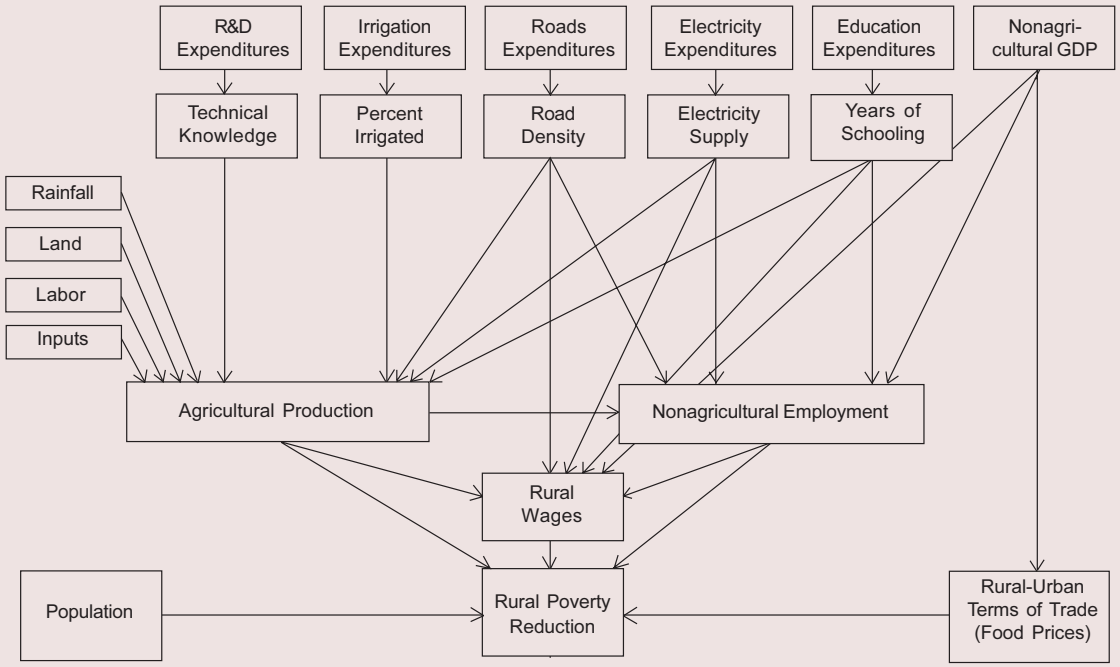
The "International Food Policy Research Institute (IFPRI) Model" uses a set of simultaneous equations to estimate the effects of different types of government expenditures (including both investment and recurrent expenditures) on rural production and rural poverty. Poverty is defined as the percentage of the rural population falling below the poverty line. In these equations,

- rural poverty reduction (DP) is estimated as a function of changes in agricultural production, rural wages, nonagricultural employment, rural-urban terms of trade, and population growth (lagged by 1 year).
- agricultural production is estimated as a function of agricultural land, agricultural labor, use of fertilizer, agricultural machinery and animal traction, percentage of irrigated agricultural land, current and lagged expenditures on agricultural research and development, road density, electricity supply, average years of schooling in the community, and annual rainfall.
- rural wages are estimated as a function of road density, electricity supply, average years of schooling, agricultural production (lagged by 1 year), and growth in nonagricultural gross domestic product (GDP) (lagged by 1 year).
- nonagricultural employment is estimated as a function of road density, electricity supply, years of schooling, agricultural production (lagged by 1 year), and growth in nonagricultural GDP (lagged by 1 year).
- rural-urban terms of trade are estimated as a function of local and national agricultural growth, as reflected in food prices, divided by a relevant nonagricultural GDP deflator.

In turn, road density is related to current and lagged public expenditures on roads, electricity supply to current and lagged public expenditures on electricity, average years of schooling in the community to current and lagged expenditures on education, and percentage of irrigated land to current and lagged expenditures on irrigation.

The independent variables are government expenditures in different sectors. Growth in nonagricultural GDP, population, and rainfall are exogenous (contextual) factors affecting outcomes. Availability of agricultural land, labor, and technical inputs (fertilizer, machinery, and animal traction) is a situational factor that is endogenous to the model, affecting outcomes in agricultural productivity. Expenditures on agricultural research and development and on irrigation are also related to agricultural growth but not to growth in nonfarm employment. Other types of public expenditure affect both the farm and nonfarm sectors of the rural economy.

The model has been applied in different countries with some variations. In India, health expenditures were included; in the People's Republic of China, expenditures on rural telephones were included; in Thailand, rural-urban migration was included. However, the results are fairly consistent across countries. They suggest that public expenditures on infrastructure are significant determinants of rural poverty reduction, partly through their positive effects on agricultural productivity, but much more importantly, through their effects on nonagricultural employment, wages, and rural-urban terms of trade.



Source: Fan, Zhang, and Zhang 1999; Fan, Hazell, and Thorat 1999.

Even today in many parts of India , this is what a "typical rural road" looks like.

Chapter 3

PROJECT REVIEW

In addition to the published literature, the study team reviewed documentation for all ADB and World Bank transport and energy projects approved by 2000 that identified poverty reduction as a primary or secondary strategic objective. The identification of poverty reduction as a strategic objective goes back only to the early 1990s, so all the projects reviewed were approved after that time. Consequently, most of them are still being implemented. Although some projects contained provisions for poverty impact monitoring, further reports from these projects were not available at the time of this review. None of the projects reviewed has yet been the subject of a post project evaluation report assessing its success in meeting poverty reduction objectives.

Asian Development Bank Projects

From 1993 to 2000, 30 ADB projects on transport and energy (26 for transport and 4 for energy) indicated poverty reduction as their primary or secondary objective. This includes transport and energy sector projects, and projects in other sectors (rural and urban development) with separately identified infrastructure components. These projects were being implemented in Bangladesh, Bhutan, Cambodia, PRC, India, Indonesia, Kyrgyz Republic, Lao People's Democratic Republic (Lao PDR), Nepal, Pakistan, Philippines, Thailand and Viet Nam.

Most (25) of these projects, including all energy projects, had poverty reduction as their secondary objective and economic growth as their primary objective. However, five transport projects (three of which were approved in FY2000) had poverty reduction as their primary objective. These projects were Indonesia's Community Empowerment for Rural Development Project, Kyrgyz Republic's Community Based Infrastructure Services Sector Project, Lao PDR's Rural Access Roads Project, Nepal's Rural Infrastructure Development Project, and Pakistan's Dera Ghazi Khan Rural Development Project. These projects were designed to contribute to poverty reduction, either by targeting a particular region or province where most of the population is poor or by targeting the poor in a relatively urbanized area.

Transport projects with a poverty reduction objective generally aim to meet development needs by constructing or rehabilitating roads and, in some cases, also by strengthening the capability of institutions or agencies to manage road networks, with the hope of generating savings from lower costs for road maintenance and administration. Most transport projects, particularly roads, have identified a reduction in transport cost as the most immediate benefit they expect to attain. The reduction in transport cost is expected to facilitate the efficient movement of goods, reduce transaction costs, and improve incomes. Rural road improvements that will reduce transport costs and allow access to agriculture services are seen to accelerate agricultural production by increasing the marketed surplus of agriculture and livestock products, reducing spoilage, and encouraging diversification into or increased production of high-value (often perishable) crops. Other expected benefits of road improvements include reducing traffic congestion and accidents.

One of the major expected outcomes of road transport projects is the generation of employment opportunities for the poor, resulting either from road construction and maintenance activities or from enhanced business opportunities where economic activity has increased. Other important outcomes that are seen to contribute to poverty reduction are social welfare improvements resulting from increased access to basic social services, such as health care and education facilities; and financial services, such as credit. Lastly, the poor are expected to benefit from improvements in the physical environment.

One attempt to evaluate ex-ante the likely impacts of a road project on poverty reduction was the Poverty Impact Study carried out for ADB's East-West Corridor Development Project (Chamberlain 1999). The project was to rehabilitate a major highway linking the Lao PDR to Viet Nam. The area traversed by the road contains isolated indig-

enous communities as well as communities established along the road by recent immigrants. Poverty, illiteracy, and disease are especially prevalent among the indigenous communities, whose traditional economic activities have been disrupted by national land allocation and forest management policies. The study points out that such communities are unlikely to benefit from the road improvement unless feeder roads are constructed in tandem with the highway reconstruction. The predicted effects on poor communities are described in Box 3.1. It also warns of the possible spread of "urban" diseases due to increased contact between minority communities and outsiders, and the potential for increased community involvement in the drug trade and other kinds of trafficking.

The construction of a limited-access toll expressway from Beijing to Tongjiang in northeastern PRC was not specifically aimed at reducing poverty; the project's goals were to reduce congestion on the road and rail networks serving the region and to improve access from the hinterland to key seaports. However, an ex post study of development impact, comparing the project area with a control area as well as to national norms, showed that access to markets and social services had improved and travel times were substantially shortened, leading to an increase in social and economic activity (Pan and Shu 2002). The supply of transport services increased markedly, especially short- and medium-distance bus services. Road accidents were significantly reduced. The project attracted industrial investment to the area and supported the growth of township and village enterprises, including tourism. Although the northeastern PRC is generally low in poverty, poor people from other parts of the country may have been employed in project construction. To enhance the poverty reduction impact, feeder roads serving low-income and vulnerable communities were also upgraded in Liaoning and Hebei provinces.

The PRC's Guizhou-Shuibai Railway Project will provide transport infrastructure to help create the conditions necessary to reduce endemic poverty in the project area and promote economic growth. Inadequate transport infrastructure has constrained the production of existing coal mines and the development of other natural resources. The project will allow the efficient transport of coal to energy-deficient areas in Guizhou and neighboring provinces. Hence, it will promote an expansion of coal mining in Guizhou. This will also facilitate the establishment of related industries, services, and tourism, creating employment and income-generating opportunities that will help reduce poverty. Similarly, construction of the Jing-Jiu

Box 3.1. Poverty Reduction Effects of Regional Highways and Feeder Roads

Short-term positive impacts

- Access to markets for agricultural produce
- Access to the villages by government health officials and service providers
- Availability of temporary unskilled jobs for villagers in construction
- Opportunity to provide food and restaurant services for construction crews

Long-term positive impacts

- Access to long-distance transport services (personal mobility)
- Access to long-distance markets (buying and selling)
- Easier access to health care facilities and medical treatment
- Increased access to agricultural extension services, including veterinary services for livestock
- Reduced environmental pressure due to reduced reliance on nonsustainable extraction of wildlife and forest products
- Increased access to education
- Increased opportunities for the development of tourism
- Diversification of income sources
- Increased participation in rural electrification schemes
- Improved social control (poaching and drug trafficking)

Short-term negative impacts

- Loss of field space and limitation of crop types
- Social disruption during construction resulting from interaction with workers from outside
- Increased risk of contracting socially transmitted diseases
- Physical disruption resulting in dust, noise, and refuse
- Potential safety hazards to villagers unfamiliar with heavy equipment
- Unaesthetic appearance of the road under construction (especially quarries), affecting tourism potential
- Potential for outside exploitation of villagers by entrepreneurs

Long-term negative impacts

- Economic exploitation—due to linguistic and educational background, poor groups are not able to compete effectively with mainstream groups
- Vulnerable groups—while it is probable that ethnic minority groups will experience many positive benefits from the project, they still are at a relative disadvantage as regards language and education
- Gender: increased economic activity may place additional burdens on women
- Increased noise and pollution will occur as a result of better roads and heavier traffic

Source: Chamberlain 1999.

Railway from Beijing to Kowloon, Hong Kong, while not targeted on poverty, promoted rapid growth in the seven provinces it traversed and generated employment, thereby reducing rural poverty significantly.

Urban infrastructure projects are expected to improve the working and living conditions of the urban poor, enhance the urban environment, stimulate economic growth, and generate employment. The Karnataka Urban Infrastructure Project in India aimed to promote decentralization of population growth and economic activity by addressing basic infrastructure deficiencies and related environmental aspects, as well as by building capacity for local governments and providing subsidized housing for low-income groups. The Kathmandu Urban Development Project in Nepal was to invest in core area upgrading, storm drainage, and flood control, bringing benefits to poor people living in squatter areas. The Subic Bay Municipal Development project in the Philippines aimed to rehabilitate and upgrade urban infrastructure, including roads, water supply, drainage and flood control, solid waste management, and markets to provide improved services to the urban population, of whom approximately one third are classified as poor.

The four energy projects reviewed are for rural electrification in Bangladesh, Bhutan, Cambodia, and Thailand. Provision of access to electricity is expected to improve the quality of life for the rural population and to enhance their income-earning potential through the establishment of local small industries that create jobs and consequently assist in poverty reduction. For instance, the Bhutan Rural Electrification Project was to provide indigenously generated hydropower to the domestic market in Bhutan to promote economic development, reduce the use of fuelwood for cooking and heating, and save foreign exchange by reducing expenditure on imported kerosene. The Provincial Power Supply Project in Cambodia was to restore and expand electricity networks in provincial towns, extending electricity coverage and making it more affordable to a greater number of poor households.

An ex ante study for a power rehabilitation project in Tajikistan included a participatory assessment of potential poverty impacts (Box 3.2). Previously, power generation, transmission, and distribution were the sole responsibility of the state power company. The centrally managed system was not responsive to client needs and suffered severe damage due to civil conflict and natural disasters. The participatory assessment recommended strategies to ensure that electricity would be provided to vulnerable households as well as to social institutions, and to industries generating employment for poor people. It was also recommended that operation and maintenance responsibilities be delegated to local authorities, who should be authorized to retain a portion of the revenues to meet these responsibilities. Participants also noted that complementary actions in other sectors would be needed for energy improvements to have a significant impact on poverty.

World Bank Projects

The World Bank had 36 poverty-oriented transport and energy projects approved from 1994 to 2000. Of these, 32 were for transport or urban infrastructure and only four for energy. Fifteen transport/infrastructure projects were in Asia, covering Bangladesh, PRC, India, Indonesia, Nepal, Philippines, and Thailand. The other projects, including all four energy projects, are located outside Asia, in Africa and Latin America.

The poverty-oriented projects in Asia comprise eight road projects, four urban infrastructure projects, two rural infrastructure projects, and one waterways project. Road infrastructure projects in Asia include highways, rural roads, road equipment, and road safety programs. These road projects were expected to relieve traffic congestion, improve the safety and efficiency of road transport, and facilitate mobility. These outcomes were expected to stimu-

Future meets past, as a pickup passes a team of oxen on an all-weather road in Jamnagar in India's Gujarat State.

Box 3.2. Poverty Benefits of Power Rehabilitation in Tajikistan

Tajikistan is a landlocked, mountainous country with a population of about six million, 85% of whom are estimated to be poor. After 6 years of civil conflict and natural disasters, the country's infrastructure was severely damaged. The Government decided to rehabilitate and strengthen the power generation, transmission, and distribution systems operated by Barki Tajik, the state-owned power company. To determine how this project would affect poor people, a participatory assessment was carried out during project preparation.

The assessment identified the people who would be directly and indirectly affected by the project, including poor people and vulnerable groups, defined in terms of gender, age, ethnicity, and displacement. It also identified other stakeholders, such as nongovernment organizations (NGOs), community organizations, private businesses, government agencies, and international organizations. Focus group discussions were held to develop an energy resource inventory for poor and vulnerable groups, map energy use in time and space, and obtain people's perceptions about different energy sources. More structured meetings with community leaders, focusing on the role of electricity in reducing poverty, followed these discussions. The results were then carried forward to a workshop with central government planners, line agencies, NGOs, and business and industry groups.

The workshop recommended strategies to ensure that electricity was provided to vulnerable groups (the elderly, female-headed households, and orphans) as well as to social institutions (schools, health care centers) and to industries generating employment for poor people. Participants urged greater transparency in tariff setting, with a portion of revenues to be retained in each community to cover operation and maintenance costs. Independent energy sources, especially renewables, should also be explored. Finally, the participants noted the need for complementary actions in the education, health care, and water supply sectors for energy improvements to have a significant impact on poverty.

Source: ADB 2001d.

late economic activity and, in some projects, to reduce regional disparities.

The road projects were to contribute to poverty reduction by creating employment, i.e., using labor-intensive methods for road construction and maintenance, as well as by providing access to essential social services. Some road projects were also expected to contribute to poverty reduction by empowering poor households in the project areas to raise their incomes through increased grain, livestock, and fishery production. The goal was to raise incomes to levels at least sufficient to meet the basic needs of food and clothing, and, in many cases, also to generate a marketable surplus to improve living standards.

In the PRC, rural road improvements were being carried out with World Bank support through a program called "Roads Improvement for Poverty Alleviation" (RIPA). The program, linked to ongoing poverty alleviation programs in five provinces, aimed at providing basic access to communities that are not connected to the road network. Basic access was defined as the least-cost improvement required to allow year-round access by the prevalent vehicles in the area (motorized and nonmotorized), and allowing for occasional (but not seasonal) interruptions of service. Roads were selected through a ranking procedure involving economic criteria (including direct measures of poverty) and social criteria (Box 3.3).

Road projects with policy reform and institutional strengthening components were expected to strengthen the capacity of transport ministries or departments so as to improve the planning, design, and operation and maintenance of road and highway networks. No direct impact on the poor is expected from such capacity-building programs.

The World Bank's urban infrastructure projects in Asia that involve the provision of urban roads and transport services have also included other components, such as water supply, drainage and flood control, and waste disposal. These projects were expected to contribute toward urban poverty reduction, mainly by improving the working and living conditions of the urban poor, enhancing the urban environment, providing better access to basic services, stimulating economic growth, and generating employment.

Rural infrastructure projects in Asia have provided for rural roads, small-scale irrigation and sometimes water supply systems, agricultural processing facilities, and institutional support. These projects were expected to improve equity and support poverty reduction, mainly by raising incomes by expanding the capacity to process livestock, horticulture, and agriculture; to provide better opportunities for poor farmers and women to contribute to agricultural growth and income generation; to improve the nutrition of the rural poor; and to relieve infrastructure constraints. The PRC's Inland Waterways Project aimed to improve connections between inland waterways and land transport services and to generate hydroelectric power, among other objectives. Two of the project site provinces—Hunan and Guangxi—are relatively poor, and project investments were expected to promote economic

Box 3.3. Road Improvements for Poverty Reduction in the People's Republic of China

The rural Road Improvement for Poverty Alleviation (RIPA) program of the People's Republic of China is linked to ongoing poverty reduction activities in five provinces: Gansu, Henan, Inner Mongolia, Ningzia, and Shaanxi. The program aims at providing basic access to poor communities that are not well connected to the road network. Basic access is defined as the least-cost improvement required to allow year-round access by motorized and nonmotorized vehicles of the types most commonly used in the area.

The levels of access that could be provided include (i) partial access, for trips that do not require all-weather accessibility (e.g., farm and forest roads); (ii) basic access, the minimum required to provide all-weather passability, with exceptions in extreme but infrequent weather conditions; and (iii) full access, a fully engineered road providing all-weather accessibility. Most communities have partial access now, but both residents and the Government consider this inadequate and inappropriate. The RIPA program defines three levels of basic access and associated design standards in relation to expected traffic.

Roads are selected for improvement through a complex process. First, priority counties are identified on the basis of economic and social criteria, including poverty measures, with the aim of targeting investments at poor areas that have potential for future development. Identified roads are then grouped into clusters, which are ranked according to a cost-effectiveness ratio (estimated cost per population served). Because cost-effectiveness criteria would tend to exclude projects in mountainous terrain, the cost of major bridges is excluded and the total cost for projects in these areas is adjusted downward. The final ranking also takes account of the severity of access problems, measured by the number of days in a year when the community cannot be reached by road. Economic rates of return are also calculated, but the minimum cutoff point is graduated (from 8% to 12%) in relation to the type of access provided.

Source: Hatim and Pendakur 2000.

development thereby helping to create new jobs, increase incomes, and reduce poverty.

World Bank poverty-oriented transport and energy projects in Africa and Latin America comprise five road/rural road projects, eight rural infrastructure/other infrastructure projects, one urban development project, four energy projects, and three others: state reform, privatization, and capacity building. The main benefit expected from highway projects was reduced transport costs. Other benefits included reduction of future road rehabilitation requirements, avoidance of road accidents, and savings in passenger time. Increasing incomes by promoting agricultural development, improving access to economic and social services, and increasing employment by carrying out project works with labor-intensive methods were expected to reduce poverty. One project, the Road Sector Investment Project in Zambia, expected to create employment opportunities in the road sector and reduce poverty by creating 30,000 new jobs in road maintenance. Another expected outcome was enhancing the capacity of communities and local stakeholders.

Rural infrastructure projects aimed to improve access to basic services by constructing roads as well as health and education facilities and by providing institutional support. Other projects were to assist governments in addressing environmental concerns. For example, the Ghana Village Infrastructure Project had components for rural water infrastructure, postharvest crop protection, institutional strengthening, and rural transport infrastructure. The rural transport component was to selectively rehabilitate and improve degraded feeder roads, develop village trails and tracks linking farms to villages to permit the use of simple wheeled vehicles, and implement a pilot program to develop intermediate means of transport for the rural poor. The rural transport component aimed to reduce the need for women and children to head-load goods to market, thereby reducing postharvest losses and saving rural women's and children's time and energy.

Two projects in Brazil, Paraiba Rural Poverty Alleviation and Maranhao Rural Poverty Alleviation, aimed to reduce poverty in the states of Paraiba and Maranhao, mainly by providing basic social and economic infrastructure and employment and income-generating opportunities. The Social Fund Project in Comoros provided for the rehabilitation and construction of feeder roads, as well as infrastructure for primary schools, health centers, water supply systems, and market facilities. This project was to assist the country's poorer communities by replenishing a social fund designed to support demand-driven initiatives that these communities have developed; in doing so, it will create employment and improve access to basic social services.

Other rural infrastructure projects aimed to contribute to poverty reduction by (i) improving equitable access to credit for the rural poor, unemployed youth, and women; (ii) improving incomes and quality of life in rural communities; (iii) strengthening local governance in rural areas; (iv) promoting social and economic empowerment

of the rural population, including women, youth, and other marginalized groups; and (v) increasing access of the rural population to basic infrastructure and services. Projects with institutional support components were expected to strengthen the capacity of selected institutions in efficiently and effectively delivering infrastructure services to the targeted poor.

The Urban Development Project in Togo was intended to contribute to urban poverty reduction with components including infrastructure improvements such as traffic management, environmental and sanitation projects, and community development and institution-building programs. Its contribution was to be mainly through small-scale urban works having optimal impact on the employment and incomes of the poor, and through the promotion of small contractors in the construction sector.

Today, thanks to many road-building projects, Thailand has an extensive network of highways, like this one leading to the Northeast Region.

Four World Bank poverty-oriented energy projects were approved in the decade prior to 2000. Two projects: Kiev District Heating Improvement and Sevastopol Heat Supply Improvement, both in Ukraine, aimed to improve heat production and distribution. Social assessments for these projects were carried out by local institutions. In Kiev, the assessment found that poor households suffered more than others from insufficient heat and hot water because they could not always pay for these services, and official subsidies were poorly targeted and managed. Many households eligible for subsidies thought they were not eligible, or preferred not to reveal their eligibility status. The social assessment recommended a public information and communication strategy for the project to improve subsidy targeting, to develop a constituency for a fair share of municipal subsidy funds, and to secure regular feedback from clients on service quality.

The Sevastopol study showed that only half the customers on the district heating system also received hot water. As in Kiev, poorer households spent a higher share of their income on food and consequently had less capacity to pay for heat. The social assistance program in Sevastopol was less well known and less used than that in Kiev. On the other hand, most people seemed to feel that they need not pay for heating services as long as the State was not paying salaries on time, and they had little confidence that the charges were related to actual costs. A large majority of the households would prefer to have meters for heating and hot water and felt that this would encourage energy conservation. The study recommended improvements in the targeting and coverage of the social assistance program, reduced bureaucratic requirements, and a more customer-friendly approach. It also recommended a public information and education strategy to promote both the effectiveness of the social assistance program and revenue collection.

The Energy and Water Project in Cape Verde involved energy and water sector reforms as well as promotion of renewable energy. This project was to contribute to poverty reduction by improving power, water, and sanitation systems and increasing the operational and end-user efficiency of energy and water infrastructure.

The Renewable Energy in the Rural Market Project in Argentina aimed to reduce poverty at the provincial level by carrying out power sector reforms. The project supported the promotion of private sector investment in the power sector, taking into account appropriate policy and regulatory frameworks. The four main components of the project were (i) installation of electricity generating equipment for rural markets, either by new or existing concessionnaires; (ii) installation of Wind Home System units in two small rural communities to demonstrate the commercial viability and long-run economic potential of wind power; (iii) technical assistance to implement power sector reform and adopt renewable energy technologies; and (iv) technical assistance for project administration.

The project also aimed to remove marketing barriers to the dissemination of renewable energy sources and to reduce greenhouse gas emissions by replacing traditional energy sources with renewable systems.

Three World Bank projects were not classified directly as transport or energy projects, but were to contribute to poverty reduction by assisting the transport and energy sectors, among others, through restructuring of public enterprises, privatization and capacity building, and community-based development. The Rio Grande do Sul State Reform Project in Brazil was expected to contribute indirectly to poverty reductionby improving efficiency in the government's service delivery through privatization and by improving the state's fiscal condition. The Privatization and Regulatory Capacity Building Project in Cape Verde appears to contribute to poverty reduction indirectly by creating an enabling environment for private sector development, including the transport sector. The Borgou Region Pilot Rural Support Project in Benin was to contribute to poverty reduction by improving the capacity of rural women and village communities to better manage their socioeconomic environment.

Monitoring and Evaluation

Most ADB projects included planned project monitoring and evaluation activities, although many were described only in a very general way in the report and recommendation of the President (RRP). Project monitoring mechanisms, including planned targets and indicators, were presented in the RRP's Project Framework. The indicators were mainly measures of project outputs or outcomes, such as the percentage of paved roads, traffic volumes, changes in passenger and freight rates, reduction in traffic congestion, and the passability of roads. For some projects, indicators included the number of jobs to be created. The more recent projects have identified poverty indicators, although some did not specify the extent of expected outcomes. Indicators of success in achieving poverty reduction objectives included, for example, a lower percentage of families below the poverty line, higher average rural household income, higher attendance in primary and secondary schools, improved literacy rates, and improved access to health care and other services.

In some cases, project monitoring mechanisms were to be put in place only when the project was implemented. Some projects stipulated setting up a project implementation office to collect and report data on the progress of the project. In other cases, benchmark data were collected during project formulation and similar data will be collected during project implementation. The reports gave limited information on how the poverty reduction objective of these projects would be addressed in the definition, collection, and analysis of the data. Proposed monitoring mechanisms included review missions, progress reports, participatory rural appraisal results, and periodic surveys.

Numerous ADB projects included provisions for studies aimed at measuring the poverty reduction impacts of transport and energy improvements. One such study was the socioeconomic impact study of the Rural Roads and Markets Improvement and Maintenance (RRMIMP II) project in Bangladesh. The Phase I report for this study (Bangladesh Institute of Development Studies 1998) describes the socioeconomic profile of the study area prior to project implementation, and the benefits expected to accrue to the rural people arising out of the improved rural transport and trading infrastructure under RRMIMP II (Box 3.4). To analyze and quantify impacts, the study adopted a "before-and-after, with-and-without" ("double difference") approach. Ten sample roads were selected, with four control roads matched to four of the sample roads. For each road, one roadside village and one remote (2 km away) village were to be studied. The household sample in each village was stratified by land ownership and occupation. Benchmark data for the key variables prior to the infrastructure improvements were collected and were to be compared with information on the set of variables 1 year after construction was completed, to assess short-term impacts, and 3 years after completion for the longer-term impact.

A review of project monitoring mechanisms and indicators described in the World Bank project appraisal reports shows that some projects, though not many, explicitly addressed poverty impacts in their proposed monitoring and evaluation activities. For instance, the PRC's Shaanxi Poverty Alleviation Project showed in a logical framework diagram how the individual project components were linked to poverty reduction. The monitoring system provided for monitoring of the direct impacts at an early stage of the project, while the indirect impacts were to be measured at a later stage. This poverty monitoring mechanism was also used in the Western Poverty Reduction project in the PRC. As part of the Mindanao Rural Development Project in the Philippines, a social assessment was carried out to ascertain the main constraints rural communities face. All these projects collected baseline information prior to project implementation.

For projects that had a specific objective of reducing poverty in a particular area, e.g., the PRC Western Pov-

Box. 3.4 Impacts of Rural Infrastructure Improvements in Bangladesh

The preliminary socioeconomic impact study of the Rural Roads and Markets Improvement and Maintenance project (RRMIMP II) in Bangladesh identified likely impacts in three interacting areas in the rural economy:

- the production and service sectors,
- the institutional and social service sectors, and
- the household sector.

In the production and service sectors, the anticipated impacts are increased access to inputs, increased marketing of outputs, and increased transport services. Increased access to inputs was expected to lead to

- intensification of factor use,
- improved input use and transition to better technology,
- increased volume of output,
- changes in the output mix, and
- a rise in productivity levels.

In marketing, the expected changes were

- locational spread of markets,
- increase in market size in terms of number of buyers and sellers and turnover leading to a rise in toll revenues,
- changes in the physical structure of shops,
- changes in the composition of goods and services traded,
- changes in the level of prices of goods exported from and imported into the area, and
- reductions in seasonal variations.

In transport services, the study expected

- increase in the volume of traffic, passenger and freight;
- change in modal mix and freight composition;
- reduction in seasonal variation in traffic flows;
- changes in transport sector ownership patterns; and
- lowered transport charges resulting in user cost savings.

In the institutional and social service sectors, indirect impacts were expected through changes such as

- better health care services,
- higher school enrollment levels,
- increased extension services, and
- more rural financial institutions.

At the household level, transport improvements would affect

- the level and characteristics of household members' employment , due to changes in both demand and supply of labor;
- the level and sources of wage and nonwage income;
- consumption and market surplus;
- use of transport;
- demand for institutional services, particularly health care, family planning, and education;
- savings and investment;
- asset accumulation; and
- demographic features.

Source: Bangladesh Institute of Development Studies 1998.

erty Reduction Project, the key performance indicators used to monitor the achievement of this objective included the percentage of population below the national poverty line, increases in crop and livestock yields, school enrollments, visits to health centers, jobs created, etc. A similar approach was used for the Shaanxi Poverty Alleviation Project, with the goal of reducing poverty in 20 of the poorest counties in Shaanxi Province. Indicators included real increase in rural incomes, percentage of households above the poverty line, employment rate, quality of housing and other assets, repayment of loans, wage income increases, etc.

For Nepal's Road Maintenance and Development Project, sector and outcome/impact indicators were classified. Sector indicators included improved access of rural population to basic infrastructure services and social facilities, and decreases in transport costs. Outcome/impact indicators were the share of population provided with increased access to basic motorized transport in the project districts, reductions in travel time and transport cost, employment creation, and improved road conditions and quality of road works. This list demonstrates that there was still some confusion about the difference between outputs and outcomes, as well as in the choice of indicators to assess project outcomes in terms of their impact on poverty reduction.

The monitoring activities for Second Shaanxi Provincial Highway Phe indicators were also classified into two other categories: those related to implementation targets (pointing to progress in reaching intermediate and end-of-project objectives) and those related to developmental impact objectives (pointing out both the more immediate/short-term conditions resulting from project investments and the longer-term outcomes of these investments). For the RIPA component, the key performance indicators included employment creation, school enrollments, hospital visits, increased traffic volumes, and reduced road closures. The assumption was that, since these investments were targeted to poor areas, the poor would gain the lion's share of the resulting benefits.

For other projects, the indicators presented were mostly of project output. For instance, the key performance indicators for the China Guangxi Highway Project were reduced time for interprovincial trips due to a more efficient highway system involving lower cost and shorter distances; more staff trained, formally and on-the-job, in technical and managerial skills, to respond to the needs of an expanded, high-grade highway network; an increased budget to rehabilitate and maintain provincial roads (other

than the high-grade network); and fewer traffic accidents, especially on the heavily traveled corridors. In the case of the Bangladesh Third Road Rehabilitation and Maintenance Project, some key indicators were completed national road network, reduced accident rates, reduced vehicle operating costs, improved feeder roads, and number of narrow bridges widened.

Mechanisms for monitoring and evaluation included the preparation of sector reports, country reports, progress reports on poverty assessment, project implementation reports (monthly, quarterly, and annual), and monitoring of disbursements. Data for assessing the achievement of project objectives were also to be collected through baseline and follow-up surveys. Other monitoring mechanisms included midterm reviews, final project evaluations, participatory rural appraisal results, community-based monitoring systems, etc. For some projects, e.g., the India Assam Rural Infrastructure and Agricultural Services Project, a project unit was set up to monitor project implementation progress regularly.

In summary, while ADB and World Bank projects generally included provisions for project performance monitoring and often included impact monitoring and evaluation as well, relatively few projects, even those that explicitly targeted poverty reduction, actually monitored the outcomes of the project as to poverty reduction impacts. To do so with methodological rigor is a complicated exercise, requiring the investment of more resources than most borrowers are willing to devote to this task. Only in exceptional cases, such as the Viet Nam Rural Transport Project (Box 3.5), can field studies be carried out to adequately assess the linkages between infrastructure investments and poverty reduction. Filling this gap is one of the main objectives of the present study.

Box 3.5. Evaluating the Poverty Impacts of Rural Roads in Viet Nam

The Viet Nam Rural Transport Project is designed to rehabilitate rural roads in 18 poor provinces of Viet Nam. A poverty impact evaluation study is being implemented in 100 randomly selected project communes and 100 control communes in six provinces, representing Viet Nam's six geographical regions. Control communes were chosen from the same districts as the project communes to maximize comparability. However, to avoid the problems of endogeneity (impacts attributable to factors influencing program placement) flagged by several researchers (Binswanger *et al.* 1993), the comparability of the control sites will be further tested through use of a logit model based on the data collected in the baseline survey.

The logit model uses a panel design. In each commune, baseline data were collected in 1997 through a commune-level survey and a survey of 15 households selected through a process of poverty-stratified random sampling. A second round of surveys was completed in 1999, a third is planned for 2001, and a fourth for 2003. The household questionnaire replicates several questions addressed in the Viet Nam Living Standards Measurement Survey, enabling subsequent inferences about household poverty levels. District-, provincial-, and project-level databases have also been constructed. The study focuses on measuring changes in the determinants of living standards in relation to road improvements. Outcome indicators include agricultural production and yields; income source diversification; employment patterns; changes in land use and distribution; availability of goods, services, and facilities; and asset wealth and distribution.

Source: van de Walle 1999.

For most people in the study areas of this report, a motorscooter or motorcycle is the first step in motorized transport.

Chapter 4

RESEARCH DESIGN

The objective of the literature and project review described in the preceding chapters was to identify the hypotheses they contain about poverty impacts, implicit or explicit, and to evaluate the evidence produced to support or disprove these hypotheses. The study group formulated hypotheses in transport or energy interventions (independent variables), poverty reduction outcomes (dependent variables), exogenous factors (contextual variables), and endogenous factors (situational variables) likely to affect these outcomes. The purpose of this exercise was to establish a propositional inventory with associated research findings to identify key gaps in current knowledge. Based on this information, the study group developed the broad outlines of a proposed research program and identified suitable sites for the field research. Domestic research institutions (DRIs) in the selected countries were then invited to make specific proposals for research that would be policy relevant in their countries and would contribute to filling some of the gaps in current knowledge.

Definition of Variables

The definition of key variables varied widely among the studies and projects reviewed (Figure 4.1).

Independent Variables

In most cases, the independent variable is the transport or energy "project." This usually means an infrastructure improvement, but it may also consist of, or include, sector policy interventions, institutional capacity building, and/or service improvements. For rural transport, poverty impact studies have almost exclusively concerned rural roads. They have distinguished between the construction of new roads (providing basic access), raising road standards (reducing transport costs), and investment in road maintenance (averting future costs). Some studies have looked at changes in transport services and/or in the means of transport used by the poor. The transport sector policy issues of concern in the context of rural roads have been the public expenditure priority given to road maintenance, acceptance of appropriate design standards in relation to traffic levels, use of labor-based technology, removal of barriers to entry into rural transport services, and fiscal adjustments to promote the use of intermediate means of transport.[5] For urban transport, the issues are mainly in the realm of sector policy and transport services. Some consideration is also given to externalities imposed on the poor by urban transport infrastructure projects. To date, with the exception of resettlement studies, few poverty impact studies have been concerned with rail, port, or air projects.

In energy, the main subject of study has been rural electrification programs, with the aim of providing as many poor people as possible with access to modern energy. Thus, the number of new connections or villages served has been the main independent variable, with some attention to whether the source of power is the national or regional grid or an off-grid system, and whether the technology used is extractive or renewable. Studies focused on the impact of privatization on the poor have tended to stress service reliability as a key independent variable. A different literature concerns the improvement of traditional energy systems using biomass. Little work has been done on the effects of intermediate fuels used by the poor, such as LPG or kerosene. Sector policy issues include the efficient operation of power utilities, privatization, pricing and subsidies, and regulatory and fiscal policy changes to improve the supply and reliability of services and to create a "level playing field" for investors to serve the poor.

Studies that look at transport and energy impacts together (usually in association with other forms of infrastructure and/or other public programs) tend to take public expenditure in each sector as independent variables. This has the effect of ignoring the private investment that is also necessary for services to be provided, in particular to the poor. In the context of multisector projects with transport and/or energy components, no attempt is usually made to

[5] Relevant policy issues in sectors other than transport are addressed under contextual variables.

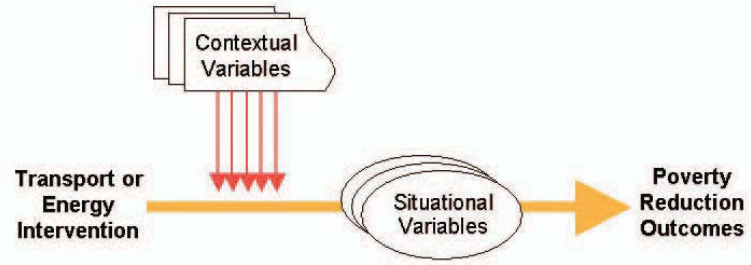
distinguish the effects of activities in the different sectors. Rather, studies evaluate the effects of the whole package or "bundle" of services on poverty reduction in the target area.

Dependent Variables

Surprisingly few of the existing studies actually use an explicit measure of poverty. Those that do rely heavily on measures of "income poverty." In much of the literature, small farmers and/or landless laborers, or households without roads or electricity, are simply assumed to be poor. Some studies use income distribution data to define higher and lower income groups, without necessarily relating these to poverty levels. Other studies take inequity, or the shape of the income distribution, as their dependent variable.

Looking beyond income effects, numerous studies propose to evaluate impacts on the welfare of poor people, generally through improved access to health care and education services. Recently, some studies have added the effects of knowledge and information, with corresponding improvements in the functioning of product and labor markets. Some ongoing studies are investigating infrastructure impacts on other dimensions of poverty, such as insecurity, exposure to risk, and powerlessness. Recent studies also pay greater attention to gender dimensions of poverty.

Figure 4.1. Conceptual Framework



Source: ADB research.

Contextual Variables

The impact of transport and energy interventions on poverty reduction is strongly conditioned by the context in which these interventions take place. A distinction is made here between contextual factors, which are exogenous to each case study and are therefore treated as constants, and situational factors, which are endogenous to the country case studies and may partially explain observed variations. The values of contextual variables do vary across regions or countries and, with appropriately defined data, may be used to explain differences in cross-regional or cross-national comparisons of case studies.

Major contextual variables include the income level, income distribution, and poverty level of the region or country concerned; population size and density; level of urbanization; natural resource endowments; macroeconomic policies, including trade, investment, and fiscal policies; patterns of public expenditure; role of the private sector; and sector policies in related sectors such as health care, education, agriculture, industry, and finance. Contextual factors also include broad sociocultural characteristics of a region or country, such as caste- or gender-based norms of behavior, the quality of governance, and the degree of public participation in political processes.

Situational Variables

Within a given context or case study, poverty reduction outcomes associated with a transport or energy sector investment may vary, depending on other factors present in the situation. For example, the effect of improved road access on agricultural incomes may depend on factors such as the availability of extension services communicating useful research results; availability and quality of land; availability and prices of inputs; availability and cost of credit; availability of associated technological requirements, such as irrigation; distance to markets and perishability of crops. To take a more qualitative example, the effect of improved access on personal security of the poor depends on the attitudes and behavior of the police, social and cultural controls on criminal behavior, and the effective functioning of the justice system.

A multitude of situational factors may be relevant to the different types of anticipated impacts on the poor. The general categories of relevant situational factors include urban vs. rural setting, land availability and quality, available technologies for production (farm and nonfarm), efficiency and effectiveness of service delivery for

various public services, availability of information, and local social and cultural factors such as land tenure or community organizations. For the field research, it is necessary to define the situational factors that seem relevant for poverty reduction in each case study setting.

Propositional Inventory

A propositional inventory derived from the review of literature and project experience is presented in Boxes 4.1 to 4.3. It should be noted that this list represents only those hypotheses that are explicit or implicit in the literature and project reports reviewed. It does not include all the hypotheses that could be formulated, nor does it imply that these hypotheses have been validated by empirical research. Some of them *have* been the subject of empirical research in numerous studies, often with conflicting findings. Others have been proposed (or assumed) on theoretical grounds, but have never been empirically tested. Generally, few statements about the impact of transport or energy interventions on poverty are sufficiently well documented to be taken as proven facts. The field seems wide open for future research.

Knowledge Gap Analysis

On the basis of this review, it appeared that the major gaps in current knowledge about transport and energy impacts on poverty reduction have to do with

- the impacts of sector policy change,
- the impacts of changes in service provision,
- the impacts of transport modes other than roads,
- the impacts of energy sources other than electricity, and
- the impacts of transport and energy projects on the urban poor.

Other gaps that have been identified by reviewers of this study include

- constraints on access by the poor to improved transport and energy services,
- gender differences in impacts of transport and energy investments,
- environmental consequences of transport and energy investments, and
- governance and institutional issues.

Box 4.1. Propositional Inventory (Transport)

Rural transport improvements (road construction, improvement, maintenance)

- decrease costs to the poor for personal travel and goods transport;
- generate farm income that disproportionately accrues to the poor;
- promote the development of nonfarm activities in rural areas that generate income disproportionately accruing to the poor;
- increase the range of opportunities for wage employment and thereby raise the price of labor in rural areas, generating income that disproportionately accrues to the poor;
- increase the availability and accessibility of education and health care services in rural areas, resulting in greater participation in these programs by the poor;
- increase the access of the poor to natural capital, especially common property resources (land, water, vegetation, wildlife);
- increase the personal security of poor people in rural areas;
- facilitate the delivery of emergency relief to the poor in case of natural disasters; and
- have a positive effect on participation of the poor (i) in local organizations (bonding social capital), (ii) in activities outside the rural community (bridging social capital), and (iii) in local political processes and management structures.

Urban transport improvements

- reduce transport costs for the poor;
- facilitate the delivery of health care and education services to the urban poor;
- reduce health and safety risks for the poor;
- increase opportunities for employment for the poor in transport services, commerce and industry, and the informal sector;
- increase the personal security of the poor in urban areas; and
- positively affect the participation of the urban poor in community organizations (bonding social capital), in activities outside their own neighborhood (bridging social capital), and in political processes.

Source: Authors' research.

Box 4.2. Propositional Inventory (Energy)

Rural energy projects

- reduce energy costs for the rural poor;
- increase farm productivity, generating income increases that disproportionately accrue to the poor;
- promote the development of nonfarm activities in rural areas, which generate income disproportionately accruing to the poor;
- improve the quality of education and health care services in rural areas, resulting in greater benefits of these programs for the poor;
- increase the flow of information to the poor;
- protect the access of the poor to natural capital by decreasing pressure on woodlands that are being exploited for fuelwood;
- increase the personal security of poor people in rural areas; and
- have a positive effect on participation of the poor (i) in local organizations (bonding social capital), (ii) in activities outside the rural community (bridging social capital), and (iii) in local political processes and management of community resources.

Urban energy reforms

- reduce energy costs for the urban poor;
- increase the access of the urban poor to modern energy services;
- improve the quality of health care and education services, resulting in greater benefits of these services to the urban poor;
- reduce health and safety risks for the urban poor;
- increase opportunities for employment of the urban poor in energy services, commerce and industry, and the informal sector;
- increase the personal security of the urban poor; and
- positively affect the participation of the urban poor in community organizations (bonding social capital), in activities outside their own neighborhood (bridging social capital), and in political processes.

Source: Authors' research.

Box 4.3. Propositional Inventory (Aggregate Impacts)

- All other things being equal, transport improvements have a significant effect on poverty at the community or district level.
- All other things being equal, energy improvements have a significant effect on poverty at the community or district level.
- Transport and energy improvements, taken together, have a significant effect on poverty at the community or district level that is greater than the sum of their individual effects.

Source: Authors' research.

However, the results in the better-researched areas still leave a large degree of uncertainty and ambiguity. In particular, few field studies disaggregate their samples into poor and nonpoor groups in internationally comparable poverty measures. This makes it difficult to assess transport or energy contributions to poverty reduction on a world scale or even, in many cases, on a national scale. Such deficiencies give rise to suspicions (as has been shown, for example, in studies on the real incidence of subsidies) that the poorest of the poor gain less than others from conventional transport and energy projects. In addition, the poor may bear disproportionate costs, especially in relation to large infrastructure projects. The dominant position of roads in the transport sector, and of electricity in the energy sector, suggests that further refinement in the body of knowledge concerning these investments is also warranted.

Conceptual Framework

The broad conceptual framework proposed for the field research posits transport or energy investments as the independent variables, macroeconomic and sociocultural factors as contextual variables, sector policies and situational characteristics as intervening variables, and poverty reduction outcomes as dependent variables. Linking transport or energy investments to poverty reduction in a robust way requires research designs that can hold all other potential contributing factors constant. In reality, of course, poverty reduction is an outcome of a complex of macro, sector, and situational factors all acting at the same time on a target population that is itself constantly changing. It is for this reason that poverty analysis needs to be conducted and poverty reduction strategies determined at the country (and even global) level before being decomposed

into their sector components. Only with overall poverty reduction targets well defined, and with strategic options well identified at the country level, will it be possible to modify the design of infrastructure sector interventions and investments so as to maximize their contribution to poverty reduction.

This interaction of multiple factors has been best articulated in the work sponsored by IFPRI in India and the PRC and earlier, in Bangladesh (the IFPRI program is discussed in Chapter 2; for more on Bangladesh, see Ahmed and Hossain 1990).

For the present research, the IFPRI model has three main limitations. One problem is its failure to address rural-urban linkages and capital flows, particularly the importance of remittances from urban family workers in rural household investment and survival strategies. Transport and energy investments bring rural and urban areas closer together, in time if not in space, and facilitate information flows that contribute to increasing productivity in the rural economy as well as the efficiency of the national labor market. Second, with its focus on public expenditures, the model fails to capture the significant contribution of the private sector to investment, especially in infrastructure service provision. Third, it is an econometric model that explains poverty reduction only in the narrow sense of reducing the share of the population living below the poverty line. Multiple dimensions of poverty may be affected by transport and energy investments, as the country case studies will show.

To place the three RETA country studies on a comparable footing in this conceptual framework, however, a special study was carried out in Thailand with assistance from IFPRI. The study was designed to build a model of public expenditures and impacts on rural poverty that explicitly addresses the effect of transport and energy investments, similar to the work that has been completed for India and the PRC. The results of this study are reported in the Thailand country study (Chapter 6).

Crosscutting Themes

The central theme of the proposed research program is the impact of transport and energy interventions on poverty reduction in the selected study areas. However, certain crosscutting themes emerged from the review of the literature that could also be addressed in the field research. These include

- gender differences in poverty impacts;
- environmental and social consequences of infrastructure projects and their implications for the natural assets and social capital of the poor;
- the changing role of government in policy setting and regulation, and of the private sector in infrastructure investment and service delivery; and
- the importance of institutional capacity, good governance, and public participation in determining whether the theoretical benefits of transport and energy projects actually reach the poor for whom they are intended.

Gender

Research has shown that the responsibility for meeting the transport and energy needs of poor households differs substantially by gender, in ways that are both universal and culturally specific. Typically, women bear the main responsibility for doing the "reproductive" work of the household, which means providing water and fuel, as well as, in many cases, producing field crops and/or garden produce for domestic consumption. Men typically dominate the production and marketing of cash crops and control household cash income and expenditures. The respective roles of men and women in undertaking wage labor, investing in and operating local businesses and small-scale industries, and traveling for employment elsewhere are very much culturally patterned, as is the distribution of cash income within the household and the effective ownership and operation of assets such as bicycles, farm machinery, and other kinds of equipment (sewing machines, grain grinding mills, etc.). The participation of men and women (and boys and girls) in education and health care programs, as well as in politics, is likewise subject to sociocultural as well as access constraints.

The culturally defined responsibilities of men and women may change significantly as poor households move from a subsistence to a cash-based economy and come to depend more on commodity and labor markets. Changes in the intrahousehold distribution of income can make a difference in household dynamics, empowering some members and disempowering others, opening up new possibilities but also aggravating tensions that may sometimes lead to violence. Changing from a rural to an urban setting also has important implications for household and community dynamics, for patterns of social organization and social control. Thus, it was important for the field research to be designed and carried out in a way that would permit disaggregating impacts by gender.

Owning a sewing machine helps women like this one in Nakhon Ratchasima, Northeast Thailand, to earn cash income.

Environment

The construction and operation of infrastructure projects often involves significant impacts on the physical environment that should be taken into account explicitly in project design. It is often alleged that such negative consequences affect the poor disproportionately. This argument is more often made in urban areas, where the poor tend to be concentrated in parts of the city that are particularly prone to flooding, have poor sanitation and solid waste management, and are vulnerable to noise and air pollution. As pedestrians and users of nonmotorized transport (NMT), the poor are often said to be more exposed than others to death and injury in traffic accidents. However, real research on this topic is notably lacking. A similar case can be made in rural areas, where poor design and/or construction can leave homes, fields, and water sources exposed to pollution and erosion, as well as creating health and safety hazards. It is worth noting that the environmental costs of projects, especially energy projects, are often borne by people who are *not* the same as the project beneficiaries.

A more subtle argument is that the development induced by transport and energy projects may have negative effects on the poor by consuming or alienating natural capital to the benefit of the wealthy. This problem is particularly acute with respect to common property resources such as forests, water, and wildlife, which may be important assets for the poor. Development that aims at fixing farmers on small plots and distributing land to migrants, or setting it aside for conservation purposes, will only succeed in benefiting the poor in remote areas if they can acquire the necessary skills to meet their needs in new ways. This transformation is likely to bring profound sociocultural changes that the people concerned may or may not desire. It was important, therefore, for the field research to identify the potential environmental impacts of projects, direct and indirect, and evaluate whether the poor bear a disproportionate share of such costs.

The construction and operation of infrastructure projects may also have direct and indirect consequences for the social environment of the poor. At the most basic level, changes in the mobility of different members of the household, access to new markets for information as well as for goods and services, and exposure to national media such as radio and television can dramatically alter intrahousehold relations among men and women, young and old. At the community level, infrastructure projects can introduce physical barriers to internal communication while facilitating relationships with the outside world. While some types of risk are reduced, others are introduced. A particular concern is the potential spread of waterborne and sexually transmitted diseases as a result of the exposure of a remote community to construction workers and nonlocal transport operators. At another level, a poor community may be invaded by outsiders with conflicting cultural values and greater economic and political power, who find ways to capture the greater part of the benefits that should accrue to the community.

Increased mobility and exchange between urban and rural areas may become an important aspect of the income generation and risk management strategies of poor households. Improvements in human and social capital may come about as a result of improved access to information, as well as community organization and participation in the planning and management of infrastructure projects. However, the extent to which these changes benefit the poor remains an empirical question. Finally, the economic growth induced by transport and energy investments may tend, at least initially, to increase inequity within a community and exacerbate political tensions.

These potential effects may be summed up in the hypothesis that infrastructure projects are likely to have negative effects on "bonding" social capital in a community, but positive effects on "bridging" social capital linking community residents to the outside world. It was important for the field research to anticipate and measure these effects and to evaluate their consequences for the poor in both urban and rural areas.

Private Sector Participation

The literature and project experience both show that in modernizing and globalizing economies, the respective roles of government and the private sector are changing rapidly. From the standpoint of the field research, these changes are part of the country or regional context in which community-specific interventions occur. It was to be hoped that at least one case study in each country could look at the impacts of a change from public to private sector provision of services, and/or at a case of the private sector coming in to fill a gap left by the public sector. It would be somewhat more difficult, though not impossible, to investigate the impacts of a change in public policy, for example, regarding tariffs or barriers to entry, on the access and affordability of services to the poor.

Such case studies could be carried out in relation to either transport or energy interventions. In transport, for example, one might look at the effects of privatizing an urban transit system or removing barriers to private provision of transport services. In energy, one could consider the effects of a community investment in minigrid electricity services based on local energy sources, or the effect on access and employment of privatizing a public utility. In any case, the contextual changes over time should be noted in each case for the purpose of later comparison across cases and countries.

Governance

The theoretical models of infrastructure impacts will only work if people behave according to the expectations of the model. In particular, it is often assumed that civil servants will behave as though they have the interests of the public at heart, while private entrepreneurs will act to maximize personal utility. Such models do better at describing the outcomes of private sector interventions than of government programs. Institutions may fail to play their expected roles in generating benefits for the poor for many reasons: among them are issues of capacity, political will, program design, and resource constraints. The field research therefore needed to pay particular attention to the effectiveness of the institutional links in the causal chain. For instance, the provision of access to health care services will only result in improved health for the poor if (i) the health care programs offered meet their needs; (ii) they are available and affordable to those who need them; and (iii) staff understand their needs, can communicate with them, and do not discriminate against the poor in delivering services. The possibility of findings regarding this governance dimension had to be considered in the design of every case study.

Participation of the poor, together with other stakeholders, in the design and implementation of transport and energy projects is another important aspect of the governance issue. The field research therefore had to evaluate the extent to which poor people participated in the design of the interventions under study and helped shape the ways in which they respond to their needs. Participation may also occur at the implementation stage, both through employment in project activities (construction, operation, and maintenance) and through provisions for beneficiary oversight and feedback, such as users' committees. The case studies would evaluate the extent to which the poor participate as equal partners and gain "voice" through such activities, as opposed to simply bearing costs on behalf of the community (e.g., through unpaid labor contributions).

Site Selection

To maximize the possibilities of the case studies' yielding insightful findings about how transport and energy infrastructure affect poverty reduction, it was agreed that field work should focus on countries with relative macroeconomic and political stability over the last 10–15 years, providing reasonable prospects that infrastructure investments could realize their potential impacts. Three of ADB's DMCs—the PRC, Thailand, and India—were identified for the field research and agreed to participate. The following criteria established by the Steering Committee guided their selection:

- each had a track record of having improved transport and energy infrastructure over time;
- poverty data were available for time series and geographically disaggregated comparisons;
- capable DRIs existed in all three; and
- they were a representative mix of countries, including both economic and cultural diversity, and a balance between subregions.[6]

In vast and diverse countries, such as the PRC and India, field work would need to concentrate on one geographical or administrative area (state or province)

[6] ADB divides its 24 DMCs into five subregions: PRC and the Central Asian Republics, South Asia, the Greater Mekong Subregion, Southeast Asia, and the Pacific Islands.

chosen according to similar criteria. On this basis, and given the other criteria, the PRC (Shaanxi Province), Thailand, and India (Gujarat State) were chosen as sites for the field research.[7]

The selected DRIs were the Chinese Academy of Social Sciences (CASS), India's National Council for Applied Economic Research (NCAER), and the Thailand Development Research Institute (TDRI). Each institution was asked to set up a team including an economist/team leader, transport and energy specialists, and specialists in poverty and participatory research. The teams were invited to make proposals regarding the transport and energy interventions they would like to study and the research hypotheses they would investigate. Each team was also asked to form a national steering committee and to hold a national seminar on its study findings.

Research Design

The focus of the field research was to trace out the causal chain of effects that, in a given context, leads from a transport or energy intervention to a poverty reduction outcome. Thus, particular attention was to be paid to identifying the links in that chain and the situational factors likely to affect the strength of those linkages. According to classical economic theory, the most direct effect of transport and energy interventions should be cost savings to users. These could be direct cost savings or implicit savings relative to the costs of current alternatives, such as time savings or service quality improvements. The impact of these cost savings on the poor depend on the extent to which the poor are users of the service provided. However, benefits to nonpoor users may also contribute indirectly to the welfare of the poor.

Any number of situational variables may affect the magnitude of these linkages. For example, the extent to which vehicle operating cost savings are passed through to passengers and freight transporters depends upon the competitiveness of the local market for transport services. The ability of the poor to capture such benefits directly (as owner-operators) depends on their ability to purchase means of transport, which in turn depends on cash income and credit availability. The extent of passenger benefits accruing to the poor depends on their personal travel patterns and their use of road transport services. Indirect benefits, such as those deriving from the travel of traders, teachers, health care workers, etc., depend on the quality of services offered and other factors affecting the participation of the poor (user fees, sociocultural barriers). The extent to which poor farmers benefit from increased crop prices and lower input costs may depend on their access to land, water, extension services, and/or credit. Landless farm laborers may benefit only from increasing employment. The ability of the rural poor to take advantage of opportunities to increase nonfarm production depends again on their access to resources, technology, and credit, while income benefits from industrial employment depend on the conditions for outside investment in income-generating enterprises. Benefits from the reduction in the prices of consumer goods go to the poor only to the extent that the poor are in the market to purchase these goods.

A similar analysis could be made for the participation of the poor in the benefits generated by energy projects. To the extent that these benefits are reflected in direct cost reductions, they accrue to the poor in relation to the use made by the poor of modern energy services. Nonpoor consumers of energy services, in particular community services such as schools and health centers, may pass some benefits along to the poor users of these services. Under the right conditions, energy services may help improve agricultural productivity (e.g., through irrigation) and stimulate investment in industries. However, the extent to which the poor will share in these benefits depends on the degree to which they own or have access to natural resources and financial capital, as well as on the amount and nature (skilled/unskilled) of employment generated.

After looking at direct cost savings and the ways in which they are reflected through the economy, the field research considered other effects that projects may have on the poor. One of the most important attributes mentioned in the literature is the provision of "access" to meet "basic needs" of the poor. In fact, studies have shown, the poor do find ways to meet their basic needs for transport and energy. These ways are often very costly in time and human energy, however, even if no monetary cost is involved. The time and human energy available to the poor have practical limits, especially given the multiple demands of meeting all their basic needs. Consequently, when these systems are designed with the real needs of the poor in mind, gaining access to modern transport and energy systems offers the potential to increase their productivity and improve their welfare.

The "access" benefit is sometimes measured by comparing modern transport or energy costs with the costs of achieving the same objective using traditional systems. Often, how-

[7] After this selection was made and approved by the Government, civil disorder broke out in the state of Gujarat, which considerably delayed the India field work. However, it is believed that these conflicts did not materially affect the views of respondents in the rural areas where the case studies were conducted.

One way of increasing the poverty reduction impact of road construction is to employ the poor as laborers, as in this project near Mundra, Gujarat State, India.

ever, the financial costs of using the modern system are greater than those of the traditional system. To assume that the poor will switch to the modern system amounts to assuming that the value to them of savings in time and effort is greater than the discrepancy in financial costs. This assumption can be tested in various ways: through willingness-to-pay studies, through evaluating opportunity costs in relation to alternative uses of time, or through observing behavior and inferring from this the value that the poor place on overcoming access barriers.[8]

A secondary benefit of an economic nature is the income generated by direct employment in the construction, operation, and maintenance of transport or energy systems. Typically, this is more important for transport than for energy, as massive amounts of employment for the poor (or at least intended for the poor) have been generated by rural road construction projects. Because these activities are sometimes seen as welfare programs rather than as investments in building a nation's infrastructure, less attention has been paid to generating continuing employment through labor-based maintenance and enabling the poor to participate in providing transport services. In urban areas, road investments have been directly inimical to the poor engaged in providing NMT services. In energy, the possibilities for direct employment benefits are more limited and often depend on the acquisition of new skills.

Linking welfare outcomes such as improved health or education status to investments in transport or energy is more problematic than evaluating income effects. Even if infrastructure investments provide access to services and help improve the quality of services, many other factors affect the propensity of the poor to use such services and the outcomes they experience. It is probably safest to stay in the realm of "opportunity" and note (when it is the case) that transport and energy investments will remove barriers to the provision of services and facilitate their use by the poor. The interaction of transport, energy, and other infrastructure investments with investments in the productive and social sectors to reduce poverty is probably best analyzed through the use of computable general equilibrium models, giving rise to specific linkages that can then be further tested through field research.

The impacts of transport and energy interventions on noneconomic dimensions of poverty (security, social capital, political participation) have been the subject of some speculation, but little empirical research to date. This is a new area for research, as an understanding of these noneconomic dimensions of poverty has only begun to penetrate the world development community. This subject proved to be one of particular interest to the field study teams, and some of the most significant findings of the field research are in this area. Another issue is the possibility of extra costs being imposed on the poor as a result of infrastructure projects. Ideally, projects should be designed to avoid such costs as much as possible, to minimize them when avoidance is not possible, and to compensate the affected people fully (especially the poor) for any losses they sustain, thus bringing the net loss to zero.

The impacts of transport and energy interventions on poverty reduction are strongly conditioned by the context in which these interventions take place. Major contextual factors were not expected to vary within the country case studies. Rather, their influence is examined in the comparative analysis of the findings (Chapter 8). However, within a given context, poverty reduction outcomes associated with a transport or energy sector investment could also vary depending on situational factors. For the field research, each team was asked to define and assess the situational factors that they thought would be relevant for poverty reduction in each case study setting.

[8] In studies of this kind it is important to consider the gender dimension, because much of the time and effort involved in the use of traditional systems is provided by women, and may be differently valued by men and women.

Research Methods

The World Bank's "Handbook for Practitioners" on evaluating poverty impacts recommends that a representative sample of people likely to be affected by the project and a matched comparator or control group be identified, and that baseline data on relevant impact indicators be collected, prior to project implementation; follow-up surveys should come at project completion and at some later time, when a new equilibrium has been established. Sample and control groups should be stratified by poverty level (measured by income and/or expenditure data) and gender. This "double difference" design allows for before-and-after, with-and-without, poor-and-nonpoor, and gender-based comparisons, and maximizes the chance of obtaining valid and reliable research results. In the field research conducted for this RETA, attempts were made to approximate this design as closely as possible. Given the time frame for the study, however, it was not possible to collect preproject baseline data, and it was also very difficult to find true control groups. Therefore, the study teams generally had to rely on the perceptions of people who had experienced project effects to a greater or lesser degree.

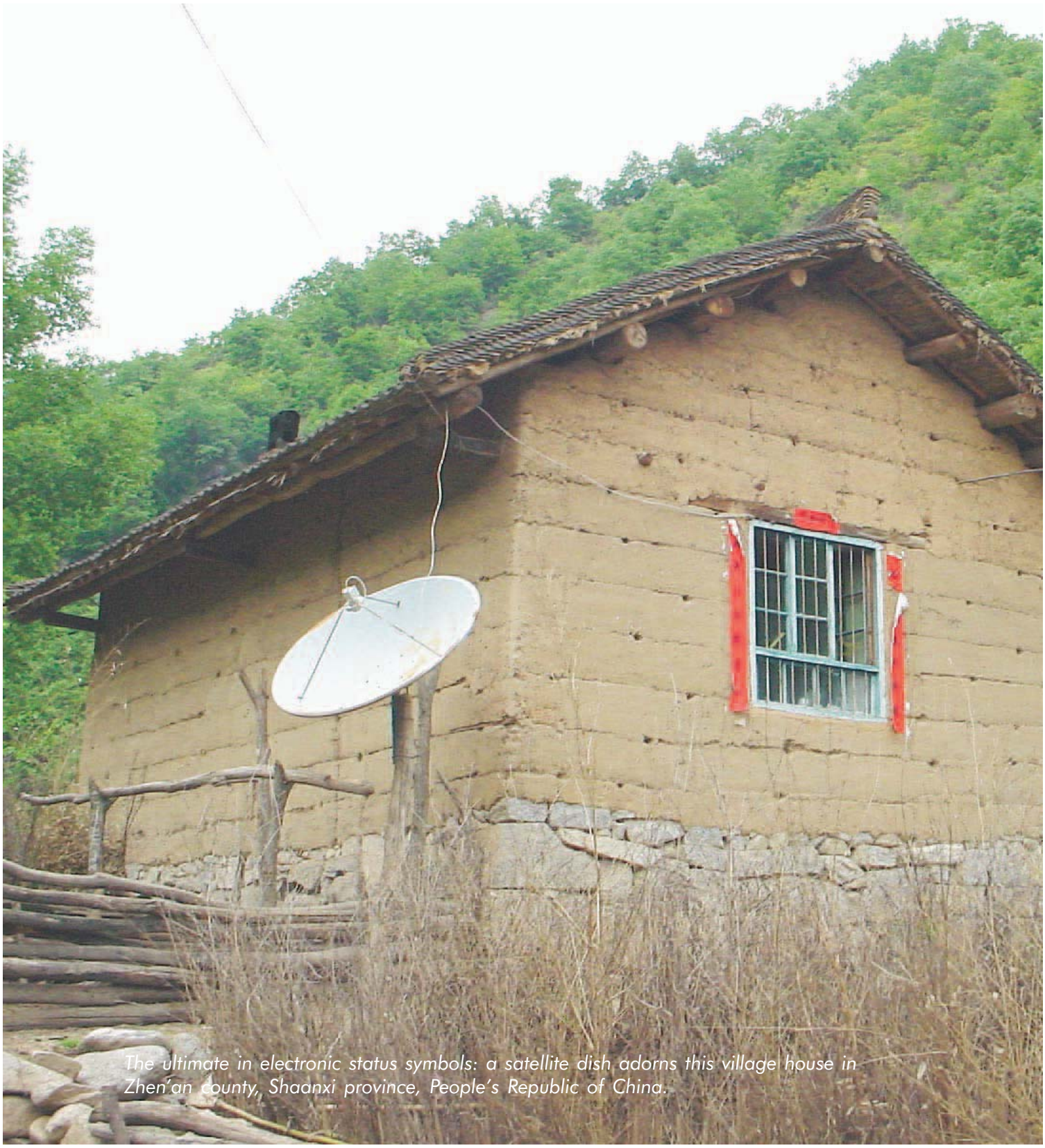
In a first stage of the field research, secondary data concerning the area under study were used to construct a sample frame. The time frame of the study was defined as the previous 10 years (1991–2000). Based on the site selection criteria, information was expected to be available about poverty, at least at the district (county) level, at the beginning and at the end of the case study time frame. Within each study area, four sample districts (counties) were selected in which significant change had taken place in transport and/or energy service provision over the past 10 years, and in which significant poverty reduction had also been accomplished. While the sample districts would not necessarily be representative of the study region, they were selected to provide a range of variation on some key situational variables. Within each sample district, four to eight communities were selected for intensive study. Within each sample community, 50–100 households were interviewed. The sample was stratified and designed to ensure adequate representation of poor and nonpoor households.

Field research involved a combination of methods, including collection and analysis of secondary data, quantitative surveys, key informant interviews, and work with focus groups. Special techniques such as transport or energy user surveys, travel diaries, time studies, and participant observation could also be used to enrich the database. Although quantitative analysis may provide more conclusive evidence, qualitative data in the form of participatory meetings and focus group discussions were also sought to add depth and richness to the study findings.

Based on the TDRI proposals, a methodology workshop was held in January 2002 in Bangkok, Thailand, to coordinate the work of the three country teams. Field research was carried out from January 2002 through June 2003. A second workshop took place in Vadodara, Gujarat State, India, in July 2003. In this workshop, the three research teams shared their preliminary findings and conclusions with one another and with the ADB task manager, the study coordinator, and representatives of the JBIC.

An illustration of the "double difference" research design.

The Thailand national seminar took place in April 2003, the PRC national seminar was held in August 2003, and the India national seminar was held in October 2003. Further comments were received at the Stage 3 draft report review workshop held in Manila in October 2003. These comments suggested that additional work would be needed by each of the country teams to meet the RETA expectations. Final reports on the country studies were delivered to ADB by April 2004. The country case studies are described in greater detail in the next three chapters of this report.



The ultimate in electronic status symbols: a satellite dish adorns this village house in Zhen'an county, Shaanxi province, People's Republic of China.

Chapter 5

PEOPLE'S REPUBLIC OF CHINA COUNTRY STUDY

National Context

The PRC is the most populous nation in the world, with about 1.25 billion people, representing almost half of all people served by ADB and more than one fifth of all people in the world. The PRC has exhibited remarkable economic growth and success in poverty reduction since the 1980s. Its gross national income per capita was estimated at $890 in 2001, equivalent to $4,260 in 1993 purchasing power parity terms.[9] On the average, the PRC is densely populated, with 136 persons per square kilometer (km^2). However, population density varies considerably from the urbanized and industrially developed coastal areas to the remote provinces of the west. PRC social indicators are generally good, with an average life expectancy of 70 and an adult illiteracy rate of 16%.

The PRC has experienced explosive economic growth, with an average annual growth rate of 10% between 1990 and 2001. The benefits of this growth have been fairly widespread, although there is a distinct gradient of development from the eastern coastal areas through the central provinces to the relatively underdeveloped western part of the country. In the past, inadequate infrastructure has been a major barrier to growth and to the diffusion of its benefits to all parts of the country. Since the PRC undertook market-oriented reforms and opened its economy to international trade, the Government has invested heavily in infrastructure development, with strong support from the development finance community. As incomes increased, so did social inequity; the country had a Gini index of 40 in 2001. The Government's poverty reduction programs seek to combat this problem.

[9] All figures in this paragraph are taken from the World Development Indicators annexed to the 2003 *World Development Report* (World Bank 2003a).

Poverty Reduction

When the PRC was established in 1949, poverty was endemic in the country. Equitable distribution of wealth was central to its ideology and command economy. Economic reforms begun in 1978 aimed to transform the PRC into a socialist market economy "with Chinese characteristics." These reforms altered the profile of poverty by enabling the majority of the rural poor to advance, while leaving some behind. Poverty was largely (officially) confined to rural areas by the policy of household registration, which did not permit rural-urban migration. Unofficial migrants to the cities were thus not eligible to benefit from urban services. However, the rapid expansion of employment opportunities in the coastal provinces and in cities encouraged a steady stream of rural-urban migrants. While this process has undoubtedly contributed to economic growth and efficient resource allocation, it has also resulted in the beginnings of urban poverty.

Official reports estimate that rural poverty declined from about 10% of the rural population in 1990 to 3.4% in 2000, or about 30 million people. In 2000, the official poverty line in the "PRC was" 625 yuan annual per capita income, equivalent to about $75.[10] This line is determined by first targeting the Government's resources for poverty reduction to the poorest, and then setting the poverty line at the limit of population that can be served with available resources. It is notably lower than the international "extreme poverty" line of $1 per day ($365 per year). Using the international standard, the World Bank also noted a sharp decline between 1990 and 1998 in extreme poverty, from 31.3% to 11.5% of the rural population (World Bank 2001b). According to this standard, more than 100 million people in the PRC were still living in extreme poverty in 1998. The remaining rural poverty is

[10] This line was originally set at about two thirds of the international $1-a-day poverty line expressed in 1993 purchasing power parity terms. Its domestic purchasing power may not be adequately represented by its dollar equivalent today.

increasingly concentrated in the country's western provinces, mostly within remote and mountainous townships. Because of access problems, these areas are also relatively deprived in food security and health care and education services. This suggests an approach to poverty reduction based on geographical targeting. In addition, minority peoples and the disabled are disproportionately represented among the rural poor.

Until recently, the PRC's poverty reduction strategy targeted poor *counties*, although half of the poor reside in counties other than those designated as poor. Poor counties are mainly located in the western part of the country, in hilly or mountainous terrain with relatively poor soils and rainfall, where the task of increasing agricultural productivity has proved most difficult. Deforestation and soil erosion due to population pressure on the natural resource base often complicate the task. Within these counties, assistance intended for the poor showed "substantial leakage" to nonpoor residents. Today, the PRC's poverty reduction strategy targets poor *townships* and aims to improve the financial monitoring and supervision of poverty programs. Participatory programs focusing on improving upland agriculture and better targeting it to market opportunities will enhance the productivity of the poor. The strategy also stresses the need to provide improved road access and other basic infrastructure, so as to deliver needed services to the remaining rural poor at a reasonable cost.

A study conducted for ADB in 2002 by the National Rural Social and Economic Survey Team, to help determine the definition of poverty to be used in ADB's Poverty Partnership Agreement with the PRC, found that the annual income level corresponding to a minimum consumption of 2,100 calories per day, plus an allowance of 60% for nonfood consumption, would be approximately 1,300 yuan ($160). Using the corresponding consumption expenditure of 860 yuan (excluding productive investments and debt service), and based on data from the 2000 Rural Household Survey sample, the study estimated a current national poverty rate of 23.2% of the rural population, or about 215 million people. Clearly, by any standard, a great deal of poverty still exists in the PRC. In addition, many of those who are not officially poor have only recently emerged from poverty and are vulnerable to various risks.

The PRC's approach to poverty started with income transfer programs. However, it soon became apparent that redistribution of national resources would not be adequate to meet the needs of the poor. It would be necessary for the poor to engage in self-help, initially through the construction of public works, mainly roads and water supply systems (Zhu and Jiang 1996). To that end, 331 poor counties were identified and targeted for national support. Another 368 poor counties were identified in each province to receive assistance through the provincial governments. Local and county governments were expected to assist poor communities located outside the designated poor counties. In addition to grants to communities for public works, funds were made available through loans for communities to undertake productive projects on their own initiative. The goal was to stimulate the creation of sustainable employment opportunities in rural areas for the poor. Lessons learned from the implementation of this approach pointed to the need to make complementary investments in health care and education in the poorest areas, focus on food security for the poor as the primary goal of poverty reduction, and involve the poor themselves more fully in program planning and implementation.

An empirical investigation of the determinants of consumption growth for farm households in the PRC used panel data on the southern PRC from the Rural Household Survey over 1985–1990 to show that geographical location makes a difference (Jalan and Ravallion 2002). The study found that living in a poor area lowers the productivity of a farm household's own investments, in turn reducing the growth of household consumption. The aspects of "geographic capital" that affect consumption growth include both privately and publicly provided goods and services, such as rural infrastructure and associated services. This research strengthens the case for expanding public investment in poor areas, on grounds of equity and efficiency.

A study to evaluate the effects of public expenditures in different sectors on rural productivity and poverty reduction was carried out for the PRC by researchers based at IFPRI (Fan, Zhang, and Zhang 2000). This study used an econometric model similar to one that had been used in India (see Chapter 7) and was subsequently used in Thailand (see Chapter 6). However, the specifications of the model were slightly different in the PRC. Community development, health care, and soil conservation expenditures were not included in the PRC model, but telecommunications expenditures were included. The study showed that education expenditures had the greatest impact on poverty reduction in the PRC, followed by rural telephones, agricultural R&D, and then roads and electricity, having approximately equal effects. For agricultural productivity, R&D was most important, followed by education and rural telephones, with roads and electricity again in fourth and fifth places. Irrigation investments had a positive impact on agricultural growth, but

little effect on poverty. The main conclusion drawn from this study was that all the types of investments considered have positive consequences, both for growth and for poverty reduction; thus, all are "win-win" strategies. The poverty reduction effects of infrastructure investments (telecommunications, roads, and power) came about mainly through increased nonfarm employment and improved wages in the agriculture sector.

ADB has undertaken numerous technical assistance (TA) activities to assist the PRC Government in formulating poverty-focused policies and programs, especially in the infrastructure sectors. It has supported participatory rural and urban poverty assessments through TA 5894-REG, Facilitating Capacity Building and Participatory Activities II (ADB 2000d), together with an urban poverty study (TA 3377-PRC, Urban Poverty Study [ADB 2002b]). It has also provided support to help develop a methodology for county-level poverty reduction planning (TA 3610-PRC, Preparing a Methodology for Development Planning in Poverty Blocks under the New Poverty Strategy of the PRC [ADB 2001e]). Other TA projects carried out for transport and energy are discussed below under the sectors concerned.

This PRC family proudly shows off its transport: part motorcycle and part two-wheeled "trailer".

Transport Sector Policy

The PRC Government has been investing heavily in infrastructure development to promote and support the high rates of growth already achieved. Annual investment in the transport sector more than doubled between 1990 and 2000, from 12.38 billion yuan ($1.5 billion) to 27.12 billion yuan ($3.5 billion). During this period, the length of highways increased from 1.0 to 1.4 million km, while the length of railways increased from 53,400 km to 58,650 km. The volume of passenger and freight traffic grew dramatically as well. Passenger traffic increased from 563 billion passenger-km per year in 1990 to 1,226 billion passenger-km in 2000, while freight traffic grew from 26,200 billion ton-km in 1990 to 44,450 billion ton-km in 2000. An increasing share of both passenger and freight traffic takes place on the nation's highways. Roads accounted for 91% of all passengers and 76% of freight tonnage transported in 2000.

Major policies in the transport sector concern the financing of infrastructure construction and operation and sector and enterprise management, as well as promoting regional development. Planning for transport development is the responsibility of different levels of government. In some cases, financial support for investment is provided by the international development community and the private sector. Among the targets established in the Tenth Five-Year Plan (2001–2005) are to

- improve the main railway network, especially in the western regions;
- construct the Tibet railway and Beijing-Shanghai high-speed railway;
- extend the length of the rail network to 75,000 km by 2005;
- accelerate the construction of the national trunk highway network;
- support construction of eight highways in the western regions; and
- extend the length of the highway network to 1.6 million km by 2005, including 25,000 km of expressways.

Transport investment is an important component of the PRC's overall development policy, focused on the western region. Existing roads and highways in the region are to be upgraded under the Tenth Plan.

Since 1984, the PRC has implemented "food for work" programs to assist poor areas in improving their transport infrastructure. In the Ninth Five-Year Plan period (1995–2000), funds invested in road construction through the food for work program amounted to 9 billion yuan ($1.1 billion), supporting the construction of over 100,000 km of roads in poor areas. This represented about 80% of all rural roads constructed during this period. With increasing investment, the accessibility of poor farmers has

improved significantly. Official statistics show that nearly 92% of villages in poor counties had gained access to motorable roads by 2000. This may overstate the actual access provided to poor farmers. Administrative "villages" may include several settlements, and a village is defined as accessible to motorized transport if any one settlement in the village has been connected to a motorable road. However, about 700 townships and 44,000 administrative villages were still not connected by motorable roads in 2000, mostly in the western provinces. The Government has placed a priority on completing motorable road access to all these townships and villages by 2010.

The Ministry of Communications and Ministry of Railways are responsible for planning and managing the national road and rail networks, respectively, in association with other relevant central government agencies. They consult with the provincial governments on the location of national road and rail links. The provincial road and rail agencies plan and manage the networks at the provincial level, in association with other relevant provincial agencies. These plans must be approved at the central level by the relevant ministry and the State Development Planning Commission.

Local railways are constructed and operated by local authorities or private investors. Roads are also managed by different levels of government. County and township roads are normally planned and constructed by county authorities. Village roads may be planned and constructed by the county roads department, by various poverty reduction programs, or by villagers themselves. Local road construction is mainly funded by local governments, with some support from the central Government for road construction in minority, remote, and poor areas. County road agencies can collect special road construction taxes and vehicle sales taxes to finance road improvements. They can also issue local bonds and shares to mobilize resources from the private sector.

Recent developments in transport sector policy reflect the Government's increasing emphasis on decentralization and institutional reform. Although more responsibilities have been shifted to the provincial, county, and municipal governments, the numbers of staff at all levels have been sharply decreased. Some functional units may be transformed into private enterprises, such as road construction and maintenance teams. Remaining bureaus and institutes may be corporatized. Road maintenance funds, previously collected from vehicle owners as a property tax, will now be derived from fuel taxes to more closely reflect real use of the highway system.

ADB, together with the World Bank and the JBIC, has been a strong supporter of the PRC's transport investment program. ADB has provided a great deal of TA in transport policy and planning, traffic management, road safety, project preparation, and environmental assessment. International development partner support initially concentrated on increasing economic efficiency by removing bottlenecks and expanding capacity through highways, railway, and port construction. However, development partners have gradually integrated poverty reduction concerns into the design of their projects, often by adding feeder road components. ADB recently assisted the Government in developing an analytic framework for the socioeconomic assessment of road projects, including ex ante assessment of the flow of benefits from expressway projects to the poor (TA 3900-PRC, Socioeconomic Assessment of Roads Projects [ADB 2004b]). The PRC's Institute of Comprehensive Transport implemented the study in collaboration with IFPRI. The study proposed a modified form of the IFPRI model, using more disaggregated measures of road and other infrastructure inputs, and with urban growth and urban poverty reduction, as well as rural growth and rural poverty reduction, as outcome variables.

At present, rural road improvements are being carried out in five provinces of the PRC with World Bank support through the RIPA program, which is linked to ongoing poverty reduction programs in the five provinces. It aims at providing basic access to communities that are not connected to the road network. Roads are selected through a ranking procedure involving both economic criteria (including direct measures of poverty) and social criteria (Hajj and Pendakur 2000). Basic access is defined as the least-cost improvement required to allow year-round access by motor vehicles, suitable for use by the prevailing vehicles in the area (motorized and nonmotorized), and allowing for occasional (but not seasonal) interruptions of service. The options include (i) partial access, for trips that do not require all-weather accessibility (e.g., farm and forest roads); (ii) basic access, the minimum required for all-weather passability, with exceptions under extreme but infrequent weather conditions; and (iii) full access, a fully engineered road providing all-weather accessibility. Interestingly, this program allows variations from officially approved design standards to serve more poor communities.

Energy Sector Policy

Government expenditures in the energy sector have remained relatively stable at about 20 billion yuan ($2.4 billion) annually from 1990 to 2000. Correspondingly, energy production and consumption have not changed very much over this period. However, the share of coal in total energy production has been declining, while other sources of energy are increasing. In 1990, coal accounted for 74% of total energy production and 76% of total energy consumption. These rates declined to about 67% by 2000.

After the United Nations Environment and Development Conference in 1992, the PRC Government drew up a sustainable energy development strategy, whose principles have been reflected in numerous new laws and planning provisions. While gradually reducing its dependence on coal as a source of energy, the Government intends to explore for petroleum and natural gas, develop new and renewable energy sources, and improve energy management. With reference to rural energy, the Government will promote the rapid commercialization of rural energy products, promote energy-saving stoves, and develop small hydro, wind power, solar photovoltaic (PV), geothermal, and biomass technologies to support communities that cannot be reached by grid power.

The Government sees energy as an integral part of its poverty reduction and rural development strategy, which is directed at the western part of the country. Two programs focus specifically on poverty: the rural electricity network innovation program and the renewable energy program for remote areas. In 1999, the PRC Government launched a series of rural power supply system reforms, including infrastructure investment and management system reforms, aimed at reducing the cost of power supply and the sale price of electricity in rural areas. The total investment for the rural network is more than 100 billion yuan ($12 billion). The major targets of this program have been achieved: the sale price of power has been reduced by 30%, more rural households are connected to the system, and rural people are provided with a more stable supply of power.

Since 1998, the government has also spent more than 100 million yuan on renewable energy projects to supply electricity to remote county townships unconnected to the grid. The target for this program is to supply 12 county seats and 800 other towns with electricity from renewable sources, especially wind and solar PV cells. The total installed capacity will be about 20 megawatts from solar and other energy sources. The State Power Corporation (the former Ministry of Electric Power) and other related ministries have set out regulations for rural electrification and rural energy development. Central and local government subsidies are also provided for some energy projects.

Official statistics show that about 92% of all villages in the poor counties had gained access to electricity by the year 2000. As with roads, this figure probably overestimates the proportion of poor households that are actually served by the system.

Case Study Context: Shaanxi Province

Shaanxi Province is located in the middle of the country, in the heartland of ancient China (Map 5.1). It is potentially a major crossroads for national and international traffic. For planning purposes, Shaanxi Province is considered to be part of the western region. The capital city, Xi'an, is a major urban center, although the province is predominantly (over 75%) rural. However, many smaller towns are rapidly becoming urban centers. In the past 10 years, the Government has made significant investments in road, rail, and energy projects in Shaanxi Province, some with ADB and World Bank financing. Over the same period, the province has experienced significant poverty reduction, with variations across the different regions within the province.

Shaanxi Province has an area of approximately 200,000 km^2 and a population of more than 36 million, divided into 107 counties and county-level districts. About three fourths of the population live in rural areas. The average population density in 2001 was 189 persons per km^2, but this varies considerably from one area to another. The province has three natural regions: the mountainous southern region, the central Weihe Valley, and the northern upland plateau. Population density is highest in the central region, which also contains the city of Xi'an. From 221 BC to the Tang dynasty, Shaanxi was the center of political activity in China.

The northern upland part of the province is on the loess plateau, where the climate and soils are unfavorable for agriculture.[11] In the south, steep slopes and soil erosion due to rapidly diminishing forest cover also pose problems for agricultural production. Shaanxi has a continen-

[11] The loess plateau covers some 640,000 km^2 in the upper and middle parts of the Yellow River floodplain. *Loess* is a light, loamy soil that is highly prone to wind and water erosion.

tal monsoon climate, but rainfall and temperature vary sharply from the north to the south. Average annual temperatures range from 9 to 16 degrees Centigrade, and annual rainfall from 265 to 975 millimeters. Per capita cultivated land is 0.11 hectares (ha) on the average, ranging from 0.2 ha in the loess plateau to 0.1 ha in the central region and 0.08 ha in southern Shaanxi Province. The variation between south Shaanxi and north Shaanxi in vegetation, rainfall, temperature, and population pressure is very similar to the variation between the southern and northern PRC. In this respect, Shaanxi Province may be considered as representative of the entire country.

Shaanxi Province sustained high economic growth from 1990 to 2000. The annual average growth in real per capita income over this period was 7.5%. However, this was not as high as the national growth rate. Consequently,

GDP per capita in Shaanxi was 76% of the national average in 1990, while it declined to 64% by 2000. The per capita income of urban and rural residents in Shaanxi Province grew by 4.6% and 2.8% per year, respectively, from 1990 to 2000.

The majority of workers (56%) in Shaanxi are self-employed in the subsistence agriculture sector. Women make up nearly half the labor force. The rate of unemployment and underemployment in rural areas is high. Consequently, many people migrate to towns and cities to seek work. In 2001, 1.2 million or 9% of rural workers did so. Employment in the urban areas of Shaanxi was once concentrated in textiles, manufacturing, and services. With the restructuring of economic activities, new industries such as electronics manufacture and tourism have been growing rapidly. The registered unemployment rate in urban areas in 2000 was 2.7%. However, this is likely to be underestimated, as it takes account only of the unemployed who have been laid off from state-owned or collective enterprises. True urban unemployment rates may be closer to 10%, with higher rates in the country towns.

Poverty

Shaanxi also has relatively high rates of rural poverty. In 2000, according to the locally defined poverty line of 700 yuan ($84) per capita, 17% of the rural residents, or about 1 million people, were living in poverty. The income composition of poor households in Shaanxi is different from the national poor and provincial averages. Although poor farm households in Shaanxi have more arable land than nonfarm households (1.8 *mu* [about 0.12 ha] per capita in 2000), they gained a lower share of their income from household production and a larger income share from wages. Poor farmers in Shaanxi have much lower land productivity than the national poor household or the provincial average. They also gain less income from township and village enterprises (TVEs) than in other regions. Consequently, they are more dependent than others are on finding employment elsewhere.[12]

Poor households in Shaanxi Province spent 6% of their incomes on transport and communication in 2000. They paid a higher share of their income for travel and transport than nonpoor households. Transport is not the highest expenditure priority for the poor, but increasing expenditures on transport seem to be part of the pattern for households that have moved up and out of the poverty class.[13] In terms of assets, about 10% of poor households owned motorcycles and almost all households owned at least one bicycle. About half of poor households owned an electric fan, about 40% owned a color television, and most of the rest owned a black-and-white television. Although their income levels were substantially lower, poor households were not very different from others in terms of consumption. This suggests that the main difference between poor households and others lies in their limited ability to save and invest in productive activities.

Transport

Between 1990 and 2000, the length of roads in Shaanxi increased from about 38,000 km to about 44,000 km. The proportion of paved roads also increased, from 70% to 80%. Length of railways increased by 30%, from 2,458 km to 3,228 km. Passenger transport increased from 2.02 million persons to 2.87 million persons, while freight transport increased from 2.16 million tons to 2.92 million tons. Highway transport increased its share in both passenger and freight transport over this period. Though the share of rail transport has been declining, it is still the most important transport mode in terms of person-km and ton-km. Transportation investment in the province increased from 364 million yuan in 1990 to 10.6 billion yuan in 2000, or about 28 times. The role of the private sector in providing transportation services has also grown over this period. By 2000, the private sector owned 46% of passenger vehicles and 38% of freight vehicles in the province.

Both ADB and the World Bank have supported transport investments in Shaanxi Province. The World Bank-financed First Shaanxi Highway Project in 1988 supported upgrading and expansion of the provincial highway network in Shaanxi and institutional strengthening for the provincial Transport Department; it showed that the provision of basic access through all-weather roads can be an effective means of reducing poverty in rural areas, especially when combined with programs for socioeconomic development. The Second Shaanxi Provincial Highway Project in 1996, also World Bank-financed, included con-

[12] The TVE policy was established in response to official restrictions on rural-urban migration. Nonfarm income from TVEs has been a major factor in poverty reduction in rural areas of the eastern region.

[13] The direction of causality is not clear. It may be that increasing expenditures on transport represents an investment with high returns (e.g., in looking for work over a wider area), thus helping people to move out of poverty. Alternatively, it may be that people who move out of poverty (for other reasons) increase their expenditures on transport as a consumption good. Most likely, both types of factors may be at work.

struction of five high-grade highways totaling about 240 km, as well as link roads at interchanges and about 4,100 km of rural roads under the RIPA program; it also financed construction supervision and environmental monitoring, maintenance of the national highways and the provincial highway network, a provincial road safety program, and studies and training. An ex post evaluation of this project concluded that the RIPA program significantly contributed to improving access in remote areas and expanding growth opportunities in poor areas of the province (World Bank 2003b, p. 20).

The Shaanxi Roads Development Project, approved by ADB in 2001, is constructing a 176-km expressway between Yumenkou on the Shaanxi Province border and Yanliang, near the city of Xi'an. This road is an important missing section in the National Trunk Highway System that will help link the western and coastal regions as part of PRC's poverty-oriented Western Development Strategy. The project will also improve 627 km of county and local roads connecting to expressway interchanges and connecting local communities in eight poor counties traversed by the expressway. The ADB-supported Hefei-Xi'an Railway Project, which traverses the southeast part of Shaanxi Province, will provide a direct rail link from four interior provinces to the coastal region, providing efficient transport for large quantities of high-grade, low-sulfur coal from Shaanxi; it will also construct 52 new railway stations. The project is expected to generate significant direct and indirect employment benefits. At present, ADB is preparing an Urban Transport Project for Xi'an that will include construction of a ring road and connector roads to the urban network, as well as urban transport planning, traffic management, safety, and maintenance components.

Throughout the country, railway construction generates substantial direct and indirect employment.

Energy

Energy production increased by 50% between 1990 and 2000 in Shaanxi Province. In the same period, energy consumption increased by 17%. Investments in the energy sector grew from 1.42 billion yuan to 10.3 billion yuan over this period. The four main energy sources of the province are crude coal, petroleum, natural gas, and hydroelectric power. Petroleum production grew at the fastest rate. Shaanxi Province is clearly a net energy exporter, but the electricity consumption of urban and rural residents increased three-fold between 1990 and 2000; that of rural residents increased 4.4 times during this period, largely due to rural village electrification programs.

ADB has been active in the PRC's energy sector policy dialogue, with the aim of promoting more efficient management and more equitable price policies and recognizing the role that energy can play in poverty reduction in rural areas. However, neither ADB nor the World Bank has yet financed an energy project in Shaanxi Province. A Global Environment Facility project implemented by the World Bank in western PRC, including Shaanxi Province, is promoting the installation of small solar PV systems to meet household energy needs.

Yulin Prefecture

The PRC study team selected two prefectures to be study sites in Shaanxi Province, one in the north and one in the south. Yulin Prefecture, in the north, has been the major energy base of the province. It contains one of the seven largest coalfields in the world, with reserves estimated at 271.4 billion tons. It also contains important petroleum and natural gas resources. In recent years, as a result of transport improvements, Yulin's resources, especially coal, are being developed. Since the late 1980s, three

railways have been built or are under construction in the prefecture; most of the main highways have been paved. The major constraint on rural poverty reduction in Yulin Prefecture is water scarcity.

Shangluo Prefecture

Shangluo, in the south, has also experienced major changes in its rail and highway infrastructure in the past 5 years. Shangluo Prefecture underwent about $2 billion in highway construction between 1996 and 2000, to build 466 km of new highways and rebuild 1,802 km of existing highways. The railway from Xi'an to An'kang passes through the counties of Zhashui and Zhen'an, which were selected as study sites. The opportunities for poverty reduction in Shangluo are mainly constrained by the very limited amount of arable land owned by farmers.

Methodology

Definition of Poverty

The PRC study team used four different definitions of poverty in its analysis. The first is a measure of income-based poverty based on the official poverty line, which was equivalent to about 66% of the international "$1-a-day" standard established in 1998 (in 1993 purchasing power parity terms). The second definition is poverty based on incomes of less than $1 a day. The third is based on consumption expenditures of less than $1 a day. The fourth measures poverty in the value of household assets, defined as less than 50% of the sample average value of assets per capita. The calculation of asset-based poverty includes the values of housing, productive assets, furniture, and electrical equipment. Based on data from the field survey, the team found relationships between income-based poverty (using the official poverty line) and asset-based poverty that are expressed in Table 5.1.

Thus, although only 20% of the field sample households were poor according to the official income-based measure, nearly half the sample households were relatively deprived in terms of their asset base. This suggests that many income-based "nonpoor" households have only recently emerged from poverty, possibly in response to recent transport and energy investments.

Transport and Energy Interventions

The study examined the use of transport and energy services by poor and nonpoor households in selected poor counties in the two prefectures of Yulin and Shangluo. An econometric analysis of household survey data was conducted, using household access to transport and energy infrastructure, the quality and intensity of services, household expenditures on services, and the value of transport- and energy-related household assets as input variables. Case studies then looked more closely at the impacts of road and railway construction, the impacts of bus and railway stations, and synergies created by adding complementary investments.

Research Methods

The study used household data from two sources. The first is the Shaanxi provincial database for poverty monitoring. This database contains data from surveys conducted annually from 1997 in the 50 officially designated poor counties of Shaanxi Province. In each poor county, 5 to 10 villages are randomly selected, and within each village, 10 sample households are randomly selected. These households maintain daily records that provide information on income, expenditure, assets, and demographic change. This study used data for 1,180 sample households in the 19 poor counties located in Yulin and Shangluo prefectures. Of these households, 1,143 were the same in 1998 and 2001. Thus, this can be considered panel data, i.e., data collected regularly from the same subjects.

The study team also undertook field surveys in four counties, two in Yulin and two in Shangluo. The selection of sample counties was based on the incidence of poverty

Table 5.1. Income-Based Poverty and Asset-Based Poverty

		Asset-Based Poverty		
		Poor	**Nonpoor**	**Total**
Income-Based Poverty (Type 1)	**Poor**	83 13.3%	47 7.5%	130 20.8%
	Nonpoor	214 34.3%	280 44.9%	494 79.2%
	Total	**297** **47.6%**	**327** **52.4%**	**624** **100.0%**

Source: Shaanxi provincial database.

in 1993 (the date of the earliest available poverty data). All poor counties in the province were ranked by the incidence of poverty in 1993. Four counties were selected from this list using systematic random sampling. Three of the four counties were located in Yulin and Shangluo prefectures. For convenience, the list was adjusted by selecting another county within those prefectures with characteristics that most closely matched those of the fourth county selected through random sampling. The finally chosen counties are Shenmu and Jingbian in the north and Zhashui and Zhen'an in the south (Table 5.2).

In 1993, on average, the sample counties had a higher GDP per capita than the prefecture and provincial averages, but a lower per capita income and a markedly higher incidence of poverty. This particularly reflects the situation in Shenmu county, where a high GDP was generated by state-owned enterprises (coal mines), but the benefits were not widely shared with local farmers. With the development of local coal production, this situation has now changed.

In consultation with county and local officials, the study team selected three sample villages within each sample county, based on recent changes in transport and energy infrastructure. The county poverty alleviation office maintains a list of poor households in each village, a classification dating from 1996. The team used this list in combination with a list of households classified by economic activity, prepared by village officials, to establish a sample frame for each village. Based on the proportion of households engaged in each economic activity and the proportion of poor households, the team determined the number of households to be selected from each category (Table 5.3). Ultimately, the field survey sample covered 624 households, of which 130 were officially listed as poor. This sample represented 30% of all households in the sample villages.

The characteristics of the field survey sample matched well with the characteristics of the sample drawn from the provincial survey database. The lower value of assets and greater incidence of poverty in the field survey sample may be explained by the fact that these data for the field survey sample are for 1996, while the provincial data (in the second part of the table) are for 1998.

The field study included village key informant interviews, household interviews, participatory assessments, and focus group discussions. Key informant interviews were used to obtain data on village-level changes in transport and energy infrastructure and services and on socioeconomic changes in the village in general. The household interviews focused on assessing the household-level impacts of transport and energy changes. Participatory discussions were carried out in all the sample villages to assess the impacts of transport and energy changes and the constraints preventing villagers from taking greater advantage of these interventions. In each village, at least 30 participants of varied occupations and gender contributed to the assessment.

To ensure that vulnerable groups, such as the poor and women, had the same opportunities as others to voice their opinions, special arrangements were made during the participatory group discussions. First, the community leaders were separated from the ordinary farmers to avoid the leaders' dominating or interfering with the discussion. For this purpose, a group interview with community leaders was arranged while the farmers' group discussion was going on. Second, all participants were asked to write down basic information such as their name, community, and

Table 5.2. Comparison of Sample Counties, Sample Prefectures, and All Poor Counties in Shaanxi Province
(Based on 1993 Census)

	Population ('000)	**Income per Capita** (yuan)	**GDP per Capita** (yuan)	**Poverty Incidence** (%)
Zhen'an	280	463	1,571	26.81
Zhashui	160	443	1,065	30.77
Shangluo	2,340	497	1,299	33.21
Jingbian	250	457	2,187	87.55
Shenmu	320	463	3,998	43.86
Yulin	3,000	432	2,419	44.07
Shaanxi (all poor counties)	**13,540**	**482**	**1,910**	**33.10**

Source: Shaanxi provincial database, PRC study team field survey database.

Table 5.3. Distribution of Sample Households

County	Village	Total Households	Households in Sample	Poor Households in Sample[a]
	Dacha	188	49	10
Jingbian	Chelukao	265	50	14
	Wanquze	323	56	19
	Gaorenlimao	142	54	4
Shenmu	Taihezhai	98	56	23
	Mengjiagou	100	45	6
	Yaowanggou	71	40	8
Zhashui	Yingzhen	196	58	8
	Mingxing	220	59	17
	Baishu	130	50	3
Zhen'an	Shantai	106	47	3
	Dianshi	218	60	15
TOTAL		**2,057**	**624**	**130**

Characteristic	Field Survey Sample (1)	Provincial Survey Sample (2)	Ratio (2)/(1)
Family Size	4.58	4.67	1.02
Labor Ratio	0.58	0.55	0.95
Average Years of Education	6.10	5.83	0.96
Per Capita Arable Land (*mu*)	2.83	2.85	1.01
Percent Mountain Households	91	82	.90
Per Capita Value of Assets	1,954	2,414	1.24
Incidence of Poverty (%)	21	17	0.81

Mu = 0.067 ha.
[a] According to the 1996 listing.
Source: PRC study team field survey database; Shaanxi provincial database.

experiences with transport and energy, and then to read the card aloud as an introduction when speaking to the group for the first time. This placed all participants on an equal footing. Finally, other participatory tools were used to give equal opportunity to all participants, such as impact matrixes, and household mobility mapping. Smaller group discussions were held on some issues to increase the interaction among participants, especially those from vulnerable groups.

Focus group discussions were also organized with specific groups of transport or electricity users of various business backgrounds and gender. The participants in these discussions were those who made the greatest use of transport and energy services. They were engaged in transport, processing, construction, commerce, and services, as well as in larger-scale commercial agriculture. Finally, institutional interviews were carried out with representatives of transport and energy agencies to complement statistical data with current information on development status and change, supply of services, and institutional governance, as well as to identify policy and institutional barriers to the participation of the poor in infrastructure project benefits.

Data from the provincial survey for 1,018 households, as well as data from the field survey for 620 households, were used to estimate probit models (a type of probability estimate) relating transport and energy variables, as well as other socioeconomic variables, to the probability of a household's being poor in 2001. Selected data, both quantitative and qualitative, were used to analyze the impacts of specific interventions. The results were then used to formulate recommendations for improving the impact of national policies and programs on poverty reduction.

Sample Communities

Three sample villages were selected in each of the four sample counties.

Jingbian County (Yulin Prefecture). The village of Wanquze is a township center located 30 km from

Community representatives in Zhen'an County, Shaanxi Province, exchange views with members of the study team.

the county headquarters at Dagou and 5 km from the nearest highway. At 323 households, it is the largest village in the sample. An earth road to Dagou was constructed in 1970 and improved to all-weather standards in 2000. The town was electrified in 1995 and every household in the town has a connection. Thirty-two households in the village have motorcycles and 5 have agricultural tractors; none owns a truck. Eleven households have refrigerators, and more than 300 have television sets. Twenty-nine households have telephones, installed since 1997. Three households are engaged in agricultural processing and the village has about 15 shops. Some farmers raise livestock and vegetables as well as less perishable crops; one household has a greenhouse. Young people have been leaving the village to look for work since 1988.

Chelukao is also a relatively large village with 265 households. It is 15 km from the township center at Dongkeng and 37 km from the county seat. An earth road was constructed from the village to the township center in 1972, and in 1976 the road from the township to the county seat was improved to all-weather standards. In 1998, the whole village was electrified. Twelve households have motorcycles and 15 have tractors; 86 have television in their homes and 6 have telephones. The village has three shops and four processing industries: two rice and flour mills and two producers of cooking oil. One village household has a truck and provides transportation services to the entire community. About 15% of the households raise livestock, mainly sheep. People have been leaving the community to seek work since 1985; the first group of long-term migrants moved away in 1987.

The village of Dacha is smaller, at 188 households, but still large in comparison with some of the other villages in the sample. It lies 10 km from the township center at Zhenqing and 20 km from the county seat. It is connected to the township center by an earth road constructed in 1997. Electricity became available in the village in 1987. Forty households have television sets. The village has 15 motorcycles—but no other motorized vehicles—eight shops, and three processing enterprises. This village has a TVE, a chicken farm owned by four households. Fifteen households raise sheep. About 60 people have left the village to look for work, and 30 have moved away for long-term employment.

Shenmu County (Yulin Prefecture). The village of Mengjiagou is a relatively small village of 100 households. Part of the township of Hejiachuanit is located 10 km from the nearest highway and 49 km from the county seat. Until recently, it took 8 hours for residents of Mengjiagou to reach the county seat. Since the construction of the Shen Peng Road in 2000 and the Sha He Road in 2001 to all-weather standards, it takes only 1 to 2 hours to get there. The village was electrified in 1978. Since the roads were improved, the number of motorized vehicles has increased dramatically: now there are 30–40 motorcycles, 80% of which were bought in the last few years, and 10 trucks, 7 of which were bought in the last few years. Eighty households have refrigerators, 45 have washing machines, 35 have refrigerators, and 31 have telephones. The village has 15 stores, 10 of which were established since the road was improved. Eight households have established processing industries, five of them since the road was improved. While few households raise livestock, four households have built greenhouses for vegetable production. Few people have left the village looking for jobs, but 70–80 persons participated in the road construction activity, earning 20–35 yuan per day.

The village of Taihezhai is a township center located 68 km from the highway at Shenmu. An earth road to the county seat was built in 1978 and paved in 1999. Electricity came to Taihezhai in 1982, and the supply of electricity was strengthened in 2001. Although the townspeople did not start to invest in motorized vehicles until recently, 83 households have purchased television sets since 1983. Ten households have telephones. The village includes 6 shops, 2 restaurants, and 1 hotel. Five families are engaged in processing activities. However, relatively little investment has taken place in agriculture and livestock. Since the road

was first built, about 35 households have migrated out of the community to find work.

Gaorenlimao, a village in Qiaochatan township, is located 108 km from the county seat at Shenmu, and 10 km from the township center. Here also, an earth road was built in 1978 and paved in 1999. Electricity became available in Gaorenlimao in 1982, and the village also benefited from network strengthening in 2001. The pattern of investment in this remote community is similar to that for Taihezhai. The community has 5 tractors (including 2 bulldozers), 6 trucks, and 2 minibuses purchased since the road was paved. Sixty families purchased television sets shortly after electricity came to the village; 10 now have telephones and 5 have refrigerators. The village includes 3 shops and 3 processing enterprises. Investment in agriculture is limited, except for about 30 families that raise sheep. Since the earth road was first built, more than 100 inhabitants have left the village to look for employment elsewhere.

Zhashui County (Shangluo Prefecture). The village of Yingzhen is located 1 km away from the township center at Yingpan and 18 km from the county seat. It is served by an all-weather road that was constructed in 1976. A railway passes near Yingzhen and the village is only 1 km from the railway station at Yingpan. The town has 196 households, and many residents have found employment in road (350 persons) and railway (270 persons) construction. Electricity has been available since 1982 to three settlements within the village, but one settlement still has no electricity. Ten households provide transportation services, with 6 minibuses and 2 trucks in the village, as well as 4 tractors, 20 motorcycles, and 43 tricycles. Almost all households have television sets, and 20 have refrigerators. The village includes 20 shops and 7 households engaged in agricultural processing. There is also a village brick-making enterprise. Agricultural activity is rather limited in Yingzhen. Some 200 people have left the village to look for work elsewhere.

Mingxing is a relatively large village (220 households) located 3 km from the highway at the township center of Xialiang and 13 km from the county seat. The railway passes by Mingxing and a railway station is located at Xialiang. An earth road was constructed from the village to the town in 1971. In 1976, this road was upgraded to all-weather standards connecting to the town and the county seat. About 200 persons from Mingxing have been employed in road construction and 100 in railway construction. The village has 4 trucks and 4 minibuses, as well as 15 motorcycles and 51 tricycles. Fifty households have refrigerators, 150 have television sets, and 75 have telephones. Four shops are located in the village, and 20 households are engaged in agricultural processing. Sixty people are employed part-time in transportation services, 20 are involved in long-distance trading, and about 10 have other specialized businesses. Four village enterprises date from 1992. About 40 households raise livestock, mostly sheep. Only a few people have left to look for work, many years ago before the improved road was built.

The village of Yaowanggou has 70 households, the smallest in the sample. It is located 6 km from the highway at the township center of Yingpan and 36 km from the county seat. An earth road was constructed from the village to the town in 1999. The railway passes within 5 km of Yaowanggou, but the nearest railway station is 10 km away. About 80 persons from the village have been employed in highway construction and 30 in railway construction. The village was electrified in 1989, and the system was upgraded in 2002. The village has 8 motorcycles, 1 tractor, and 1 tricycle, all purchased since 1997. Sixty-one households have television sets, 3 have refrigerators, and 12 have telephones. No shops or other family or village enterprises are located in the village, although two households provide transportation services. About 30 households have left the village to seek work elsewhere.

Zhen'an County (Shangluo Prefecture). The village of Shantai is relatively small (100 households). It is located 8 km from the township center of Zhangjia and 58 km from the county seat. The earth road from the village to the town was constructed in 1978 and upgraded to all-weather standards in 1997; the road from the town to the county seat has been all-weather since 1975. The village is 20 km from the railway and 35 km from a railway station. More than 200 persons have been employed in highway construction and 27 in railway construction. The village has been electrified since 1987. The village has 6 motorcycles, 9 tricycles, and 1 minibus. Practically all households have television sets, while 2 have refrigerators and 5 have (mobile) telephones. The village includes 1 shop and 3 households engaged in agricultural processing. About 60 households have undertaken specialized agriculture, planting tobacco, watermelons, and fruit trees. About 35 households have substantial numbers of livestock, mainly sheep and pigs. Only 17 persons have left the village to look for work, starting in 1985.

Dianshi is a relatively large village of 218 households, located 3 km from the township center of Jiezi and 11 km from the county seat. An all-weather road connecting the

township center to the county seat was constructed in 1987. A road paved with stones was constructed in 1990 from the village to the township center. Some 450 persons from Dianshi Village have been employed in highway construction and 210 in railway construction. One village group (four households) was connected to electricity in 1981, but electricity became available to the whole village only in 1990. The system serving one settlement was upgraded in 2001. The village has 48 motorcycles, 6 trucks, 4 tractors, and 5 tricycles; 15 households provide transportation services. Twelve households have refrigerators, 68 have telephones, and 182 have television sets. The village has 20 shops and 8 processing enterprises, and 1 TVE in mining. Two households are engaged in long-distance trading, and five have other specialized businesses. Quite a number of households raise sheep and pigs, and others produce vegetables. Since 1986, 86 persons have left the community to find jobs.

The village of Baishu (130 households) is located 25 km from the township center of Qingtongguan and 61 km from the county seat. An earth road from the village to the township center was constructed in 1972 and upgraded to all-weather standards in 1999. A national highway built in 1970 connects the village to the county seat. Electricity became generally available in Baishu in 1992, although four households have had it since 1984. The village has 10 motorcycles, 7 tricycles, 1 tractor, and 1 truck. Ninety-one households have television sets, including 60 that have color, while only 4 have refrigerators and 5 have telephones. The village has about 20 shops and six households are engaged in agricultural processing. More than 50 farm (tobacco) and livestock raising. No migration out of the village was reported by village authorities.

Household Characteristics

Household data from the provincial survey and from the field survey were analyzed to compare the poor with the nonpoor, using the official income-based definition of poverty; and the poor with the nonpoor, using the constructed measure of asset-based poverty. In the provincial survey data used for the probit analysis, income-based poor households accounted for 28% of the sample and the asset-based poor represented 30% of the sample. However, these were not always the same households. About 30% of the nonpoor by an income standard were poor by the asset-based standard, and about 30% of the nonpoor by an asset-based standard were poor by an income standard. In the field survey, the income-based poor constituted 40% of the sample used for the probit analysis and the asset-based poor constituted 55%. In this case, about 44% of the nonpoor by an income standard were relatively poor in terms of assets, while 24% of the nonpoor in terms of assets were poor as defined by the national poverty line.

The distribution of household characteristics between poor and nonpoor households according to these two poverty criteria are shown in Table 5.4 for the provincial database and Table 5.5 for the field survey database.

Poor households, by both criteria, tend to be slightly larger than nonpoor households, and to have slightly lower rates of labor force participation. Not a great deal of variation exists between the poor and the nonpoor in educational levels, although the nonpoor are slightly more likely to have completed 6 years of schooling. However, a sharp difference exists in the percentage of households with skilled labor, especially in terms of income-based poverty. Seventy-four percent of the provincial sample households are located in mountainous areas, with a slightly higher proportion of nonpoor households in these areas. Sixty-five percent of the provincial sample households are located in the north, but 91% of the income-poor households are in this region. Poor households are likely to have a bit more arable land, but they are much less likely than the nonpoor to have income from off-farm employment. They also have less opportunity to access technical training, although they appear to have approximately equal access to credit.

In terms of access to infrastructure, the income-poor are somewhat less likely than the nonpoor to live in a village with direct access to an improved road. However, the poor and nonpoor in terms of assets are little different in this respect. The income-based poor are slightly less likely to live within 5 km of a bus station, but the asset-based poor are slightly more likely to do so, while the situation is reversed for access to railway stations. Nearly all sample households have access to electricity. Though the poor have relatively good access to transport and energy infrastructure, they are markedly less likely to use these services, as measured by per capita expenditure on transport and energy.

The provincial data also show that from 1998 to 2001, the prevalence of income-based poverty increased from 16% to 28%. This is probably due to prolonged drought in Shaanxi Province over those years. However, asset-based poverty declined slightly, from 33% in 1998 to 30% in 2001.

Data from the field survey sample differ from the provincial averages in only a few respects. The field survey did register a higher incidence of poverty in the selected sample counties and villages, particularly with respect to asset-based poverty. This is partly an artifact of the analy-

Table 5.4. Characteristics of Poor and Nonpoor Households (Provincial Database)

Household Characteristics	Sample Average (n=1,018)	Income-Based Poverty		Asset-Based Poverty	
		Poor (n=284)	Nonpoor (n=734)	Poor (n=308)	Nonpoor (n=710)
Income Poverty (2001)	27.90	100.00	0.00	24.05	29.57
Asset Poverty (2001)	30.30	26.12	31.91	100.00	0.00
Household Size	4.32	4.41	4.28	4.56	4.21
Labor Force Participation	0.61	0.59	0.62	0.61	0.61
Average Education (years)	6.03	5.84	6.10	5.85	6.10
Maximum Education	3.89	3.84	3.91	3.88	3.89
Percent Skilled Labor	7.98	2.04	10.24	6.01	8.83
Mountain Location	74.30	60.14	79.79	69.62	76.34
North Shaanxi Location	65.00	90.72	55.05	65.51	64.79
Per Capita Arable Land (*mu*)	2.79	2.97	2.72	2.86	2.77
Off-farm Employment	0.14	0.08	0.16	0.12	0.15
Income Per Capita (1998) (in yuan)	1,041.99	948.64	1,078.12	960.93	1,077.23
Value of Assets Per Capita (1998) (in yuan)	2,475.95	2,581.24	2,435.19	1,509.13	2,896.18
Technical Training (%)	13.52	3.78	17.29	12.34	14.03
Access to Credit (%)	23.59	22.34	24.07	28.16	21.60
Road Access (1998)	31.93	24.05	34.97	31.96	31.91
<5 km from Bus Station	59.25	52.23	61.97	60.44	58.73
<5 km from Rail Station	6.23	3.44	7.31	4.75	6.88
Per Capita Transport Expenditure (yuan)	41.66	15.12	51.94	36.57	43.88
Access to Electricity (1998)	97.03	98.97	96.28	94.62	98.07
Per Capita Energy Expenditure (yuan)	15.93	16.06	15.88	15.55	16.10
Income Poverty (1998) (%)	16.30	24.40	13.16	18.67	15.27
Asset Poverty (1998) (%)	32.98	28.87	34.57	65.82	18.71

Mu = 0.067 ha.

Income poverty = percent of households with per capita incomes below the national poverty line in the year concerned; asset poverty = percent of households with a per capita value of assets below the average for the sample in the year concerned; household size = number of household members; labor force participation = average percent of household members of working age who are employed (including self-employed); average education = average years of education of all adult household members; maximum education = index from 1 (illiterate) to 7 (university level), measuring the highest educational attainment of any household member; percent skilled labor = average percent of household members of working age who have acquired a productive skill; mountain location = percent of households living in mountainous areas; North Shaanxi location = percent of households in the North Shaanxi part of the sample; per capita arable land = average amount of arable land per household member; off-farm employment = percent of household members of working age employed in other than household or farm work; technical training = percent of households who have received some form of technical training during the previous year; access to credit = percent of households who have received commercial or policy loans during the previous year; road access = percent of households living in villages with motorable village road access; access to electricity = percent of households connected to the electricity grid.

Source: Shaanxi provincial database.

Table 5.5. Characteristics of Poor and Nonpoor Households (Field Study Database)

Household Characteristics	Sample Average (n=620)	Income-Based Poverty		Asset-Based Poverty	
		Poor (n=245)	Nonpoor (n=375)	Poor (n=343)	Nonpoor (n=277)
Income Poverty (2001) (%)	39.6	100.0	0.0	52.5	23.7
Asset Poverty (2001) (%)	55.3	73.3	43.5	100.0	0.0
Household Size	4.6	4.7	4.5	4.6	4.5
Labor Force Participation	0.6	0.6	0.6	0.6	0.6
Average Education (years)	4.8	4.0	5.4	4.2	5.7
Maximum Education	2.9	2.7	3.1	2.8	3.1
Percent with Good Health	87.0	81.6	90.5	83.1	91.8
Percent Off-farm Employment	26.2	17.6	31.8	20.5	33.2
Mountain Location	91.4	87.5	93.9	89.6	93.6
Per Capita Arable Land (*mu*)	3.1	3.6	2.8	3.4	2.7
Income per Capita	1,430.3	228.3	2,253.2	791.9	2,049.1
Value of Assets per Capita (1998) (in yuan)	5,671.2	2,881.7	7,604.3	2,021.1	9,209.6
Technical Training (%)	16.0	15.8	16.2	13.6	19.0
Access to Credit (%)	65.4	66.8	64.5	61.4	70.2
Road Access (1998)	38.3	27.8	45.6	31.2	45.2
Paved Village Road	53.5	50.2	55.4	49.9	57.7
Distance from Main Road	41.8	48.9	37.2	45.4	37.3
<5 km from Rail Station	18.7	9.31	24.9	11.3	28.0
Village Road Density	0.77	0.78	0.77	0.74	0.81
Per Capita Transport Expenditure (yuan)	66.4	40.7	83.2	44.9	93.0
Access to Electricity (1998)	97.8	97.9	97.7	97.2	98.3
Electricity Improvement	28.4	19.0	34.5	22.0	36.2
Per Capita Energy Expenditure (yuan)	115.3	57.9	153.0	65.4	177.1
Asset Poverty (1998) (%)	47.8	62.4	38.2	70.4	19.7

Mu = 0.067 ha.

Income poverty = percent of households with per capita incomes below the national poverty line in the year concerned; asset poverty = percent of households with a per capita value of assets below the average for the sample in the year concerned; household size = number of household members; labor force participation = average percent of household members of working age who are employed (including self-employed); average education = average years of education of all adult household members; maximum education = index from 1 to 7, measuring the highest educational attainment of any household member; percent with good health = percent of households where household member is disabled or suffers from chronic disease; percent off-farm employment = percent of household members of working age employed in other than household or farm work; mountain location = percent of households living in mountainous areas; per capita arable land = average amount of arable land per household member; technical training = percent of households who have received some form of technical training during the previous year; technical training = percent of households that received some form of technical training during the previous year; access to credit = percent of households that received commercial or policy loans during the previous year; road access = percent of households living in villages with motorable village road access; distance from main road = average km from the household's village to the main road linking it to a county town; village road density = length of motorable village roads per km^2 of village area; access to electricity = percent of households connected to the electricity grid; electricity improvement = percent of households living in villages with a "reformed" electricity grid connection (larger loads and more reliable service).

Source: PRC study team field survey database.

sis, since a higher average value of assets was constructed for the field survey sample, reflecting in part the effects of the transport and energy interventions studied. However, greater disparities between the poor and the nonpoor were found in the field sample than in the provincial sample. In the field survey, the asset-based poor had a slightly higher rate of labor force participation than the asset-based nonpoor, but the differences are small and may not be statistically significant. The average years of education figure recorded by the field survey is lower than the provincial average for poor counties, between 4 and 5 years rather than 6 years, with nonpoor household members being more likely to have completed 5 years of schooling. In the field survey, a question was also asked about family health. About 87% of all households reported good health, but poor households were less likely to do so than nonpoor households.

Over 90% of the field survey sample households, compared with 74% of the provincial sample, are located in mountainous areas. However, in both cases a higher proportion of the nonpoor lives in the mountains. As in the provincial sample, poor households cultivate more land than nonpoor households, but are markedly less likely to have income from off-farm employment. Among the field survey sample households, much less difference is notable between the poor and the nonpoor in access to technical training than in the provincial sample. In both cases, relatively little difference was found in access to credit. Asset-based poverty appears to be more important than income-based poverty in determining household access to technical training and credit.

The field survey added some further measures of the quality of transport and energy infrastructure available to the sample households. Just over half of all sample households had village access to a paved road. The income-poor were slightly less likely than the income-based nonpoor to live in a village with a paved road; the difference was larger between the asset-based poor and nonpoor. The average distance from a main road was 42 km, with poor households, on the average, living farther from the road than nonpoor households. Village road density varied little as far as the income-poor were concerned, but slightly more for the asset-based poor. Per capita expenditures on transport were notably higher for the field survey sample than for the provincial sample, although large differences between the expenditures of the poor and nonpoor were recorded in both cases. Some 28% of field sample households had benefited from improvements in the quality of service provided by the rural electricity grid. Here, too, the percentages of poor and nonpoor households benefiting from these improvements showed marked differences.

The field survey did not attempt to reconstruct household incomes at a previous point in time. However, it did record the value of household assets in 1996. Asset-based poverty increased from 48% to 55% between 1996 and 2001 among the surveyed households. This was most likely due to the prolonged drought, which forced many households to liquidate assets. However, about 20% of the households that were asset-poor in 1996 were not asset-poor in 2001, indicating some progress in asset poverty reduction.

Findings

Use of Transport and Energy Services

The PRC study team based its analysis on the premise that a fundamental prerequisite for transport and energy infrastructure to have an impact on poverty reduction would be that the poor used transport and energy services effectively. For this reason, they examined household expenditures on transport and energy and the value of household assets that could be used in both cases (Table 5.6). Not surprisingly, the poor spend less than the nonpoor on both transport and energy. However, the expenditures of the poor on transport and energy are significantly higher as a percentage of their income than those of the nonpoor: the poor spend, on average, 18% of their (cash) income on transport and 25% on energy, while the nonpoor spend less than 8% on either service. This proportion declines sharply, especially for transport, with rising income levels. Relatively little variation in expenditures on electricity can be seen. In fact, the poor, as defined by the national

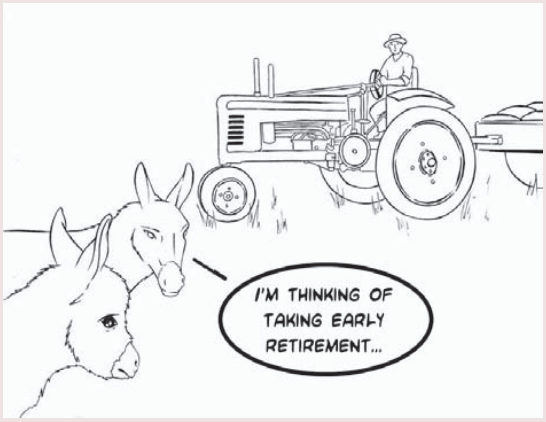


Table 5.6. Use of Transport and Energy Services by Poor and Nonpoor Households
(Yuan)

Expenditures	Average (n=624)	Asset-Based Poverty		Income-Based Poverty	
		Nonpoor (n=327)	Poor (n=297)	Nonpoor (n=494)	Poor (n=130)
Per Capita Transport Expenditure	66.36	87.35	43.40	73.78	41.00
Per Capita Value of Transport-Related Assets	227.30	265.02	186.05	257.87	177.24
Per Capita Energy	115.22	164.44	61.38	122.54	82.11
Electricity	(47.24)	(60.53)	(32.70)	(46.15)	(51.22)
Other Fuels	(67.98)	(103.91)	(28.68)	(76.39)	(30.89)
Per Capita Value of Electrical Appliances	400.27	581.02	202.53	413.29	230.39
Per Capita Value of Processing Assets	269.27	477.15	41.85	250.66	61.11

Source: PRC study team field survey database.

poverty line, actually spend, on average, a little more than the nonpoor on electricity. The major difference, as far as energy is concerned, is in the value of expenditures on other fuels. This may reflect the greater propensity of nonpoor households to own motor vehicles and also, perhaps, to use LPG appliances such as stoves. It may also be related to the greater propensity of nonpoor households to own processing assets, which may be powered by grid electricity or other fuels (e.g., diesel).

Detailed information about the transport and energy assets owned by poor and nonpoor households is presented in Tables 5.7 and 5.8. Bicycles are the most popular means of transport for both poor and nonpoor households. About one third of all households are still using animal traction, mainly donkeys and oxen, for goods transport.

In north Shaanxi, where over half the province's poor counties and poor population are located, donkeys have played an important role in farming. They have been used for threshing grain as well as for transporting crops to market and inputs from market to farm. With the construction of motorable roads, agricultural three-wheel tractors are starting to take the place of donkeys for farm transport and threshing grain. For example, Dacha village of Jingbian county had about 900 donkeys before 1996, when the motorable road was built. By 2002, the number of donkeys in the village had dropped to less than 400. In the meantime, the number of agricultural three-wheel tractors increased to 50.

On average, 14.4% of sample households owned three-wheel tractors by 2002. Nonpoor households owned more than poor households by a factor of about 30%. These vehicles can also be used for commercial transport. Agricultural three-wheel tractors also used to be important for passenger transport to markets and bus stations. Recently, however, the transport administrative authority forbade their use to carry passengers because they are thought to be unsafe. This has created a problem for passenger transport in villages not served by buses.

Motorcycles have started to become an important means of transport, especially for young people. Over 10% of sample households had motorcycles. Mainly, these are nonpoor households. About 11% of the sample owned other large commercial vehicles, including trucks, pick-ups, tractors, and cars. More than two thirds of these vehicles were owned by nonpoor households.

Unlike nonpoor households, the poor spend more on electricity than they do on other types of fuel. This implies that the poor mainly use energy as final consumers (e.g., for lighting and television) rather than as an input to production. This argument is supported by the significant differences between the poor and nonpoor in the types of electrical appliances and processing assets the poor and nonpoor own (Table 5.8).

The distribution of irrigation and processing assets strongly favors the nonpoor. The number of pumps owned per 100 asset-poor households is less than 10% of the num-

Table 5.7. Transport Assets Per 100 Households
(Percent)

Transport Mode	Average (n=624)	Asset-Based Poverty		Income-Based Poverty	
		Nonpoor (n=327)	Poor (n=297)	Nonpoor (n=494)	Poor (n=130)
Bicycles	61.06	73.01	47.99	58.55	56.10
Motorcycles	10.42	16.01	5.03	12.72	3.25
Tricycles	0.80	0.98	0.63	0.88	0.00
Draft Animals	48.72	41.41	56.71	52.63	49.59
Percent of Households Owning Draft Animals	33.51	29.20	37.38	31.58	40.65
Three-wheel Tractor	14.42	16.99	11.95	15.35	13.01
Tractor	4.01	5.23	2.83	4.17	4.07
Farm Truck	2.56	4.90	0.31	3.07	1.63
Truck	2.40	4.25	0.63	1.97	1.63
Car	2.24	2.94	1.57	2.41	1.63

Source: PRC study team field survey database.

ber owned by the asset-based nonpoor. The number of food processing machines owned by asset-based poor households is less than two thirds the number of those owned by the nonpoor; this discrepancy is even greater with respect to income poverty. In contrast, television is very popular with most households. More than three fourths of the poor households had television sets, as did almost all nonpoor households. This situation presents an opportunity for the Government and other organizations to introduce new policies, programs, and technologies to both the poor and the nonpoor through television programs.

Changes in Transport Mode

Five years ago, 65% of the interviewed farmers went to market on foot. This proportion has now declined to 42%.

Table 5.8. Energy Assets Per 100 Households
(Percent)

Appliance	Average (n=624)	Asset-Based Poverty		Income-Based Poverty	
		Nonpoor (n=327)	Poor (n=297)	Nonpoor (n=494)	Poor (n=130)
Diesel Engine	5.45	6.75	4.03	4.82	7.32
Electric Pump	9.78	17.18	1.68	9.43	4.88
Food Processors	21.96	26.38	17.11	25.00	7.32
Fodder Grinders	4.33	4.91	3.69	5.48	0.81
Threshers	1.12	1.23	1.01	1.54	0.00
Television Sets	92.31	105.83	77.52	93.42	80.49
Cable Television	0.16	0.31	0.00	0.22	0.00
Gas Stove	0.64	0.92	0.34	0.44	0.81

Source: PRC study team field survey database.

The bus is the most important means of transport for farmers traveling to county towns.

The proportion of farmers who take a bus to market has increased from 11% to 33%, and the number of farmers using three-wheel tractors has doubled from 3% to 6%. It is noteworthy that buses took over not only one third of the walking trips but also almost the same share of trips previously made by bicycle or motorcycle (mainly bicycle). This is understandable because most of the sample farmers live in the mountain areas, where bikes are not suitable for goods transport. Five years ago, the share of (asset-based) poor farmers walking to market (61%) was less than the share of nonpoor farmers walking to market (69%). With transport changes, the share of poor farmers has dropped only to 45%, while the share of nonpoor farmers has dropped to 39%. Thus, nonpoor farmers have been more likely to take advantage of market transport improvements (Table 5.9).

County towns are usually the small cities closest to farmers. Five years ago, about 30% of farmers went to county towns on foot or by bicycle. Now less than 10% do so. In that period, the proportion of farmers who took the bus to county towns (including those who walk and then take the bus) increased from 66% to 86%. The bus has become the most important means of transport for farmers to county towns (Table 5.10).

A striking change has occurred in the modes of transport used by rural residents to travel to Xi'an, the provincial capital and the largest city in northwestern PRC (Table 5.11). Five years ago, train travel was not available, but today 69% of survey respondents take the train. Significant variation between the north and the south exists on this point. Today, 75% of the respondents in the south take the train to Xi'an, while only 17% of those in the north do so. Five years ago, nearly 80% of the interviewed farmers took the bus to Xi'an. The change in mode of transport for travel to Xi'an is mainly due to the comparative advantages of rail transport over road. These advantages were identified in household interviews and participatory group discussions as (i) saving time—on the average, round-trip rail travel to Xi'an was about 9 hours shorter than the road trip; (ii) greater reliability—train travel is less likely to be affected by storms and flooding; and (iii)

Table 5.9. Change in Transport Mode to Market
(Percent)

Transport Mode	5 Years Ago			Present		
	Average	Nonpoor	Poor	Average	Nonpoor	Poor
Walking	65.07	69.03	61.21	42.11	38.87	45.34
Bicycle or Motorcycle	13.32	12.83	13.31	8.91	8.91	8.91
Three-Wheel Tractor	3.06	2.21	3.88	6.28	6.07	6.48
Bus	10.92	7.52	14.22	33.20	35.63	30.77
Train	0.00	0.00	0.00	0.40	0.40	0.40
Walk and Bus	6.11	7.52	4.74	5.26	6.48	4.05
Bicycle and Bus	0.22	0.00	0.43	0.20	1.21	1.62
Bus and Train	0.00	0.00	0.00	0.20	0.40	0.00
Donkey Car or Oxcart	1.31	0.88	1.31	1.62	2.02	1.62
Others	0.00	0.00	0.00	0.61	0.00	1.21

Source: PRC study team field survey database.

Table 5.10. Change in Transport Mode to County Town
(Percent)

Transport Mode	5 Years Ago			Present		
	Average	Nonpoor	Poor	Average	Nonpoor	Poor
Walking	15.77	19.03	12.82	1.69	1.71	1.68
Bicycle or Motorcycle	13.46	13.77	13.19	6.10	6.83	5.39
Three-Wheel Tractor	2.88	2.02	3.66	4.07	4.44	3.70
Bus	52.31	44.53	59.34	75.76	71.33	80.13
Train	0.00	0.00	0.00	0.17	0.00	0.34
Walk and Bus	13.46	19.03	8.42	9.49	14.33	4.71
Bicycle and Bus	0.58	0.40	0.73	1.02	1.02	1.01
Bus and Train	0.00	0.00	0.00	0.00	0.00	0.00
Donkey Car or Oxcart	0.38	0.40	0.37	0.17	0.34	0.00
Others	1.15	0.81	1.47	1.53	0.00	3.03

Source: PRC study team field survey database.

Table 5.11. Change in Transport Mode to Provincial Capital
(Percent)

Transport Mode	5 Years Ago			Present		
	Average	Nonpoor	Poor	Average	Nonpoor	Poor
Walking	0.00	0.00	0.00	0.00	0.00	0.00
Bicycle or Motorcycle	0.00	0.00	0.00	0.00	0.00	0.00
Three-Wheel Tractor	0.57	0.00	0.89	0.00	0.00	0.00
Bus	79.89	80.65	79.46	25.70	26.87	25.00
Train	2.30	0.00	3.57	52.51	47.76	55.36
Walking and Bus	12.07	17.74	8.93	2.79	5.97	0.89
Bicycle and Bus	0.57	0.00	0.89	0.00	0.00	0.00
Bus and Train	2.87	1.61	3.57	16.76	19.40	15.18
Donkey Car or Oxcart	0.00	0.00	0.00	0.00	0.00	0.00
Others	1.72	0.00	2.68	2.23	0.00	3.57

Source: PRC study team field survey database.

greater safety—trains are less likely to be involved in accidents.

However, the bus remains the most important means of transport for farmers traveling to other regions within or outside the province. About 70% of the trips made to other regions within the province are by bus, or a bus combined with the train. For transport to other provinces, the bus is also the most important means of transport, but trains have increased their share of this market. These findings show that the rail network does not serve as wide an area as the highway network. The interviewed farmers also traveled mainly to nearby provinces.

Changes in Frequency of Travel

The use of transport infrastructure is reflected not only in the choice of transport mode but also in the frequency of travel to different destinations. Five years ago, 59% of

all farmers in the field survey sample visited markets once a month or more often. The share of farmers visiting markets this often has increased by 10 percentage points over the past 10 years (Table 5.12). Although the proportion of nonpoor households visiting markets once a month or more is still greater than the proportion of poor households, the poor have increased their access to markets more than the nonpoor over the last 5 years.

A significant change has occurred in the frequency of travel to county towns. Five years ago, less than 30% of interviewed farmers visited county towns once or more per month. Now this proportion has increased to 46% (Table 5.13). The frequency of visits by poor farmers to county towns has increased at a higher rate than the sample average. However, the proportion of the poor visiting county towns once or more a month is still only 63% of that of the nonpoor.

The change in frequency of visits to Xi'an is very interesting (Table 5.14). On the one hand, the proportion of farmers visiting Xi'an more often than once a month

Table 5.12. Change in Frequency of Travel to Market
(Percent)

	5 Years Ago			Present		
Frequency of Travel	**Average**	**Nonpoor**	**Poor**	**Average**	**Nonpoor**	**Poor**
> Once a Week	22.25	30.34	13.97	23.74	32.13	15.32
Once a Week	11.45	13.68	9.17	16.50	18.07	14.92
Twice a Month	10.58	9.83	11.35	14.08	12.05	16.13
Once a Month	15.12	13.68	16.59	15.29	12.45	18.15
Once Every 3 Months	13.17	10.68	15.72	11.67	10.04	13.31
Once Every 6 Months	10.15	9.83	10.48	7.85	8.03	7.66
Once a Year	6.91	6.84	6.99	5.03	2.81	7.26
< Once a Year	6.91	2.99	10.92	3.42	3.21	3.63
Once Only	3.02	2.14	3.93	2.21	1.20	3.23
Never	0.43	0.00	0.87	0.20	0.00	0.40

Source: PRC study team field survey database.

Table 5.13. Change in Frequency of Travel to County Towns
(Percent)

	5 Years Ago			Present		
Frequency of Travel	**Average**	**Nonpoor**	**Poor**	**Average**	**Nonpoor**	**Poor**
> Once a Week	6.19	9.16	2.87	10.02	14.81	5.14
Once a Week	3.87	5.86	1.64	5.09	6.06	4.11
Twice a Month	6.77	8.06	5.33	11.38	13.13	9.59
Once a Month	12.19	13.55	10.66	19.19	21.89	16.44
Once Every 3 Months	18.38	16.85	20.08	20.20	18.52	21.92
Once Every 6 Months	14.70	14.65	14.75	11.38	9.43	13.36
Once a Year	13.51	13.92	12.30	9.00	6.40	11.64
< Once a Year	14.51	9.89	19.67	10.02	7.07	13.01
Once Only	8.32	6.59	10.25	2.72	2.02	3.42
Never	1.93	1.47	2.46	1.02	0.67	1.37

Source: PRC study team field survey database.

has declined from 4.6% to 2.8%. On the other hand, the proportion of farmers visiting Xi'an more than once a year has increased from 25% to 37%. About 10% of the interviewed households had never been to Xi'an 5 years ago but are going now. Interviews show that the reduction in the proportion of farmers visiting Xi'an frequently was due to nine farmers who traveled to Xi'an to purchase goods to sell to railway workers during the railway construction. Now that the railway is completed, they no longer need to make this trip. However, the increase in the proportion of farmers visiting Xi'an at least once a year is mainly owing to the improvement of highways and the opening of the new railway. In particular, with the improvement in transport infrastructure, more rural workers travel to Xi'an to seek employment. Generally, the nonpoor visit Xi'an more frequently than the poor.

In general, with the improvement in transport infrastructure, rural residents are visiting other provinces and other regions within the province more frequently. The shares of surveyed households visiting other regions within the province and other provinces at least once a year have increased by 6.2 and 5.0 percentage points respectively (CASS 2004, Appendix 3, Table 2). For travel within the province, the increase was almost entirely due to increased travel by poor households. However, nonpoor households accounted for most of the increased travel outside the province. Most of them traveled to these places to seek employment (Box 5.1).

Transport Time and Cost Savings

Changes in transport mode and in the frequency of travel are associated with an increase in transport efficiency and time saving. Transport times and costs used in this study were defined as the essential time and costs spent to make a round trip from home to destination, including the time and money spent in vehicles, and on accommodations needed while waiting for or changing buses or trains. As shown in Table 5.15, travel time to market over the past 5 years was reduced by 1.2 hours on average, although transport cost increased almost 50%. The average time to travel to county towns declined by 50%, while the cost declined by 10%. Focus group discussions and analysis of the change in transport services show that the decline of transport costs to county towns is mainly due to increased competition in the local transport market. The number of vehicles providing passenger transport services in the four sample counties had nearly quadrupled since 1995.

Average transport times to Xi'an, other regions within the province, and other provinces were reduced by 33%, 42%, and 15%, respectively. Average transport costs to those destinations increased by 23%, 4%, and 10%, respectively. The reasons why costs increased while travel times decreased have to do with the lack of competition in long-distance transport and, hence, higher prices for services. In the PRC, rail transport is monopolized by the state. Competition in long-distance road transport is constrained by high initial investment costs and other barri-

Table 5.14. Change in Frequency of Travel to Provincial Capital
(Percent)

	5 Years Ago			Present		
Frequency of Travel	**Average**	**Nonpoor**	**Poor**	**Average**	**Nonpoor**	**Poor**
> Once a Week	1.73	2.70	0.00	1.13	0.90	1.52
Once a Week	1.73	1.80	1.61	0.56	0.90	0.00
Twice a Month	1.16	1.80	0.00	1.13	1.80	0.00
Once a Month	4.05	6.31	0.00	7.34	9.91	3.03
Once Every 3 Months	8.09	9.91	4.84	12.43	15.32	7.58
Once Every 6 Months	6.94	8.11	4.84	10.17	12.61	6.06
Once a Year	5.78	6.31	4.84	7.34	7.21	7.58
< Once a Year	19.08	20.72	16.13	20.90	18.02	25.76
Once Only	24.86	19.82	33.87	22.03	20.72	24.24
Never	26.59	22.52	33.87	16.95	12.61	24.24

Source: PRC study team field survey database.

Box 5.1. Road Construction and Migration for Employment

Dianshi, a village in Jiezi township, Zhen'an County, saw a significant change in work-related travel after the construction of a road from the village to the county town. Although the distance between the two is only 8 km, the trip each way took about 3 hours on foot because of its steep slopes. Before the road was built, only 19 farmers traveled to the town to seek jobs.

Now farmers can reach the county town by riding bicycles or motorbikes, or by taking the minibus, a 1-hour trip; 41 of them now regularly travel from Dianshi to look for work.

Among the six village groups covered by the case study, none of the residents in group five, villages which are still not accessible by road, traveled to the county town to seek employment.

Source: PRC study team.

ers to entry established by the administrative agency for road transport. Most important, the price of fuel is rising and tolls are being added to user charges. However, these costs are directly linked to ensuring the adequate maintenance of the network and enabling private investors to make profits.

Changes in Energy Use

Energy use by the sample households includes both electricity and other fuels. Rural electrification in the sample villages started in the mid-1970s. In 1980, about 10% of sample households were connected to electricity, principally generated by hydropower. By 1990, 42% of the households were connected to the grid. In the 1990s, the rate of rural electrification accelerated, especially after 1997, when the national Government implemented a program to make "every village accessible to power." By 2000, 99% of the sample households had access to electricity, and all sample households had been connected to electricity by 2001.

However, electricity is being used mainly for consumption purposes: 89% of the sample households used electricity only or mainly for lighting and powering electrical appliances, though a few have used lighting to improve their incomes (Box 5.2).

Before connecting to electricity, 99% of households had been using kerosene for lighting. Due to cost and other constraints such as market availability, the sample households spent, on average, 43.6 nights a year without lighting. As a result of replacing kerosene with electricity, women and children had more time for study in the evenings and for engaging in income-generating activities. On the average, women spent about 1.8 hours after dinner on these activities, half an hour more than they spent before having electricity. Similarly, students spent three quarters of an hour longer studying than they did before their households were electrified.

The field survey showed that after electricity service became available, 63% of the sample households were able to use an electric pump for irrigation (Table 5.16). This proportion does not vary significantly between poor and nonpoor households. However, electric pumps have not helped very much during the recent drought because of the lowering of water tables. Especially in north Shaanxi, where rainfall is low and irregular, the main source of water for irrigation is the Yellow River. Farmers in the north, poor and nonpoor, depend on pumps for irrigation. More nonpoor farmers have their own pumps, while most poor farmers had to rent pumps. Eighty percent of the interviewed households in the north used pumps for irrigation, but only 46% of the sample households in the south did so.

In addition to lighting, most sample households use electricity to power electrical appliances, mainly television sets. On the average, households watch 2.4 hours of television daily in normal months and 0.8 hours in the peak agricultural season. Respondents mostly watched news and soap operas. The news that concerns them focuses on politics, the economy, and new technologies. For farmers living in remote areas, television is the main way for them to learn about the outside world. Television is also a very important source for farmers to learn about new technologies and to access market information. Over 50% of the survey respondents said they had learned about new tech-

As a result of replacing kerosene with electricity, children now have more time for study in the evenings.

Table 5.15. Change in Travel Times and Travel Costs

Item	5 Years Ago			Present		
	Average	Nonpoor	Poor	Average	Nonpoor	Poor
Travel Time (hours)						
Market	3.26	2.60	3.92	2.08	1.72	2.43
County Town	6.03	5.63	6.47	3.18	2.85	3.51
Xi'an	21.41	22.36	19.73	14.25	14.00	14.67
Other Shaanxi	27.50	25.50	30.41	47.03	26.95	80.22
Other Provinces	37.68	37.70	37.66	32.10	31.19	33.72
Travel Cost (yuan)						
Market	4.59	4.47	4.74	6.86	5.61	7.97
County Town	12.85	13.55	12.06	11.43	11.13	11.74
Xi'an	80.11	87.08	67.64	104.01	123.45	70.51
Other Shaanxi	109.70	114.27	100.44	113.86	127.16	85.78
Other Provinces	183.67	199.88	160.88	204.30	211.75	191.23

Source: PRC study team field survey database.

Table 5.16. Change in Irrigation Methods
(Percent of households)

Irrigation Method	Before Electricity			After Electricity		
	Average	Nonpoor	Poor	Average	Nonpoor	Poor
Human Powered	24.53	21.74	26.67	7.22	5.83	9.09
Gravity Fed	62.26	65.22	60.00	25.56	26.21	24.68
Electric Pump	1.89	0.00	3.33	63.33	64.08	62.34
Diesel Pump	9.43	8.70	10.00	3.33	2.91	3.90
Hand Irrigation	1.89	4.35	0.00	0.56	0.97	0.00

Source: PRC study team field survey database.

nologies from television, and over 20% said they had adopted such technologies.

Other types of fuel used by sample households included firewood, coal, charcoal, LPG, biogas, and agricultural residues (grass or straw). Firewood is the principal fuel used for cooking and heating in most households (Table 5.17). The surveyed households used about 40% of their crop residues as fuel. In addition, each farmer spent, on the average, 12.6 days a year collecting firewood. The poor were more likely than the nonpoor to use firewood; consequently they spent 2 more days per year on firewood collection. The adults in the family, both men and women, usually carried out this task.

Probit Analysis

A probit model was used to estimate the impacts of transport and energy infrastructure, in conjunction with other factors, on poverty reduction. This type of model correlates the various factors with the probability of a household's being poor; it was tested on both the provincial database and the field survey database. The categories of intervention variables include access to transport and energy infrastructure, quality and intensity of infrastructure, transport and energy expenditures, and value of transport and energy assets. Other categories include household size and employment patterns, locational

Table 5.17. Other Fuels Used by Sample Households
(Percent of households)

Fuel	Winter			Summer		
	Average	Nonpoor	Poor	Average	Nonpoor	Poor
Firewood	52.50	49.35	55.35	61.32	58.17	64.35
Coal	25.64	28.76	22.64	19.26	21.90	16.72
Charcoal	0.16	0.00	0.31	0.00	0.00	0.00
Firewood and Coal	20.19	19.94	20.44	18.30	18.63	17.98
Firewood and Charcoal	0.32	0.33	0.31	0.00	0.00	0.00
Liquefied Petroleum Gas	0.48	0.98	0.00	0.32	0.65	0.00
Biogas	0.32	0.33	0.31	0.32	0.33	0.32
Firewood and Biogas	0.16	0.00	0.31	0.16	0.00	0.32

Source: PRC study team field survey database.

variables and land resources, household income and assets, access to credit and technical training, and previous poverty levels. The results are shown in Tables 5.18 and 5.19.

When the provincial database is used, the model coefficients for two transport-related intervention variables have the expected signs and are statistically significant at the 1% level. These variables are distance to train stations and per capita transport expenditures. These findings suggest that both road and rail investments do contribute to poverty reduction (Table 5.18). Whether a village had road access or not in 1998 has no observable effect on household poverty for the extreme poor (those below the national poverty line), although it has the expected effect for the poor defined in other ways (incomes less than $1 a day, consumption less than $1 a day, and asset-based poverty). This may mean that the extreme poor could not take advantage of the village road access to escape from poverty. On the contrary, improvement of village road conditions seems to cause the extreme poor to lose some income generation opportunities. This may be because some poor households once made money from collecting and selling firewood or from carrying construction materials. These jobs are now carried out by more economic means. Only if the households have reached some income or asset accumulation threshold can village roads contribute to poverty reduction. Distance from bus stations does not show the expected signs for the poor by any definition except the most generous one ($1-a-day consumption expenditure). This confirms once again that the presence of transport infrastructure alone cannot directly contribute to poverty reduction.

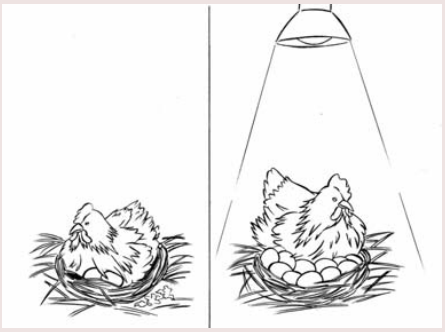
Access to electricity in 1998 had the expected impact on poverty only in the case of poverty defined by the value of assets. This probably implies that farmers increased their ownership of electrical appliances (especially televi-

Box 5.2. Profiting from a Power Grid System Reform

Li Fagui, a 49-year-old chicken farmer living in Mingxing Village, Xialiang township, Zhashui County, invested 20,000 yuan ($2,400) in 1998 to establish a chicken farm of 3,000 birds. Owing to the unstable supply of electricity on his farm, each chicken could only produce an average 18 kilograms of eggs, costing 70 yuan and generating revenue of about 80 yuan. Li's after-tax profit on his chicken farm was 12,000 yuan before the power grid system reform.

After the reform, the revenue per chicken increased by 10% because the more stable power supply made possible a higher egg yield. Li's total profit after tax increased to about 30,000 yuan, 2.5 times more than before.

Source: PRC study team.



sion) after gaining access to electricity, but that they did not use electricity much for income-generating activities.

Other socioeconomic variables showed the expected signs and, in most cases, statistically significant relationships to poverty. The labor force participation rate was positively correlated with poverty, probably because the labor of poor households in the sample is not effectively utilized. Poor households had a much lower rate of off-farm employment than nonpoor households. The returns to their labor in agricultural production were low because of limited arable land and lack of investment capacity. Although health variables in the provincial database could not be accessed, the results for the field sample suggest that lower productivity among poor households may also be correlated with health problems. The average years of education variable does not show the expected correlation. This may be because most labor is employed in the conventional agriculture sector, where traditional technologies are still used. Other studies have found that average years of education variables do not contribute much

Table 5.18. Results of Probit Estimation Using Provincial Database
(N=1,018; data for 2001 except where indicated)

	Income-Based Poor		$1-a-Day Poor (Income)		$1-a-Day Poor (Consumption)		Asset-Based Poor	
Item	**Coeff.**	**Z**	**Coeff.**	**Z**	**Coeff.**	**Z**	**Coeff.**	**Z**
Family Size	0.027	***	0.130	***	0.140	***	0.153	***
Labor Force Participation	0.238	***	0.082	**	0.570	***	0.292	***
Average Education (years)	0.031	***	0.070	***	–0.006	*	–0.017	***
Highest Education	–0.099	***	–0.206	***	–0.152	***	–0.008	
Skilled Labor	–0.304	***	0.406	***	–0.732	***	–0.226	***
Mountain Location	–0.175	***	–0.040	**	–0.022	*	–0.111	***
North Shaanxi Location	1.534	***	1.133	***	–0.163	***	0.295	***
Per Capita Arable Land (*mu*)	–0.102	***	–0.083	***	–0.020	***	–0.024	***
Off-Farm Employment	–0.656	***	–0.780	***	–0.335	***	–0.135	***
Per Capita Income (log)	–0.214	***	–0.083	***	–0.316	***	–0.066	***
Per Capita Asset Value (log)	0.032	***	0.003		–0.064	***	–0.351	***
Technical Training (%)	–0.190	***	–0.169	***	0.211	***	0.090	**
Credit (%)	0.230	***	0.051	**	–0.141	***	0.018	*
Village Road Access (1998)	0.199	***	–0.113	***	–0.162	***	–0.087	***
Distance to Bus Station	0.019	*	0.037	***	–0.147	***	0.160	***
Distance to Train Station	–0.371	***	–0.482	***	–0.181	***	–0.175	***
Transport Expenditure	–0.008	***	–0.004	***	–0.009	***	0.000	*
Electricity Access (1998)	0.236	***	0.501	***	–0.019		–0.184	***
Energy Expenditure	–0.003	***	–0.002	***	–0.005	***	0.001	***
Income Poor in 1998	0.173	***						
$1-a-Day Income Poor in 1998			0.256	***				
$1-a-Day Consumption Poor in 1998					0.634	***		
Asset Poor in 1998							0.825	***
Constant	–0.152		–0.554	***	2.863	***	2.087	***

Mu = 0.067 ha; Z = significance; *** = significant at 1% level; ** = significant at 5% level; * = significant at 10% level.
Source: Shaanxi provincial database.

to income generation in the PRC (Zhao 1997). The maximum educational level attained is more important because the family member with the highest education level is usually influential in household decision making. This variable is significant at 1% in the probit model and shows the expected sign for all income-based measures of poverty. In relation to asset-based poverty, it is insignificant.

Most rural residents felt that traveling, employment opportunities, and living standards had improved because of transport and energy investments; a few, however, disagreed.

Access to technical training helps reduce income-based poverty, but it had a negative effect on reducing poverty based on consumption expenditure and value of assets. A possible explanation for this is that the households that had participated in technical training needed to generate savings to invest in new technologies, and that consequently they reduced expenditures on consumption and asset accumulation. Access to credit seems to help only in reducing consumption-based poverty rather than income-based poverty, as expected: 36% of the loans to households in the provincial sample in 2001 were used for consumption and 31% for crop production. Due to the serious drought in north Shaanxi in that year, a large part of the crop failed, which may account for the failure of production loans to increase income.

Though poverty in 2001 was significantly associated with poverty in 1998 for all four definitions, the coefficients indicate that this relationship is stronger for consumption-based and asset-based poverty than for income-based poverty. In other words, income-based poverty is more volatile, while consumption patterns and asset accumulation change more slowly.

Similar results were obtained in running the probit model with data from the field survey sample (Table 5.19). However, new variables were included that help to interpret the findings from the provincial database. For example, in the field survey data, the labor force participation rate was *negatively* related to poverty for the extreme poor, though the relationship is only significant at the 10% level. This difference can be explained by the inclusion of a health measure in the field survey. In about 20% of the income-poor households, one or more family members is disabled or suffers from chronic diseases. Inclusion of this variable in the model helps rule out the effects of working-age family members who are not capable of participating in the labor force. Family health has a significant positive relationship with poverty reduction, whether defined by income or assets. Its effect on poverty defined by consumption is not significant, possibly because expenditure for medical treatment is included in consumption expenditure.

Access to technical training in this regression shows signs opposite to those in the regression using the provincial database. This is probably because a much higher share of household income in the field survey villages comes from off-farm employment, while most technical training is provided on crop production and livestock. In other words, poor households from the field sample may be more likely to seek technical training, while better-off households with income from nonfarm employment would be less likely to do so. In this case, access to technical training does have a positive impact by reducing consumption-related and asset-based poverty.

The field survey database includes additional measures of the quality of transport and energy infrastructure. Paved village roads and the density of village roads are positively related to poverty reduction, as expected. The relationship for paved roads is highly significant (at the 1% level) for all types of poverty except the extreme poor (where it is significant at the 10% level). It is highly significant for road density for all types of poverty. Reducing the distance from major highways also supports poverty reduction for all except the extreme poor. Reforming the power grid (increasing load capacity) has a strong positive relationship with poverty reduction for all types of poverty. When these results are linked to those found in the regressions on the provincial database, it is possible to make the argument that transport and energy infrastructure of poor quality may not contribute much to poverty reduction. Higher densities of roads and stronger electricity systems can have an even greater impact on poverty than simply providing basic access, especially if that level of access

fails to assure a steady supply of transport or energy services.[14]

Participatory Assessment

To complement the quantitative analysis of survey data, the PRC study team carried out participatory assessments of transport and energy changes in the 12 sample villages. During these assessments, participants were encouraged to discuss how their lives had changed since transport and electricity improvements reached their village, and then to "vote" on whether their lives had improved or gotten worse in a variety of ways. These discussions did not distinguish between poor and nonpoor participants, nor was it possible to distinguish clearly between the impacts of transport change and those of energy change. Further, these perceived changes cannot be attributed to infrastructure changes alone, as many other factors could affect participants' views about changes in the quality of life.

A large majority of the rural residents participating in the assessments believed that the situation has improved with respect to the ease of traveling, access to employment outside the village, living standards, ease of food processing, and access to technical services (Table 5.20). However, a few participants felt that their situations had become worse in these respects, except for traveling conditions and food processing. More than half thought that access to medical services, educational conditions, agricultural prices, household income, and employment within the village had improved, as well as in social contacts and opportunities for marriage outside the community (a key

[14] Of course, basic access is a necessary prerequisite, and conceivably may be the only intervention that has significant effects on chronic poverty.

Table 5.19. Results of Probit Estimation Using Field Survey Database
(N=630; data for 2001)

	Income-based Poor		$1-a-Day Poor (Income)		$1-a-Day Poor (Consumption)		Asset-Based Poor	
Item	**Coeff.**	**Z**	**Coeff.**	**Z**	**Coeff.**	**Z**	**Coeff.**	**Z**
Family Size	0.108	***	0.067	***	0.100	***	0.079	***
Labor Force Participation	–0.050	*	–0.027		0.465	***	0.877	***
Average Education (years)	–0.016	**	–0.067	***	–0.015	*	–0.139	***
Highest Education	–0.080	***	0.079	***	–0.200	***	0.241	***
Health	–0.621	***	–0.506	***	0.008		–0.314	***
Per Capita Arable Land (*Mu*)	0.024	***	0.010	***	0.057	***	–0.044	***
Mountain Location	0.000	***	0.000	***	0.001	***	–0.422	***
Off-Farm Employment	-0.684	***	–0.916	***	–0.415	***	0.203	***
Credit	0.196	***	0.135	***	0.162	***	0.000	***
Technical Training	0.072	***	0.082	***	–0.286	***	–0.391	***
Paved Village Road	0.033	*	–0.131	***	–0.325	***	–0.136	***
Distance to Train Station	–0.131	***	–0.454	***	–0.484	***	–0.412	***
Distance to Main Road	0.001	***	–0.001	*	–0.007	***	–0.001	**
Village Road Density	–0.083	***	–0.204	***	–0.415	***	–0.100	***
Transport Expenditure	–0.005	***	–0.005	***	–0.009	***	0.000	***
Electricity Improvement	–0.392	***	–0.215	***	–0.388	***	–0.099	**
Energy Expenditure	–0.128	***	–0.253	***	–0.206	***	0.001	***
Per Capita Value of Transport Assets	–0.002		–0.002	***	–0.009	***	0.000	***
Constant	–0.185	***	–0.301	***	0.643	***	1.576	***

Mu = 0.067 ha; Z = significance; *** = significant at 1% level; ** = significant at 5% level; * = significant at 10% level.
Source: PRC study team field survey.

Table 5.20. Perceived Changes After Transport and Energy Interventions
(Percent of discussion group participants)

Item	Better	Unchanged	Worse
Frequency of Travel Outside the Village	100.0	0.0	0.0
Employment Outside the Village	95.2	0.0	4.8
Employment Inside the Village	60.4	24.5	15.1
Living Standards	93.3	3.2	3.5
Household Income	71.5	10.6	17.9
Prices of Agricultural Products	54.9	20.9	24.2
Access to Technical Services	77.5	15.0	7.5
Access to Medical Servces	74.9	6.3	18.8
Food Processing Conditions	81.9	18.1	0.0
Schooling Conditions	69.1	7.1	23.8
Social Contacts	60.9	20.5	18.6
Community Consensus	43.9	35.2	20.9
Relations with Neighboring Villages	36.4	52.3	11.3
Opportunities for Marriage with Outsiders	60.7	39.3	0.0
Difficulties in Getting Married to Outsiders	47.3	14.5	38.2

Source: PRC study group participatory assessments.

indicator of social interaction in the rural PRC context), but a substantial minority of the participants felt that things had been getting worse in these respects. Less than half of all participants felt that the situation had improved with respect to consensus within the community, relationships with neighboring villages, and difficulties in getting married outside the community. These findings might be interpreted to mean that although the socioeconomic situation in the village is objectively better than in the past, subjectively the villagers are beginning to experience internal social differentiation and to compare themselves with outsiders, to their disadvantage.

Five Case Studies

The findings from the statistical analysis of data from the provincial database and the household survey database, together with the results of participatory village discussions, key informant interviews, and focus groups, were combined to assess the impacts of five different types of interventions: rural road improvements, road construction, railway construction, rural electrification, and roads and electrification combined with access to technical services and credit.

Rural Road Improvements. Using the provincial database, it was possible to divide households into those that had village direct access to a motorable road in 1998 and those that did not (Table 5.21). Among 1,043 sample households, 170 (16.3%) were classified as poor by the national standard. Of the poor households, 139 or 81.7% lived in villages inaccessible by road, while 65% of the nonpoor households lived in such villages. Using the $1-a-day income standard to define poverty, 68% of the sample was poor. At this level, less difference is observable between the share of the poor (73.6%) and the share of the nonpoor (62%) living in villages inaccessible by road. When a $1-a-day consumption criterion is used, little difference is observed between the poor and nonpoor (69% and 67%, respectively). These data might be interpreted to mean that village road access is positively related to the incomes and consumption of at least some poor households, moving them above the national poverty line and closer to, though still below, the international standard.

As shown in Table 5.21, households with and without village road access were highly comparable in 1998 in terms of family size, labor force participation, educational levels, and proportion of skilled workers. They were almost the same in terms of per capita consumption expenditure. However, the households without road access were in more favorable natural environments: they had more arable land and more irrigated land, and a smaller proportion of households in mountain environments. This may result from the fact that in households with access to roads, a higher proportion of people were migrating to work elsewhere. Higher migration rates may also be directly due to road access. Households with access to roads had higher per capita incomes and lower per capita asset values than those who did not have access to roads. Poor households without access to roads had

better conditions, excluding per capita income and consumption expenditure, than their counterparts with access to roads. The differences in per capita income and consumption may be explained by remittances from migrant workers.

The study team then compared changes experienced by this panel of households between 1998 and 2001, to see if significant differences emerged between households accessible and not accessible to roads in 1998 (Table 5.22).

Owing to serious drought from 1998 to 2001 in north Shaanxi, poverty according to the provincial definition worsened over this period. In most cases, village road access did not make much difference in this effect. However, villages with access to roads in 1998 reduced the incidence of near-poverty (above the official poverty line, but below the $1-a-day standard) by 3.56 percentage points, while the incidence of poverty among households without access to roads increased by 3.27 percentage points. Although the incidence of poverty defined by $1-a-day consumption expenditure rose for both groups, the increase was much less for households with access to roads than for those without.

The proportion of households that were poor according to the national income standard in 1998 and remained poor according to this standard in 2001 declined dramatically. This effect was even more marked for poor households in villages with good road access. Relatively little change occurred in the status of the near-poor, while a considerable increase took place in the incidence of income poverty among those whose consumption expenditures (but not incomes) would have classified them as poor by the $1-a-day standard in 1998. This suggests that poor households tended to cope with drought by seeking income-earning oppor-

Table 5.21. Household Characteristics by Village Road Access and Poverty Status in 1998

	No Road Access				Good Road Access			
Household Characteristics	**Sample Average** (n=710)	**Poor** (n=139)	**Income Poor[a]** (n=365)	**Cons. Poor[b]** (n=367)	**Sample Average** (n=333)	**Poor** (n=31)	**Income Poor[a]** (n=131)	**Cons. Poor[b]** (n=165)
Family Size	4.67	4.94	4.84	4.58	4.68	4.79	4.73	4.48
Labor Force Participation	0.55	0.52	0.54	0.57	0.54	0.53	0.52	0.56
Average Education (years)	5.92	5.65	5.92	6.24	5.64	5.50	5.62	6.14
Highest Education[c]	3.68	3.57	3.67	3.79	3.64	3.33	3.51	3.72
% Skilled Labor	6.10	4.21	6.28	4.65	6.75	7.71	8.11	10.32
% Off-Farm Employment	10.93	7.70	10.07	12.12	20.34	21.86	14.51	27.43
Per Capita Asset Value (yuan)	2,512.00	2,337.00	2,291.00	2,727.00	2,211.00	1,811.00	1,774.00	2,809.00
Per Capita Arable Land (*mu*)	3.19	2.68	2.87	3.92	2.12	1.34	1.49	2.00
Per Capita Irrigated Land (*mu*)	0.20	0.08	0.09	0.07	0.08	0.05	0.07	0.10
Mountain Location (%)	76.14	79.40	76.38	69.62	95.58	87.23	92.99	95.89
Per Capita Income (yuan)	980.40	458.50	639.20	1,170.30	1,101.00	487.20	690.00	1,275.30
Per Capita Consumption	904.30	676.80	750.00	1,241.20	909.80	825.60	779.50	1,240.40

Mu = 0.067 ha.
[a] Income poor: less than $1 a day per capita income; [b] Consumption poor: less than $1 a day per capita consumption; [c] Measured by an index ranging from 1 (illiterate) to 7 (university level).
Source: Shaanxi provincial database.

Table 5.22. Changes in Welfare (1998–2001) by Village Road Access and Poverty Status in 1998

Welfare Measures	No Road Access				Good Road Access			
	Sample Average (n=710)	Poor (n=139)	Income Poor[a] (n=365)	Cons. Poor[b] (n=367)	Sample Average (n=333)	Poor (n=31)	Income Poor[a] (n=131)	Cons. Poor[b] (n=165)
Poverty Reduction[c]	11.61	–51.85	0.29	31.58	11.42	–81.02	–2.79	17.48
Poverty Reduction[d]	3.27	–28.41	–35.05	32.20	–3.56	–67.15	–64.30	14.99
Poverty Reduction[e]	2.67	–8.30	–3.53	–30.92	0.88	12.77	–2.50	–27.94
Growth of Per Capita Income (%)	15.60	82.20	42.80	12.00	17.10	112.70	59.80	20.20
Growth of Per Capita Consumption (%)	14.90	22.30	18.70	32.50	12.30	–3.20	2.50	25.00
Growth of Per Capita Asset Value (%)	47.70	41.10	44.60	47.40	141.60	98.30	151.40	135.80
Reduction in Dropout Rates	–0.02	–0.04	–0.03	–0.01	0.01	–0.02	0.01	0.02
Better Access to Drinking Water	0.03	0.04	0.02	0.05	–0.03	–0.06	–0.05	–0.01

[a] Income poor = less than $1 a day per capita income; [b] Consumption poor = less than $1 a day per capita consumption; [c] Change in percentage of households with incomes below the national poverty line; [d] Change in percentage of households with per capita incomes of less than $1 a day; [e] Change in percentage of households with per capita consumption less than $1 a day.
Source: Shaanxi provincial database.

tunities elsewhere, while near-poor households coped by liquidating assets to cover consumption expenditures. It shows the vulnerability of the near-poor to the impacts of extreme events such as drought, which can quickly push them back into poverty. These effects tend to level out when poverty is measured by a more generous income criterion. However, it remains true that households with access to roads in 1998, both poor and nonpoor, were more successful in staving off an increase in incidence of poverty due to drought.

Households with access to roads in 1998 gained higher growth in per capita income and per capita value of assets than those without access to roads. In particular, poor households with access to roads achieved higher growth than poor households without access to roads. In fact, the income of poor households grew faster than that of nonpoor households in villages that had good road access in 1998. However, households without access to roads had slightly higher growth in per capita consumption than households with good road access. This pattern also seems to hold true for poor households. One might speculate that households, including poor households, in villages with good road access may have a higher propensity to save and invest from higher income earnings than is the case in households that do not have good road access.

Changes in school dropout rates were not statistically significant: the baseline rate in 1998 was 2.78% for villages with good road access and 3.33% for villages without road access. The drinking water supply situation improved slightly in villages with road access and worsened slightly in villages without road access, suggesting that road access may help to resolve drinking water supply problems during periods of drought.

To better understand the impacts of village road access on poverty, the study team analyzed household income sources, agricultural productivity, and access to resources (Table 5.23). A striking difference exists between households with road access and those without in addressing the challenge of sustaining agricultural income under conditions of serious drought. Households without road access chose to increase the commercialization of nonperishable food crops, while households with good road access raised the commercialization rate of cash crops and livestock. Thus, the households with road access acquired a higher productivity of land by increasing their cash crop income. This conclusion is reinforced by data from the field survey sample (Table 5.24).

Owing to the constraints on land and climate conditions, the varieties of food crops planted in Shaanxi are mainly the traditional ones, such as wheat, maize, and

Table 5.23. Changes in Household Production Patterns by Village Road Access and Poverty Status in 1998

(Percent)

Change in Factors Affecting Household Production and Income	Without Electricity				Good Road Access			
	Sample Average (n=31)	Poor (n=139)	Income Poor[a] (n=365)	Cons. Poor[b] (n=367)	Sample Average (n=333)	Poor (n=31)	Income Poor[a] (n=131)	Cons. Poor[b] (n=165)
Change in Share of Income from Wage or Salaried Employment	17.58	23.47	19.84	17.43	16.62	20.86	20.54	11.97
Change in Share of Income from Farm and Household Business	–19.73	–25.36	–22.69	–20.67	–16.21	–21.24	–19.00	–10.60
Change in Share of Income from Transfer Payments (nonfamily)	2.02	1.76	2.87	3.17	–0.17	0.27	–1.12	–1.09
Change in Share of Income from Property	0.13	0.13	–0.02	0.07	–0.24	0.11	–0.41	–0.28
Change in Grain Marketing	12.19	12.48	9.69	10.55	7.40	–2.35	–0.15	7.18
Change in Cash Crop Marketing	1.08	5.29	–1.93	2.39	16.75	5.36	5.06	12.21
Change in Livestock Marketing	5.48	10.34	9.23	8.55	9.85	–14.80	0.52	13.10
Change in Income per *Mu* of Land	–128.73	–111.73	–99.49	–124.74	–20.23	106.45	77.05	14.55
Change in Cash Income per *Mu* of Land	–15.46	–22.22	–10.27	–13.76	14.32	108.51	48.80	4.01
Change in Number of Farmers Receiving Technical Training	6.82	6.47	8.52	11.85	8.72	14.18	11.03	–2.71
Change in Number of Farmers Having Access to Credit	5.29	4.90	6.70	4.01	10.51	8.71	14.14	–0.78

Mu = 0.67 ha; [a] Income poor = less than $1 a day per capita income; [b] Consumption poor = less than $1 a day per capita consumption.

Source: Shaanxi provincial database.

Table 5.24. Change in Agricultural Production Before and After Road Access

Item	Before Road Access			After Road Access		
	All Households	Poor	Nonpoor	All Households	Poor	Nonpoor
Grain Area (*mu*)	6,811.0	3,620.0	3,191.0	4,923.0	2,619.0	2,305.0
Cash Crop Area (*mu*)	263.0	114.0	149.0	595.0	294.0	301.0
Vegetable Area (*mu*)	34.6	12.1	22.5	47.3	22.7	24.6
Number of Pigs	774.0	358.0	416.0	1,145.0	496.0	649.0
Number of Sheep	394.0	220.0	174.0	463.0	242.0	221.0
Number of Goats	1,769.0	1,176.0	593.0	1,626.0	752.0	874.0
Number of Chickens	1,944.0	981.0	963.0	7,844.0	1,376.0	6,468.0

Mu = 0.067 ha.

Source: PRC study team field survey.

potatoes, which do not have a comparative advantage in the area. An effective way for farmers in the region to increase their incomes is to profit from its comparative advantage in cash crops such as fruit and medicinal products. However, the production of cash crops requires cash investment and technical know-how. The data show that households, especially poor households, with road access gained increased access to credit and technical training. Access to these services in other villages increased as well, but not as much. Improved access to these services may help explain why households, especially poor households, in villages served by good roads were better able to raise their incomes by shifting to cash crops and livestock to cope with drought.

Another important reason for this difference is that access to roads reduces transaction time and costs for farmers. It was frequently heard during the field survey that access to roads helps the farmers get higher prices for their products and reduces the time they have to spend on marketing their products. Access to roads also improves the farmers' negotiating position in marketing by improving access to market information and reducing the costs of good transport for dealers, thereby encouraging competition.

The study team concluded that the better performance in poverty reduction in villages with road access can be attributed to two main factors: easier access to credit and technical training, and direct effects of road access on transaction costs and time. Smoother and faster motorized road transport also facilitates the shift to high-value perishable products such as livestock, fruits, and vegetables (Box 5.3).

The evidence also indicates that over this period, both poor and nonpoor households substantially increased the share of their income coming from off-farm employment. Village road access does not seem to have made a significant difference in this outcome.

The provincial database was used to evaluate the impact of village road access on the quality of educational services, as measured by the percentage of qualified public teachers in local schools. It is believed that better road conditions help attract and hold qualified teachers. In rural areas of the PRC, two types of teachers have worked for more than 30 years: public teachers have attained professional or university degrees and are paid by the Government; local teachers have not received professional education and are paid by the community. The percentage of public teachers can be used as an indicator of the quality of rural schooling. The data showed that before 1995, 86% of the schoolteachers in villages accessible to roads were public teachers, while only 11% of those in inaccessible villages were public teachers. By 2001, the proportion of public teachers in these types of villages was 92% and 41%, respectively. On the demand side, it can be

Box 5.3. Changes in Family Farm Production Patterns

Liu Shangbo, aged 24, lives in Santai village, Zhangjia township, Zhen'an county, with his family of six people. His education reached junior middle school. His family rently rented 3.5 *mu* (almost .6 hectare) of farmland. Before construction of the road leading out of the village, they cultivated food crops on 2.5 mu, vegetables on 0.5 mu, and watermelons on 0.5 mu of the land. Though food crop production was less profitable, Mr. Liu's family still had to plant mainly food crops because of the high cost of transporting agricultural production to market.

For example, 0.5 mu planted in watermelon yields an output of 500 kilograms (kg). The watermelon must be transported to market at a fair about 7.5 kilometers (km) from the village. Normally, the watermelon must first be moved to the nearest motorable road, about 1 km from the village. Moving 500 kg of watermelon to the nearest motorable road normally took him 5 hours, making 20 trips back and forth. Then he hired a three-wheel motor bicycle to transport his watermelon to the market. The transport cost him about 50 yuan, while the sale of 500 kg of watermelon only brought him 200 yuan. Moreover, he had to get up very early and be very cautious when moving his watermelon down to the motorable road in order to reach the market in time and not damage the watermelon in transport.

The year after the construction of a road linking to the village in 2000, Mr. Liu raised the funds to buy his own three-wheel motor bicycle. He had been able to rent 1.5 mu more farmland after he got married in 2000. Then he adjusted his land use by increasing the planting area of watermelon and decreasing the area for food crops. He used 3.5 mu for planting watermelon, 1 mu for vegetables, and 0.5 mu for food crops. Transporting his own larger watermelon crop to market, Mr. Liu now earns twice as much as before the construction of the road.

Source: PRC study team.

observed that when road infrastructure is poor, children usually do not start attending school until they reach the age of 8 or 9 years. Children can go to school at the age of 6 or 7 in villages with good road conditions. Statistics in the provincial database showed that in 1998, 5% of school-age children in the villages without road access do not attend school. In the villages with road access, this figure was only 3%.

While direct data on health services and health conditions were unavailable, the impacts of road infrastructure are reflected in the time and cost needed to access the service. When no motorable road is available, doctors or patients and their families have to walk or ride a bike to obtain health care. Therefore, patients in villages without road access are not as likely to see doctors, as long as their diseases are not very urgent. Some patients who could be saved lose their lives because of not seeing doctors in time. With the improvement of road infrastructure, doctors can use motorcycles to visit their patients, and patients can receive timely treatment by calling an ambulance or traveling to hospitals by car. In the field survey, the proportion of people suffering from disability or chronic diseases was 10% in the villages with paved roads and 17% in the villages without paved roads.

The study team also examined the distance of households from bus stations as a determinant of income growth and poverty reduction. Living close to bus stations not only facilitates bus travel, but also provides opportunities for income generation because of large bus passenger flows. The provincial database shows that 33% of 1,043 sample households live less than 2 km from a bus station, 21% live 2–5 km away, 13% live 5–10 km away, 11% live 10– 20 km away, and the remaining 23% live more than 20 km away. Approximately half the households in this sample are poor (defined for this purpose as those living on per capita incomes of $1 a day). No significant difference between the poor and nonpoor is discernible from the distance they live from a bus station. Households in the five distance classes have similar characteristics in family size, labor force participation rate, percentage of skilled workers, and educational level (average and maximum). Their share of off-farm employment is also quite comparable, except for households living 10–20 km away from a bus station, who were somewhat less likely than others to have off-farm employment. Households living closer to bus stations were generally less well off in terms of income, asset value, arable land, and irrigation.

"I'm sorry, you can't come with us to school—it's too far for you to walk. You'll have to wait till you're older."

Households living closer to bus stations performed best in poverty reduction during 1998–2001. The incidence of near-poverty ($1-a-day income and $1-a-day consumption) in households living less than 2 km from a bus station declined by 7.8% and 5.1%, respectively. If the official poverty standard is used, the incidence of poverty in this group increased by 6.5%. However, this is the lowest increase found in the five distance classes. The other four distance classes do not show the same type of correlation between distance and poverty reduction. In fact, households more than 20 km from a bus station performed better than some others. With these facts, it is reasonable to assume that the impacts of bus stations on poverty reduction probably do not extend beyond a radius of 2 km. Households living less than 2 km from a bus station had the highest growth in per capita value of assets, and a growth in per capita income second only to those living in the 10–20 km range. In general, households in these two classes performed better in income growth, consumption, and value of assets. Poor households in all distance classes had much higher income growth rates than their nonpoor counterparts. However, no consistent relationship between distance from bus stations and these variables can be observed. Nor did changes in dropout rates or access to

safe drinking water show any relationship to distance from bus stations.

Over 400 discussion group participants in 12 villages gave their own assessment of the impacts of changes in road transport services. They were asked to rate their satisfaction with different aspects on a scale of 1 to 10. The average score was 5.2, indicating that rural residents are only slightly satisfied with the current state of transport services. About 6% were fully satisfied, and at the other extreme, 5% were completely dissatisfied. The most frequently assigned general score was 8, indicating moderate satisfaction with the changes.

About 30% of the participants complained about poor road transport conditions in the villages. The main problems mentioned were poor road quality, inadequate width, and poor drainage. Farmers feel that these problems are due to insufficient investment in road construction. Nineteen percent thought that the main problem was poor access to transport services: bus locations are not convenient and the village road does not connect to a paved road. About 17% felt that the main problem was transport management and road maintenance, and 14% complained about higher transport fares. In addition, about 10% of the participants felt that compensation was inadequate for the land taken by roads, and 10% thought that roads led to more accidents and greater pollution.

Farmers' contributions to road construction were mainly in the form of unskilled labor, but their earnings and expenditures had a multiplier effect in the local economy.

Although participants were not very satisfied with transport services, they recognized that transport infrastructure had made a positive contribution to their quality of life. More than half thought that the principal benefits generated by transport improvements were facilitating access to social and economic services and time savings. These participants reported that transport infrastructure improvement makes it more convenient for them to leave the village to look for employment, to sell their products and conduct other commercial activities, and to attend school and see doctors. About 12% mentioned that travel is more comfortable and safe now that one can take the bus. The next most important benefits were ready access to information, better driving conditions, and promoting local economic development. Other benefits mentioned include changing the ideas of farmers, helping to cope with shocks, increasing demand for transport services making it possible to buy vehicles, and raising the prices of agricultural products. In one village, farmers thought that road construction also created employment and income-generation opportunities for the residents, increasing their capacity to cope with drought.

Road Construction Impacts. In the 12 sample villages, on average, farmers worked for about 154 days on road construction between 1991 and 2001 (Table 5.25). Most of this work took place between 1998 and 2001. Nonpoor households had gained 40% more employment opportunities from such work than the poor. About half of the labor days used for road construction were free (unpaid) days contributed by the community to build village and county roads. Poor and nonpoor households contributed about the same number of free labor days. On average, each household earned about 982 yuan from participating in road construction. Income earned in the last 3 years averaged about 200 yuan per household, or about 3.5% of all household income. However, the poor did not benefit proportionately from the employment created by road construction.[15]

From focus group discussions, it was found that farmers' participation in road construction had a multiplier effect in the local economy through their increased income and expenditure. For example, 31 persons in Mengjiagou village spent most of their time on road construction in recent years. Thirteen of them bought motor vehicles; seven built new houses. On the other hand, since employment in road construction was mainly given to male workers, the wives of the construction workers were obliged to take over and manage the family farms. (This effect was also observed with the families of workers who migrated to find urban employment.) Thus, in order for

[15] This statement is based on the income benefits shown in Table 5.25. The true benefits are income earned less the opportunity cost of time. Thus, the "free" labor days provided by both the poor and the nonpoor constitute a tax that weighs more heavily on the poor, who are severely time-constrained.

Table 5.25. Household Employment and Income Generated by Road Construction

Item	Average	Nonpoor	Poor
Total Labor Days Used	153.95	180.60	127.60
Paid Labor Days Used	81.79	103.91	60.52
Free Labor Days Used	72.16	77.29	67.08
Income Earned (*yuan*)	981.72	1,239.18	727.13

Source: Shaanxi provincial database.

the household to gain increased income, women's workloads increased.

Railway Construction and Operation. In the PRC, railways that link poor regions to developed regions are usually called "railways for poverty reduction." However, little research has been done to determine the actual impacts of railways on poverty reduction in the regions that they serve.

Among the four Shaanxi counties under study, three have rail lines running through them. The railways in Shenmu (in the north) were either in operation from 1989 or are not yet in operation; hence, as far as railway service is concerned, no change occurred during the study period. (However, the impacts of railway construction have been important, as noted below.) The railroad from Xi'an to An'kang, which passes through Zhen'an and Zhashui counties in Shangluo Prefecture, southern Shaanxi, was one of the so-called railways for poverty reduction. It was built starting in 1996 and has been in operation since 2000. Though it may be too early to assess its full impact on economic growth and poverty reduction, it is still possible to compare the results in these two counties with comparable counties not served by railways.

Shangluo Prefecture has seven counties. Their natural conditions and resource endowments are very similar to those of Zhen'an and Zhashui counties. This implies that without external intervention, the results of economic development, in particular agricultural growth, in these counties would not diverge very much. In 1993, the per capita income of farmers in Zhen'an and Zhashui was lower than in any of the other counties. In 1993, the incidence of poverty in Zhen'an and Zhashui was 80.7% and 89.3%, respectively, at almost the same level as the other counties, except for Shangzhou.

The construction of the railway brought sharp changes to the two counties, as shown in Table 5.26. From 1996 to 2001, the annual GDP growth rate per capita in Zhen'an and Zhashui was about 15% and 21%, respectively, higher than in any of the other counties in the province. The same is true for annual growth in household per capita income, especially in Zhen'an County. The effects of the railway on economic growth are due mainly to induced development. For example, it is estimated that the direct and indirect income generated from tourism in Zhashui in 2001 was 61.2 million yuan, compared with less than 5 million yuan per year before the railway was opened. Zhashui has absorbed investment of 250 million yuan in the past 5 years, mainly for the development of local mineral resources.

Although the construction and operation of the railway has contributed to the growth of the local economy and farmers' incomes, poor households did not benefit proportionally from this growth. By 2000, the incidence of poverty in Zhen'an and Zhashui was still higher than in most other counties in the prefecture. The reason for this inequitable distribution of benefits may be that the railway affects only the areas along the rail lines. The railway passes through only 13 of the 49 townships in the two counties. It has very limited effects on the farmers who live far away from the lines. But in villages close to the railway, significant changes can be observed. For example, the number of people employed in village enterprises in the six sample villages in Zhen'an and Zhashui increased by 98 between 1991 and 2001; 95 of these were in three sample villages through which the railway passed. However, the limited range of railway effects means that railways alone cannot address all problems related to poverty reduction.

Railway construction also generates employment opportunities and demand for locally produced products in the areas where the rail lines are located (Table 5.27). Three of the four sample counties for the field survey have had railways under construction since 1996. In the 5 years starting in 1996, sample households in Zhen'an and Zhashui provided, on the average, about 61 days of labor for railway construction. The average household income from this labor in the 5 years was 1,510 yuan. The average daily earning was about 25 yuan ($3). However, this figure overvalues the wage rate of most ordinary workers. Some people interviewed earned much more than ordinary workers because they used their agricultural tractors or three-

Table 5.26. Comparative County Development After Railway Construction

Item	Shangzhou	Luonan	Danfeng	Shangan	Shanyang	Zhen'an	Zhashui
1993 Per Capita Arable Land (*mu*)	0.86	1.22	0.85	0.93	1.06	0.06	0.85
1993 Per Capita Irrigated Land (*mu*)	0.17	0.17	0.20	0.17	0.13	0.06	0.14
1993 Per Capita Income (*yuan*)	560.00	506.00	473.00	495.00	473.00	463.00	443.00
1993 Poverty Incidence (%)	59.13	82.00	91.85	81.82	86.41	80.71	89.29
1996–2001 Growth in GDP Per Capita (%)	12.11	10.47	11.46	11.75	12.64	14.95	21.31
Growth in Rate of Per Capita Income	3.90	6.85	5.71	6.35	7.41	9.67	6.02
% Annual Reduction in Poverty	–8.72	–11.22	–11.37	–11.16	–8.62	–9.28	–9.45

GDP = gross domestic product; *Mu* = 0.67 ha.
Source: National Statistics Bureau 2001.

wheelers to provide transport to the construction site. Ordinary workers earned about 15 yuan ($2) per day.

The survey results show that no discrimination against the poor occurred in providing access to employment opportunities. This is because jobs for local people in railway construction mainly require only unskilled labor. Employment in railway construction is very important for the poor to supplement farm incomes and improve their living standards. On the average, income-poor households earned about 300 yuan per year from railway construction. This is about 10% of the household income corresponding to the provincial poverty line. Employment in railway construction mainly goes to men because it requires much bodily strength. Women got less than 10% of the employment generated in railway construction, although they had more opportunities in other areas, such as washing clothes and cooking for the construction workers.

In addition to employment, railway construction created other opportunities for local residents to increase their incomes. During the construction period, thousands of construction technicians and workers lived in the area. Their consumption created demand for locally produced products and services. Between 1996 and 2000, for instance, average annual meat production in Zhen'an and Zhashui increased by nearly 50% compared with 1995. The output of vegetables and fruits also greatly increased. In addition, railway construction creates employment in services, such as restaurants, hotels, and commerce, during the construction period. Although this increase is only temporary, it induces investments that should become sustainable if the railway is successful in stimulating the growth of the regional economy on a long-term basis.

The impact of railway construction on employment generation is not only expressed in the form of directly increasing job opportunities, but also in its demonstration effect. It was noted that a large part of the migration for employment in Zhen'an and Zhashui was initiated after 1996. Before then, county residents had lived only by farming. Employment in railway construction gave them the confidence, the skills, and the knowledge of alternatives to seek other employ-

Table 5.27. Contribution of Railway Construction to Local Income and Employment

Item	Sample Average	Income-Based Poverty		Asset-Based Poverty	
		Poor	Nonpoor	Poor	Nonpoor
Labor Days	60.85	84.15	58.20	43.81	76.42
Income Earned (yuan)	1,509.97	1,515.45	1,657.51	1,137.42	1,850.53

Source: PRC study team field survey.

ment outside their villages. Railway construction employment was therefore important in building local capacity to participate in larger labor markets.

The study team also examined whether households living close to railway stations showed a faster rate of poverty reduction than others. The provincial database shows the breakdown of households by the distance from home to a railway station. In 1998, for the sample of 1,043 households used in this study, only 19 households lived 2–5 km from a railway station and only 35 households lived 5–10 km away. No households lived closer than 2 km to a railway station. By 2000, however, 14 households lived within 2 km of a station and 55 households lived 2–5 km away. The number living 5–10 km away remained unchanged, so the number of households living more than 10 km away was slightly decreased. However, 90% of the sample households are still located more than 20 km from a railway station.

In 1998, households living less than 5 km from a railway station had higher educational levels, more workers involved in off-farm employment, and less arable land than other households. Those living less than 2 km away also had a higher share of skilled labor. None of the households in this group was poor by the official poverty standard. However, this group reported the lowest average per capita income in 1998 among the five distance classes, though it had a higher average value of assets.

In general, households living within 5 km of a railway station made larger gains in poverty reduction and income growth in 1998–2001 than did households living farther away. Within the other three distance classes (5–10 km, 10–20 km, and more than 20 km), no correlation was observed between the distance from rail stations and income growth or poverty reduction, whether measured by income or by assets; nor in other welfare measures, such as school dropout rates or access to safe drinking water. These findings lead to the conclusion that the influence zone of railway stations with respect to poverty reduction is a radius of about 5 km (compared with 2 km for bus stations).

Two principal mechanisms may be responsible for the greater progress in poverty reduction made by households living closer to railway stations. A comparison of data for the five distance classes shows that households living within 5 km of a railway station had a high growth in income from off-farm employment. Households in all income classes decreased the share of their income from farming and increased the share from off-farm employment. Households living within 2 km of a railway station saw their off-farm income increase by 39%, and those living between 2 and 5 km away showed an increase of 19% in off-farm income. This shift was less important in two of the three other distance classes. However, households living 10–20 km from a railway station increased off-farm income by 30% on the average, showing that long-distance migration for employment is also important for rural households living at some distance from railway stations.

In the People's Republic of China, railways that link poor regions to developed regions are called "railways for poverty reduction."

An important feature of off-farm employment for households living within 5 km of a railway station is that over 90% of this employment is found within the same county or province. Two thirds of the off-farm jobs found by families living within 2 km of a railway station were located within the same county. It is not clear whether this growth in off-farm employment is related to the greater access to employment provided by the railway, or to the general growth of employment opportunities within the county. By 2001, households living less than 10 km from the railway gained nearly half of their income from off-farm employment, while households living farther away gained about one third of their income from this source.

Another possible reason for greater success in poverty reduction could be that households living closer to railway stations were more likely to have received technical

training. The proportion of households receiving such training increased by nearly 50% between 1998 and 2001 among households living within 2 km of a railway station, and by 13% among those living 2–5 km away, while little change occurred among households living farther away. This improved access to technical training tended to benefit households in the near-poor category rather than the very poor, who were not likely to be living in the vicinity of a railway station. However, it is not clear that this technical training had anything to do with better access to off-farm employment opportunities. Such access may rather reflect the higher educational status of households living near railway stations.

Rural Electrification. In the provincial sample, 1,012 households had access to electricity in 1998, and only 31 households were without electricity. The two types of households were comparable in terms of family size, labor force participation rates, years of education attained, and highest education level. The households without electricity were located in mountain areas and had more arable land than others, though they had less irrigated land. They had higher shares of skilled labor and off-farm employment, and higher per capita incomes. However, households with electricity in 1998 had a higher per capita value of assets (Table 5.28).

Households with access to electricity performed better than those without electricity in income and consumption growth over the period 1998–2001 (Table 5.29). The average per capita income growth rate among households with electricity was 16%, while in households without electricity it was only 8%. Consumption expenditures in households with electricity also grew by about 15%, while they grew hardly at all among households without electricity. The value of assets, however, grew faster among households without electricity than among those with electricity. Poor households with electricity, especially the poorest, showed faster income growth rates than poor households without electricity. In poverty reduction, however, access to electricity showed no benefits. In fact, households without electricity performed better in terms of poverty reduction. Similarly, electrification does not seem to affect primary school dropout rates or access to safe drinking water.

The main reason for the contrast between impacts on income growth and poverty reduction is that households with electricity increased their income from both farm and nonfarm activities more than the poor among them, and increased their income more from off-farm employment (Table 5.30). They also were more likely to shift into cash crops and livestock than the households without access to electricity. Farmers in the households without electricity were slightly more likely to receive technical training during this period, but had more sharply declining access to credit than households with electricity. However, little significance can be attributed to the differences between these two groups, because of the small size of the nonelectrified sample.

Residents of the 12 sample villages also discussed the effects of electricity on household welfare. Positive effects were mainly attributed to improvements in lighting and power for electrical appliances. The next most important effects were on off-farm economic activities, in particular, food processing. Participants also mentioned positive effects on irrigation, health care services, education, and labor savings in household tasks. In general, however, participants were only moderately satisfied with the electricity services available. The key problems they identified were the poor quality of services, high prices, poor management and administration, and problems in getting technical support.

The main problems in quality of electricity are unstable or insufficient voltage and frequent power failures: 43% of the participants felt these were the most important problems. High prices, cited by 26% of the participants, were also a subject for complaint by many of the interviewed farmers. The average rate charged to residents in the sample villages for electricity was 1.52 yuan ($0.19) per kilowatt-hour (kWh), almost three times that charged to urban residents. On the rural grid before the current reform began, the Rural Electrification Corporation did not charge each household individually, but instead charged the village as one consumer by metering beyond the village transformer. After the rural power grid reform is fully implemented, electricity consumption will be metered and charged by the Rural Electrification Corporation directly to each end user. The aim is to lower the rate to a level comparable with that currently charged to urban households.

Complementary Investments. The study team wanted to test the hypothesis that farmer access to credit and technical assistance (agricultural extension services) enhances the impacts of transport and energy infrastructure. The PRC Government has promoted improved access to credit and technical assistance as key measures for assisting the rural poor to escape from poverty. Great efforts have been made to increase the access of poor households to these services. The study team believed that credit and technical support would help farmers make better use of the opportunities provided by infrastructure investments.

Table 5.28. Household Characteristics by Electricity Access and Poverty Status in 1998

Household Characteristics	Without Electricity				With Electricity			
	Sample Average (n=31)	Poor (n=3)	Income Poor[a] (n=12)	Cons. Poor[b] (n=24)	Sample Average (n=1,012)	Poor (n=167)	Income Poor[a] (n=484)	Cons. Poor[b] (n=525)
Family Size	4.95	5.71	5.17	5.11	4.66	4.90	4.80	4.78
Labor Force Participation	0.56	0.47	0.50	0.49	0.55	0.52	0.54	0.54
Average Education (years)	4.98	4.74	4.35	3.87	5.86	5.64	5.88	5.52
Highest Education[c]	3.62	3.35	3.40	3.35	3.67	3.53	3.64	3.58
% Skilled Labor	13.85	11.76	14.44	13.33	6.06	4.70	6.55	6.03
% Off-Farm Employment	23.27	11.76	23.67	25.71	13.66	10.26	10.90	10.91
Per Capita Asset Value (*yuan*)	1,528.00	947.00	808.00	706.00	2,444.00	2,269.00	2,192.00	2,127.00
Per Capita Arable Land (*mu*)	3.47	2.39	3.15	3.19	2.83	2.43	2.49	2.43
Per Capita Irrigated Land (*mu*)	0.02	0.00	0.03	0.06	0.17	0.08	0.08	0.08
Mountain location	100.00	100.00	100.00	100.00	81.83	80.40	80.21	86.05
Per Capita Income (*yuan*)	1,062.00	529.00	709.00	787.00	1,018.00	462.00	651.00	852.00

Mu = 0.67 ha; [a] Income poor = less than $1 a day per capita income; [b] Consumption poor = less than $1 a day per capita consumption; [c] Msseasured by an index ranging from 1 (illiterate) to 7 (university level).
Source: Shaanxi provincial database.

Table 5.29. Changes in Welfare by Electricity Access and Poverty Status in 1998

Household Characteristics	Without Electricity				With Electricity			
	Sample Average (n=31)	Poor (n=3)	Income Poor[a] (n=12)	Cons. Poor[b] (n=24)	Sample Average (n=1,012)	Poor (n=167)	Income Poor[a] (n=484)	Cons. Poor[b] (n=525)
Poverty Reduction[c]	–0.69	–60.00	–9.93	–12.12	12.04	–57.05	–0.33	11.47
Poverty Reduction[d]	–18.75	–60.00	–75.00	–72.73	2.02	–34.90	–41.90	–3.32
Poverty Reduction[e]	18.75	33.33	–7.14	–54.55	1.77	–5.91	–2.95	–29.62
Growth of Per Capita Income (%)	8.01	36.50	31.53	22.42	16.35	88.78	47.65	14.52
Growth of Per Capita Consumption (%)	0.24	–7.17	15.66	32.75	14.50	18.19	14.40	29.97
Growth of Per Capita Value of Assets (%)	133.06	175.03	133.97	169.73	76.08	48.62	70.94	74.15
Reduction in Dropout Rates	–15.56	–25.00	–28.62	–22.82	–0.70	–3.30	–1.08	–1.09
Better Access to Drinking Water	–1.54	0.00	0.95	1.56	0.89	2.11	0.15	0.24

[a] Income poor = less than $1 a day per capita income; [b] Consumption poor = less than $1 a day in per capita consumption; [c] Change in percentage of households with incomes below the national poverty line; [d] Change in percentage of households with per capita incomes of less than $1 a day; [e] Change in percentage of households with per capita consumption less than $1 a day.
Source: Shaanxi provincial database.

Table 5.30. Changes in Household Production Patterns by Electricity Access and Poverty Status in 1998
(Percent)

Change in Factors Affecting Household Production and Income	Without Electricity				With Electricity			
	Sample Average (n=31)	Poor (n=3)	Income Poor[a] (n=12)	Cons. Poor[b] (n=24)	Sample Average (n=1,012)	Poor (n=167)	Income Poor[a] (n=484)	Cons. Poor[b] (n=525)
Change in Share of Income from Wage or Salaried Employment	25.21	17.10	28.49	30.43	17.00	23.08	19.79	18.54
Change in Share of Income from Farm and Household Business	–28.60	–35.77	–32.95	–29.49	–18.26	–24.57	–21.41	–20.26
Change in Share of Income from Transfer Payments (nonfamily)	2.28	8.67	1.89	–2.89	1.28	1.35	1.82	1.58
Change in Share of Income from Property	1.11	0.00	2.56	1.96	–0.02	0.13	–0.19	0.14
Change in Grain Marketing	–0.77	–5.17	–3.79	–5.25	11.02	10.12	7.38	10.02
Change in Cash Crop Marketing	26.72	67.68	39.49	45.59	5.46	4.05	–1.17	0.42
Change in Livestock Marketing	24.70	49.43	25.16	20.37	6.30	4.87	–1.17	0.42
Change in Income per *Mu* of Land	–89.07	98.02	–58.09	–22.47	–93.76	–76.33	–52.89	–77.12
Change in Cash Income per *Mu* of Land	–1.93	–4.25	–4.96	5.43	–5.98	1.44	5.49	–12.76
Change in Number of Farmers Receiving Technical Training	25.21	17.10	28.49	30.43	17.00	23.08	19.79	18.54
Change in Number of Farmers Having Access to Credit	–28.60	–25.77	–32.95	–29.49	–18.26	–24.57	–21.41	–20.26

Mu = 0.067 ha.
[a] Income poor: less than $1 a day per capita income; [b] Consumption poor: less than $1 a day per capita consumption.
Source: Shaanxi provincial database.

The team examined 15 combinations of transport, energy, credit, and technical support interventions on the basis of the provincial database (Table 5.31). Among 1,143 sample households, about 45% had access to electricity in 1998, but not to roads, credit, or technical training. The next largest group, about 20%, had roads and electricity but no access to credit or technical training. About 12% had access to electricity and credit but not to roads and technical training; 7% had electricity and technical training but no roads or credit. Finally, 6% had roads, electricity, and credit, but no technical training. Other combinations have relatively few examples and are not of statistical significance.

The distribution of poor households among these groups is roughly comparable to the distribution of the entire sample, except that a lower percentage of income-poor households is in the group that had both infrastructure interventions but neither of the complementary investments. It can be seen from Table 5.32 that roads and electricity generally precede household access to credit and technical training. While the largest group is the one that has had infrastructure interventions but no comple-

Table 5.31. Distribution of Sample Households by Interventions Received

Type	Combination	Total	Poor	Income Poor[a]	Cons. Poor[b]
I	All Interventions	11	2	7	2
II	Credit, Roads, and Electricity	64	8	34	27
III	Credit, Training, and Electricity	19	4	13	13
IV	Credit, Training, and Roads	8	0	2	1
V	Training, Roads, and Electricity	30	4	12	10
VI	Roads and Electricity Only	209	15	72	122
VII	Credit and Technical Training Only	1	0	0	0
VIII	Credit and Roads Only	1	0	1	1
IX	Credit and Electricity Only	129	25	68	60
X	Technical Training and Roads Only	2	1	2	1
XI	Technical Training and Electricity Only	70	10	38	42
XII	Roads Only	3	1	1	1
XIII	Electricity Only	475	99	241	249
XIV	Credit Only	13	0	5	3
XV	No Interventions	3	1	1	0

[a] Income poor: less than $1 a day per capita income; [b] Consumption poor: less than $1 a day per capita consumption.
Note: The poverty categories in this table are not discrete, hence the numbers in the different categories do not add up to the total. "Total" refers to the number of sample households receiving any one combination of services: the "Poor" (defined by the national standard) are also included in the $1-a-day income category and may or may not be included in the $1-a-day consumption category.
Source: Shaanxi provincial database.

Table 5.32. Changes in Welfare by Electricity by Combined Interventions
(Percentage change)

Intervention	II Roads, Credit, and Electricity (n=64)	VI Roads and Electricity (n=209)	IX Credit and Electricity (n=129)	XI Technical Training and Electricity (n=70)	XIII Electricity Alone (n=475)
Poverty Reduction[a]	14.54	16.81	16.67	–1.71	–33.33
Poverty Reduction[b]	–13.12	6.29	5.73	–8.53	8.33
Poverty Reduction[c]	0.00	–2.82	10.76	–12.29	25.00
Growth of per Capita Income	49.31	5.72	19.44	27.22	–14.97
Growth of per Capita Consumption	30.88	9.59	12.16	29.75	–15.83
Growth of per Capita Value of Assets	284.09	101.17	45.62	74.60	426.39

[a] Change in percentage of households with incomes below the national poverty line; [b] Change in percentage of households with per capita incomes of less than $1 a day; [c] Change in percentage of households with per capita consumption less than $1 a day.
Source: Shaanxi provincial database.

mentary investments, few households (and no income-poor households) lacking roads or electricity have received any complementary investments.

Comparing the poverty reduction performance of these different groups, it can be seen that electricity alone had by far the greatest impact on severe poverty. However, it did not contribute to the reduction of poverty defined as incomes of less than $1 a day, and it even increased consumption-related poverty. A comprehensive approach combining electricity with road access and credit had a greater impact on poverty defined as per capita income less than $1 a day than any other statistically significant combination. Electricity combined with roads alone or with credit alone did not help in poverty reduction, although electricity combined with technical training had a positive effect in reducing poverty. The combination of electricity, roads, and credit had the highest impact on per capita income growth and consumption growth, and an impact on growth in asset value second only to that of electricity alone.

The number of households without electricity in the sample was so small (31) that all the combinations without electricity were statistically insignificant. Thus, it is not possible with this approach and database to evaluate the contribution of complementary investments to road impacts alone.

The study team concluded that combining transport and energy investments with access to credit and technical training is likely to be an effective solution in the new era, when the target for poverty reduction in the PRC will be households with per capita incomes of less than $1 a day.

Conclusions and Recommendations

The PRC country study showed that transport and energy infrastructure contributes to poverty reduction, not only by directly improving the living conditions of the poor, but also by diversifying income and employment sources and helping improve the productivity of poor households. It also helps improve health care and education conditions and enhances the contact and communication of the poor with the outside world. However, the study team found that the positive impacts of transport and energy investments on the poor were constrained by existing policies and institutional arrangements.

Following the draft report review workshop, the PRC team reexamined the provincial and field survey data to learn more about the characteristics of the sample households that did not succeed in escaping from poverty, or fell back into poverty, over the study period. These households were characterized by a higher incidence of chronic disease, higher dependency ratios, and lower educational levels. The age and gender of the head of household did not significantly affect the household's chances of escaping or staying out of poverty. These results suggest that households that are not able to take immediate advantage of infrastructure investments to increase their economic welfare may nevertheless benefit in the longer run from improved provision of health care and education services, and from employment opportunities likely to arise from induced development.

The team formulated the following recommendations.

- *Make the planning of transport and energy infrastructure more pro-poor.*

Poverty reduction should be better integrated into the design, construction, and operation of infrastructure projects by both the Government and its development partners. At the project preparation stage, poverty reduction criteria should be included in deciding on the need for investment, determining the project design, and evaluating the return on investment. For example, feeder roads linking to poor villages should be included in the design of expressways or major highways. Poverty reduction is in itself an important return on investment, and investments will always be needed to achieve poverty reduction. At the construction stage, the selection of technologies is important for poverty reduction: if labor-intensive approaches are used, such projects can bring employment and income-generation opportunities to the poor. It may be necessary to make special provisions to ensure that the poor have at least equal access to these opportunities: for example, a project may establish that a certain percentage of labor be provided by the poor. Project management can also require that construction materials be locally procured if possible. In the operation stage, transport price policies should aim at increasing the number of users. Operating regulations should be pro-poor: for example, policies to encourage the development of private transport and energy enterprises should be adapted to improve outreach to the poor.

- *Adopt a comprehensive approach to maximize the benefits of transport and energy infrastructure for poverty reduction.*

The key to enabling transport and energy infrastructure to have an impact on poverty reduction is enabling the poor to increase their utilization and consumption of transport and energy services, especially for productive purposes. This means increasing their capabilities and opportunities to make use of these services. The study found that increasing the access of the poor to credit and technical training, as well as to education and health care services, improves the impact of transport and energy infrastructure on poverty reduction. Poverty reduction is now more and more closely linked to market integration. Combining other services with infrastructure interventions can help the poor raise their capacity to cope with market competition by increasing productivity and diversifying their employment and income sources.

- *Shift the target for providing road access from the village to the household.*

Due to funding limitations, the PRC Government has set its targets for providing transport and energy infrastructure in rural areas on village access. This is understandable because of the need to ensure regional balance in the use of available resources. However, village access can only partly address the transport needs of poor households. The study found that a higher density of village roads made a larger contribution to poverty reduction than village road access alone. If the goal of reaching all households with motorable roads is still unattainable, it would at least be better to move the target from (administrative) village access to settlement or group[16] access.

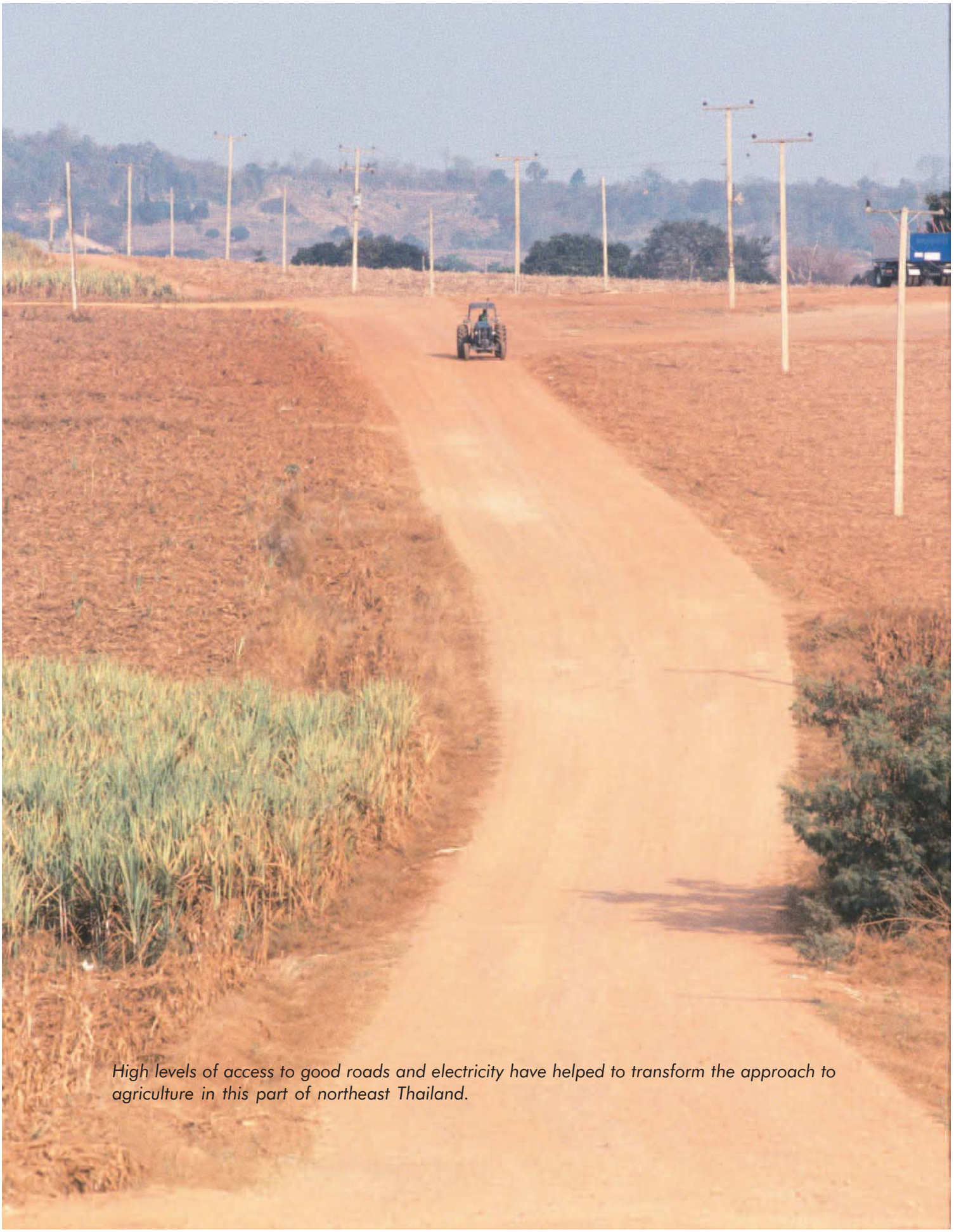
- *Strike a better balance between quantity and quality in developing transport and energy infrastructure.*

In the past, development of transport and energy infrastructure in the rural PRC has concentrated more on quantity than quality. To make funds go farther, the investment per unit has usually been much lower than the level needed for quality infrastructure. For example, planned investments for rural roads are usually between 20,000 and 30,000 yuan per km, less than one third of what is actually needed. As a result, large parts of the newly built roads have been damaged by floods or freezing. Although the statistics increase every year for roads constructed and villages made accessible, the actual increase in all-weather and fully operational roads is not as great as reported. This poor quality considerably reduces the impact of road infrastructure on poverty reduction. Investing the funds needed to build qualified and well-functioning roads is likely to make greater contributions to poverty reduction in the long run. The case for energy infrastructure is similar to that for roads.

- *Take advantage of television programs to enhance the impacts of transport and energy infrastructure on poverty reduction.*

The widespread use of television, even by poor and remote households, offers a good opportunity for the Government and its development partners to take advantage of television programs to introduce new technologies and to disseminate market information to poor households. Well designed and suitably timed television programs can provide an economical and effective means of training and communicating information to the poor. This will produce better impacts if television programs can be combined with some on-the-spot training.

[16] A "group" in the rural PRC is a management unit below village level and based mostly on settlements.



High levels of access to good roads and electricity have helped to transform the approach to agriculture in this part of northeast Thailand.

Chapter 6

THAILAND COUNTRY STUDY

National Context

In comparison with other Asian countries, Thailand is a medium-sized country of about 62 million people, with a gross national per capita income in 2001 of nearly $2,000 ($6,550 in 1993 purchasing power parity terms). Thailand achieved one of the highest economic growth rates in the world during the period between 1975 and 1995. Broadly, Thailand's development policy has revolved around an "open door" for trade and heavy investment in infrastructure to promote industrial development, especially in labor-intensive industries. Thailand has largely succeeded in meeting basic human needs and has good social indicators: an average life expectancy of 69 and an adult illiteracy rate of only 5%. The economy experienced a setback during the Asian financial crisis of 1997–98, but recovered fairly rapidly due to continuing strong growth in exports.

Thailand's long experience of sustained growth, good communications, and labor force mobility has led to rising expectations and perceptions of increasing inequality between the poor and the nonpoor. According to 1998 data, less than 0.5% of the population is living below the extreme poverty line of $1 a day per person. However, about 28% of the population is still poor by world standards, with incomes of less than $2 a day per person. The Gini index is 41.4, showing that income inequality in Thailand is relatively high.

Poverty Reduction

Thailand has an enviable record in poverty reduction, the poverty level having dropped from over 57% in the early 1960s to around 13% in 1992 (World Bank 1997). The remaining poverty is geographically concentrated in the North and the Northeast, with pockets of poverty in rural areas of the Central and Southern regions. Poverty is increasingly concentrated among farm households with low levels of education that tend to preclude participation in the nonfarm rural or urban labor markets. Consequently, income inequality is rising, both between urban and rural areas and between regions. Thailand's poverty reduction strategy was formulated in the late 1990s. It assessed the main constraint to broader participation by the poor in the expanding market for wage employment as lack of education. The poverty reduction strategy therefore focused on expanding educational opportunities, combined with stronger prohibitions on child labor. Social service expenditures were geographically targeted to poor areas, and program designs were improved to reach the poor more efficiently and to enhance their welfare more effectively.

The financial crisis of the later 1990s caused a temporary increase in poverty, to a peak of about 16%, and gaps between the rich and the poor widened. Presumably, the resumption of growth has brought a renewed decline in poverty since 2000, as measured by international standards. Nevertheless, Thai policymakers still view poverty, and especially inequality, as major problems.

For this RETA, a special study of public expenditure and poverty reduction in Thailand was carried out to provide a comparable framework to the studies conducted in India and the PRC (Fan, Somchai, and Nuntaporn 2003). The study focuses on rural poverty because of the concentration of poverty in rural areas (20% in rural areas compared to 6% in urban areas in 2000). Using regional-level data over 20 years, it examines the impact of rural roads and electricity expenditures on poverty reduction, as well as the effects of irrigation, agricultural research and extension, and education expenditures. The model traces the effects of public expenditures on poverty through their effects on agricultural employment, nonagricultural employment, and food prices. The study showed that all of these government investments had contributed to growth in agricultural production and to the reduction of rural poverty in Thailand.

Government spending on rural electricity had the largest poverty reduction effect, as well as having a substantial

impact on growth in agricultural productivity. Among the channels linking rural electricity to poverty reduction, increase in nonfarm employment accounted for 75% of the effect, and growth in agricultural productivity for only 20%.[17] Expenditures on agricultural research and extension had the second highest poverty reduction impact, followed by expenditures on rural roads. Roads had little effect on agricultural productivity, however; their poverty reduction impacts came mainly from effects on nonfarm employment. The study results also suggest that rural nonfarm employment is driven much more by urban growth than by growth in the agriculture sector.

The Department of Highways manages the interurban road network, most of which is paved and regularly maintained.

Government spending on education had the fourth largest impact on poverty, while irrigation had little effect on poverty, although it had the second largest effect on agricultural production. Since the importance of education to reducing poverty has been demonstrated where this model has been applied in other countries, the authors suggest that basic education needs have now been largely met in Thailand, even in rural areas, so that additional spending on primary education has a low marginal impact on poverty. The study also compared the regions and found that government spending had the largest poverty reduction effect in the Northeast Region, where poverty is now concentrated. In this area, the highest returns in poverty reduction were associated with electricity and road investments.

[17] The remainder is accounted for by rural-urban migration, which may be considered another measure of nonfarm employment.

Transport Sector Policy

In Thailand, policymaking, planning, and program implementation have traditionally been centralized in Bangkok. Although road construction falls under various government agencies, all of them are based in the capital. At present, the Government is moving in the direction of decentralizing responsibility for public investment planning and management, but these changes are not yet fully operational. The national policy on infrastructure, as set out in the current Ninth Economic and Social Development Plan, proposed to shift away from the past emphasis on construction toward improved infrastructure management, better transport services, and greater involvement of the private sector. In addition, it encourages local participation in both infrastructure construction and service provision. Lastly, it takes into account potential linkages with the infrastructure systems of neighboring countries.

Roads. Several government agencies are responsible for developing the national road network, which covered more than 200,000 km in 1996. The Department of Highways (DOH) is responsible for interurban roads and highways, accounting for almost half of the total network. Rural roads are the responsibility of the Accelerated Rural Development Department, the Public Works Department, or the Royal Irrigation Department, while urban streets and expressways are managed by the Bangkok Metropolitan Administration or the Expressway and Rapid Transit Authority, respectively. Most of the DOH network is paved and regularly maintained. These roads link the national capital to the main centers of each province, and these centers in turn to the (district) centers. Traffic on these roads is heavy, varying from less than 1,000 vehicles per day (vpd) on the tertiary roads to more than 25,000 vpd on the most heavily trafficked roads in the Central Region.

Few barriers constrain entry into the transport services sector, and a wide variety of vehicles can be seen on the roads, especially on rural roads. In addition to cars, pickups, minivans, buses, and trucks, three-wheelers adapted for passenger and freight transport, *e-tains* (truck bodies built over tractor engines), and motorcycles are commonly used for public (taxi) as well as private passenger trans-

port. Most households, even poor ones, own at least a bicycle. Motorcycles and bicycles are often adapted to carry small amounts of goods. Animal transport (bullock and buffalo carts) and pedestrians also use the roads, especially in rural areas.

Rail. The development and operation of railroads in Thailand comes under the responsibility of the State Railway of Thailand (SRT). The SRT network comprises four main lines and seven branch lines serving 47 provinces, with a combined route length of more than 4,000 km. In 2001, SRT operated 286 passenger trains per day, 79 of them express trains, carrying 56 million passengers over the year. In the same year, the SRT operated 75 freight trains per day, transporting 9.8 million tons of freight over the year. Over 40% of this was container traffic, with petroleum products and cement accounting for most of the rest of the freight. Agricultural and industrial products represented only a small fraction (1.7% and 1.2%, respectively) of rail freight traffic.

The SRT operates at a net loss, mainly because it subsidizes rates for third-class passenger service, which accounts for 92% of all passengers. These rates have not been increased since 1985, and they are about 50% lower than the rates for intercity bus service. Nevertheless, the railroad has been steadily losing passenger traffic, while freight traffic is increasing. For this reason, the merits of continuing to subsidize third-class passenger traffic as a poverty reduction measure have been under discussion for some time.

Energy Sector Policy

Electricity generation was originally the responsibility of the Electricity Generating Authority of Thailand (EGAT). In the early 1990s, however, the Government decided to allow private companies to invest in power generation plants. These are classified as small power producers (SPPs) and independent power producers (IPPs). Companies in both groups sell electricity to EGAT and can also sell directly to the public. SPPs may produce up to 150 megawatts but can sell only up to 90 megawatts to EGAT. The total contribution of private producers to the electricity supply system is still small, but is expected to increase under the Government's privatization policy. If this happens, lower costs and increased availability of electricity throughout the country are likely. Some SPPs use renewable fuels such as bagasse (agricultural residues), paddy husks, wood chips, sawdust, municipal waste, and biogas. Although the present contribution of these projects

Providing electricity to households with no legal identification has been a problem; people have connected illegally to the lines serving their legally resident neighbors.

to energy supply is minimal (less than 1% of the total), this share could increase in the future. Such renewable energy projects may benefit the poor, who are often involved in the supply of renewable fuels.

In rural areas, electrification is provided by the Provincial Electricity Authority, which has carried out an aggressive campaign of rural electrification over the past 10 years, aiming to reach as many remote areas as possible. Services to remote locations are partly subsidized by profit sharing from EGAT. Consequently, community coverage is now almost universal, except in a few very remote locations. Most rural households have access to electricity, either through direct connections or through their neighbors.

Providing public services, including electricity, to urban poor households that do not have a legal household identification has been a problem. In the past, such households have had to make illegal connections to the lines serving their legally resident neighbors, often paying these neighbors more than the electricity would cost if they had service of their own. Recently, the Government began to issue "quasi-household IDs", which enables these households to acquire electricity services legally.

Case Study Context

The Thai research team chose to study the poverty reduction effects of (i) rural transport improvements, (ii) rural electrification, (iii) urban electrification, and (iv) long-distance transport by road and rail. With these topics in mind, the team decided to conduct its field surveys in three rural sites and two urban sites. The three rural

sites included two sites in the Northeast Region and one in the Southern Region. In addition to being centers of rural production, both regions are major destinations for interregional transportation and are well served by both road and rail systems. The Northeast Region (Map 6.1), being the poorest, is also the one from which long-distance migration for employment most frequently occurs. Migration is less important as a survival strategy in the Southern Region , but the region relies heavily on transport to send its primary products (e.g., rubber) to markets. The two urban sites are slum settlements located in Nakhon Ratchasima (provincial capital and major city of the Northeast Region), and in Bangkok. These sites were chosen for reasons of convenience, as the Thai Development Research Institute had already conducted some research there and had built up good relations with the communities concerned.

Northeast Region

Sample rural districts were selected on the basis of an analysis of secondary data from a rural village database maintained by the Thai Ministry of Interior. Village data for 1990 and 1999 were analyzed to classify villages that had experienced significant improvements in road transport and electrification over that period. "Significant improvements" were operationally defined as (i) a reduction of at least 50% in traveling time from the village to the nearest district office using the most convenient transport mode, and (ii) the connection to electricity of more than 35% of village households over the 10-year period. With this information, it was possible to classify villages in a four-cell sample frame (Table 6.1).

The goal was to select districts that had villages of all four types, to facilitate field work and to control, to some extent, for situational factors that might affect with-and-without comparisons. However, relatively few villages fell into Types A and B, even based on the secondary data, since even in 1990, more than 70% of households in most villages were connected to electricity. A field check on the secondary data showed that even those communities having lower (less than 70%) electricity penetration in 1999 were almost fully electrified by the time of the field research in 2001. Thus, it became impossible to compare "electrified" villages with "nonelectrified" ones. Instead, the team opted to compare households with and without electricity within the same village. As a result, differences in road access became the main criterion for selection of the sample villages.

Based on the above analysis, the team selected two districts, Wung Kata and Klong Muang, in Pak Chong County of Nakhon Ratchasima Province, to form one of the Northeast Region sites. The other Northeast Region site was Pung Gu District in Prakomchai County, Buri Ram Province.

Nakhon Ratchasima Province is the gateway to the Northeast Region. The city of Nakhon Ratchasima is the region's main urban center and transportation hub. Per capita incomes in this province are about twice those of Buri Ram Province, which is a more "typical" area for the Northeast Region. The 1999 per capita income in Nakhon Ratchasima was about $940. Nakhon Ratchasima is home to many prominent national politicians, which means that the province is relatively better provided with publicly supplied infrastructure than the national average. Overall population density in Nakhon Ratchasima is rather low (124 persons per km^2 in 1999), due to the presence of a large national park in the province. The sample districts selected in Nakhon Ratchasima are located on the far side of this park, which means they are relatively distant from the region's major road network.

Wung Kata and Klong Muang districts are relatively poorer areas in Pak Chong County and Nakhon Ratchasima Province. Wung Kata, in particular, is isolated by its hilly terrain and its location on the far side of Khao Yai National Park. Both districts suffer from problems of water availability and water quality. Agricultural yields are higher in Klong Muang than in Wung Kata; Klong Muang is slightly better connected to the road network and has better road conditions in general. From the county seat at Pak Chong, it takes about 1 hour on a tertiary road to reach Wung Kata District. Most of the road is still laterite, although some portions are paved with asphalt. Because of its beautiful scenery, Wung Kata was the site of much speculative land purchase during Thailand's economic bubble of the late 1980s and early 1990s.

Within Wung Kata and Klong Muang districts, seven villages were chosen for the study, divided into three

Table 6.1. Distribution of Northeast Region Sample Villages by Transport and Electricity Improvements

		Transport Improvement	
		No	Yes
Electricity Improvement	No	Type A	Type B
	Yes	Type C	Type D

Source: Ministry of Interior rural village database.

groups: villages with relatively poor road access, villages with average road access, and villages with relatively good road access. (The sample design, which called for selecting 100 households from each unit in the sample frame, required clustering more than one village in order to obtain an adequate sample). The three villages with relatively poor road conditions and the two villages with average conditions were in Wung Kata District, while relatively good conditions prevailed in Klong Muang District. The first group is farthest from the main road system and has been reached with minor road improvements only recently. Some of the earthen and laterite roads become impassable during the rainy season. Only small stretches of the roads are paved, in front of schools or temples. These villages are served by one privately operated passenger vehicle that leaves each village and returns once a day. Children going to school ride on motorcycles or bicycles to reach the point where they are picked up by passenger cars. It takes 2 hours for people in these villages to reach the county seat, and often much longer in the rainy season.

The villages in the second group are located closer to the main road system. Most village roads that are not paved are laterite rather than earthen. These villages benefit from being located along the public transport routes that serve the more remote communities, like the first group. Thus, they have several options for daily travel outside the villages. These communities also have several stores selling consumer products. Having good links to the national road network makes it easy to obtain goods from major markets, even by traveling to Bangkok.

The third village cluster, in Klong Muang District, has been served by paved access roads for more than 10 years. However, one village (Nong Sai) has mainly earth roads inside the village, while the other (Nong Sai Nea) has concrete roads, as it is the site of an important temple. Agricultural production patterns in all three groups are similar, based on maize and cattle (including dairy production) and some tapioca production.

Buri Ram Province is located farther toward the northeast. It is more densely populated (147 persons/km^2), more

Rural roads carry a great variety of vehicles: three-wheelers and tractors adapted for freight and passengers, motorcycle taxis, bicycles and animal-drawn carts, in addition to cars, pickups, minivans, and buses.

agricultural, and less urbanized. Covering an area approximately half that of Nakhon Ratchasima (including the park), the value of Buri Ram's provincial production in 1999 was less than a third of that of its sister province. Per capita income in Buri Ram Province in 1999 was about $520. Though average household incomes were lower than those in Nakhon Ratchasima Province, expenditures were about the same, indicating that households in Nakhon Ratchasima have greater opportunities to save and invest. Generally, Buri Ram Province is less well endowed with commercial services than Nakhon Ratchasima. However, it is comparable in terms of providing physical infrastructure and social services (Table 6.2).

Pung Gu District in Buri Ram Province is a typical northeastern district, located south of the provincial capital in Prakomchai County. People in this district speak the northeastern Thai dialect. Some also speak Cambodian, because it is located near (though not on) the Cambodian border. The primary crop in this area is rice, although some farmers also grow vegetables or raise pigs. Employment outside the village is also an important source of income in this area. Six villages were selected for the study, grouped according to road conditions. In the villages with poor road conditions, most working age adults have migrated to nearby cities or to Bangkok to look for work; only children and elderly people are left in the village. Most villagers have little land (averaging 2 *rais* [0.16 ha] per family), and droughts occur frequently. The villages are located on laterite roads about 2 km away from the nearest paved road.

The second pair of villages offers a contrast in road conditions, showing that roads alone cannot always explain differences in welfare. The road to one village, Pung Gu, was recently paved. The other village, Sri Takrong, is still 3 km from a paved road, but the villagers in Sri Takrong appear economically better off because they carry on commercial transactions with businesses in the Prakomchai county seat. The last group of two villages has good road access. One of them appears more affluent, as it is located on a major intersection well served by public transportation. However, the other village has not benefited much from having good roads, possibly due to the fact that, as in Pung Gu, most villagers do not own land.

Table 6.2. Characteristics of Northeast Sample Provinces

Characteristic	Nakhon Ratchasima	Buri Ram
Population Density	124.00	147.00
Km of Roads/Area (km^2)	2.31	2.85
Km of Roads/Population	0.02	0.02
% Electrified Villages	98.30	99.10
% Electrified Households	96.60	97.10
Schools per 1,000 Population	0.60	0.60
Teachers per 1,000 Population	8.90	9.00
Students per 1,000 Population	184.00	193.80
Hospitals per 1,000 Population	0.01	0.02
Health Centers per 1,000 Population	0.14	0.15
Clinics per 1,000 Population	0.12	0.03
Bank Branches per 1,000 Population	0.04	0.02
Hotel Rooms per 1,000 Population	1.40	0.35
Telephone lines per 1,000 Population	17.60	8.09

Source: Department of Local Administration, Ministry of Interior. Data for 1999.

Southern Region

Within this region, the study team selected villages from Wung Hin and Ban Nikom districts in the county of Bang Chan, Nakhon Si Thammarat Province. Nakhon Si Thammarat, like Nakhon Ratchasima, is a major rail hub and destination for road travelers. The province enjoys relatively good economic conditions, including good soils and climate for agriculture. It also benefits from the accumulated wealth of a once prosperous fishing industry. In 1999, per capita gross domestic product in Nakhon Si Thammarat was $937, approximately the same as in Nakhon Ratchasima. However, in physical area and population density, Nakhon Si Thammarat is more like Buri Ram Province. Commercial agriculture in the province is based on the production of rubber, coffee, and paddy rice. The capital city of Nakhon Si Thammarat is located on the coast. It is large and historically important, but is not directly served by a trunk highway. Rather, the main highway passes through Thung Song County, another major business center in the province. The sample districts in Bang Chan County, which is not located on the coast, have better access to the road network via Thung Song.

Villages in these two districts are primarily engaged in rubber production. Rubber trees are the symbol of Southern Region agriculture, and have long been the major source of economic prosperity in the South. Rubber price supports also contribute to the economic welfare of the region's people. Educational levels are high; the region is known for its active participation in the political life of the country. On average, household landholdings are significantly larger than those in the Northeast Region. Although the sample districts in the Southern Region are less well served than the sample districts in the Northeast in terms of physical infrastructure, they are still considerably better off than those in the Northeast in terms of economic productivity.

The two sample districts are about 90 km from Nakhon Si Thammarat city center, and about 20 km from Toong Song county seat, the province's second most important business center. The districts are reached by a tertiary highway from Thung Song. Compared to other districts in Bang Chan County, they are relatively isolated. Many

households in these districts have no direct access to public passenger transport. Consequently, almost all of them own motorized vehicles, at least a motorcycle. Most of the seven sample villages were selected from Wung Hin District. One adjacent village from Ban Nikom District was added to the sample to provide an adequate sample frame. The villages with poor access are located far from paved roads and, because houses are spread out on relatively large landholdings, some households do not even have access to a laterite road. The medium-access group is well served with laterite roads, while the good-access villages are located near a recently improved asphalt road linking them to a nearby business center in Trang Province. Two of the three villages in this group also received major electricity improvements in the last 5 years.

Urban Settlements

The study also covered selected slum communities in Nakhon Ratchasima City and Bangkok. In Nakhon Ratchasima, the community is located along the railway and is called the Bailey community. In Bangkok, the selected site was the Thepleela community, which is made up of several neighborhoods scattered around the Thepleela Road near Ramkhamheang University. Three subcommunities were selected for the study. The residents of these areas are generally poor and vulnerable, experiencing problems of job security as well as low status and low social capital within the community. The Bangkok community was selected because of the recent improvement in a nearby major road (it was widened), as well as the continual improvement of within-community roads over the past 10 years. The Nakhon Ratchasima site was selected because of its location along a rail line and also its unusually low electrification rate.

In the urban sites, the transport intervention studied was not so much road improvements as the availability and quality of transport services, measured by access (walking) times to pickup points for different transportation modes. Slum dwellers in Bangkok could generally access motorcycles, minibuses, and buses by walking for less than 10 minutes, while for the Bailey community in the Northeast the average was 12 minutes. Bangkok slum residents also had access to boat service (10 minutes) and minivans (15 minutes). In contrast, for all slum residents, train service was half an hour or more distant by walking. In Nakhon Ratchasima, 77% of the slum residents interviewed had no electricity connection. The reason for this low level of connectivity is that the community is located along a railway, and it is difficult and dangerous to lay electricity lines across the rail line. In Bangkok, all slum dwellers had access to electricity, although 30% used community meters and 10% were connected through their neighbors.

In Nakhon Ratchasima City, a slum called the Bailey community is located along the railway.

Methodology

Definition of Poverty

The Thai country case study used three different definitions of poverty. The first definition is income-based or "objective" poverty. The poverty classification used in the study was calculated separately for the rural and urban samples, based on the household data obtained in field interviews. The median annual per capita income for the rural household sample was close to 12,000 baht (B, about $285), which is the same as the national official poverty line for rural households in 2002. Households with per capita incomes above this level were defined as nonpoor; those below this level were defined as poor. Households with per capita incomes below two standard deviations from the mean (B8,500 or about $200) were defined as ultra-poor. Based on this approach, about half of the rural

sample was poor (of which 35% were ultra-poor), and about half was nonpoor.

Thailand has separate poverty lines for different urban centers. In 2002, the poverty line was B12,650 (about $300) for Nakhon Ratchasima and B13,447 (about $320) for Bangkok. According to the official poverty lines, only 34 urban households (16% of the sample) were poor, and most of these were in Nakhon Ratchasima. However, it is believed that these poverty lines underestimate the real extent of urban poverty, because they may not adequately account for differences in urban consumption patterns. Consequently, the study team classified urban households with incomes below the urban poverty line as poor, and households whose incomes were above the poverty line but below the median income of the urban sample households (B17,845, or $425) as near-poor. Conceptually, in terms of consumption and quality of life, the category of poor plus near-poor in urban areas corresponds to the category of officially poor in rural areas, whereas the officially poor in urban areas correspond more closely, though not exactly, to the ultra-poor in rural areas.

The remaining urban households were classified as nonpoor. It is interesting to observe that although many more urban sample households (77) were in the near-poor category than in the poor category (34), the great majority of the nonpoor households (83 out of 98) had per capita incomes more than two standard deviations above the median (i.e., more than B20,380 or $485). This distribution illustrates the skewedness of income distribution in Thailand, especially in urban areas.

The Thai study team was also interested in how people's perceptions of poverty affect their perceptions about infrastructure improvements. For this reason, they introduced the notion of subjective poverty, or poverty status as reported by key informants (village and community leaders). Using this method, relatively few of the rural sample households were identified as poor (20%, as compared to the 50% objectively poor). In urban areas, the proportion subjectively classified as poor corresponded more closely to the proportion of poor and near-poor. Strikingly, about 40% of the sample households living in slum settlements could be classified on the basis of income as well-to-do,[18] but less than 10% were perceived by community leaders as being so. The team also measured relative poverty through self-reports, finding that the results closely corresponded to the results using subjective poverty. It shows that people perceive their own status and are seen by their neighbors in relation to local rather than national norms. Hence, in rural areas, especially poor areas, objectively poor people may not be seen as poor, whereas in urban areas, even the nonpoor, especially those living in poor neighborhoods, may see themselves and be seen by others as poor.

Finally, the Thai team used the subjective poverty information to classify the sample households in terms of change in poverty status over the last 10 years. A high percentage of rural households (about 44%) were said to have moved out of poverty during this period, while 10% had slipped into poverty. For the rest, 23% remained poor, and 23% remained well-off. Among the urban sample households, 47% have not been poor for more than 10 years, and 25% more moved out of poverty during this period, while only 2% slipped back into poverty and 25% remained poor.

Transport and Energy Interventions

As noted above, the basis for defining change in transport accessibility was the recorded change in travel time, by the most convenient means, from each village to the district center. Changes in travel time could reflect road improvements, transport service improvements, and/or changing modes of transport, including increased private vehicle ownership.

Out of the 20 rural communities selected for the study, 15 experienced a reduction in travel time to the district center between 1990 and 1999. However, only 7 of these experienced a reduction of over 50% in travel times.[19] In Nakhon Ratchasima, out of six sample communities, travel times improved in three villages but were reduced by more than half in only one village (Pa Pai Dang). The cause of the difference here seems to be not a change in the length or type of road, but a striking increase in vehicle ownership. In Buri Ram, three of six communities experienced significant changes in travel times, and this seems to be at least partly due to improvements in road quality, including paving. Three of seven communities in Nakhon Si Thammarat saw significant changes in travel times, and this also appears to be attributable to partial paving of access roads. Vehicle ownership increased dramatically in all communities over the past 10 years.

With respect to rural electricity, the measure of change was the percentage of households within each village con-

[18] Households were classified as "well-to-do" if they had incomes more than two standard deviations above the sample median.

[19] This analysis is based on information from the Nrd2c database for 1990 and 1999. The study team also evaluated this information for changes between 1992 and 2001.

nected to electricity in 1990 and 1999. According to the village level data, two villages in Nakhon Ratchasima had no electricity at either time, and one that had no electricity in 1990 was 100% electrified by 1999. The other three sample villages from this province were approximately 50% electrified in 1990 and somewhat more so (ranging from 67% to 80%) in 1999. In Buri Ram, two of six sample communities had no electricity in 1990, but were 100% electrified in 1999. The other four communities had electricity in 1990, serving a little more than half the households, but were fully electrified by 1999. Only one sample village in Nakhon Si Thammarat reported no electricity in 1990, but the other six had electricity available in less than half of all households. In 1999, connection rates among the sample villages ranged from 70% to 90% of households. Based on this information, the sample of approximately 900 rural households can be distributed according to the sample frame in Table 6.3.

No attempt was made to establish an objective measurement of how the transport services available to the urban slum residents changed over time. The *soi* (alley) serving the Bangkok communities was recently widened and has become a major thoroughfare, making a variety of transport services more readily available. With respect to electricity, the picture was radically different between the two cities. In Bangkok, 100% of the surveyed households had access to electricity, although 64% were unable to say how long they had had it; 27% reported having had electricity for more than 10 years, 2% had had it for more than 5 years, and 7% had been connected for less than 5 years. It is possible that the length of time served by electricity has more to do with the length of time the household has resided in the community than it does with the time since service was provided, as it appears that electricity has been available in this community for more than 10 years. In contrast, in Nakhon Ratchasima, 73% of the interviewed households had no electricity connection. Only one household had had electricity for more than 10 years, while the remaining 25% were connected during the past 10 years.

Table 6.3. Distribution of Rural Households by Degree of Transport and Electricity Improvements

		Transport Improvement	
		Minor	Major
Electricity Improvement	Major	168 (19.9%)	152 (17.3%)
	Minor	300 (34.1%)	260 (29.5%)

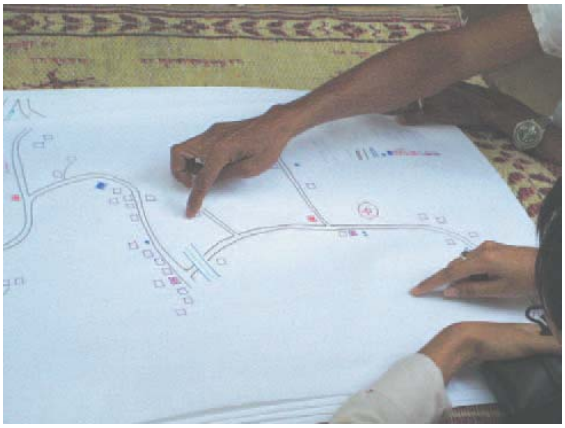
Source: Nrd2c database, 1990 and 1999.

Research Methods

The study aimed to adopt a double-difference approach (before-and-after, with-and-without) at both the village and the household level. Thus, it sought to compare welfare changes over time between villages and households with and without transport interventions, with and without electricity, and with both types of changes, with the objective of determining if impacts were significantly different between the poor and the nonpoor. The Thai study team was particularly interested in letting respondents themselves explain how they perceived such effects. Consequently, they built the main part of the study around household interviews, complemented by village-level information and key informant interviews, limited participatory focus groups, and supplemental secondary data analysis.

The household survey covered 913 rural households and 209 urban households. The rural sample was designed to include approximately 300 households each from the selected sites in Nakhon Ratchasima, Buri Ram, and Nakhon Si Thammarat. The urban sample was designed to include approximately 100 households each from two urban settlements. As described above, villages in rural areas were stratified into three groups based on the quality of their road access. A list of households in each community was established in consultation with local authorities. This list was further stratified according to "subjective" socioeconomic status as reported by the authorities, and households were then randomly selected from the lists until the desired sample size was reached. For the urban sample, about 100 households at the Bangkok site were randomly chosen, out of around 3,000 households, while almost all households in the Nakhon Ratchasima site were interviewed.

The household questionnaire included three modules: (i) basic socioeconomic information; (ii) information on access to and use of transport and energy services; and (iii) perceived impacts of improvements in roads, rail transport, and electricity. The first module included information on occupation and income; assets (including vehicles and electrical appliances, expenditure on energy, electricity transport, and vehicle purchase); and additional information on health, education, and debts, the role of women, and family participation in social activities. In each of these areas, the questionnaire explored changes over the last 10 years. The second module explored access



Residents help the Thailand study team to map some of the features of their village.

to and use of transport and energy services in greater detail. The third module asked about perceptions of the impacts of transport and energy improvements in a number of areas (suggested by the study research hypotheses) and also solicited views on the distribution of those impacts within the community. At the end, the questionnaire asked for the respondent's opinion about development in general and about the need for more investment in transport and energy infrastructure. Questions about positive and negative impacts were asked separately, and respondents were then asked to evaluate net impacts.

The questionnaire was administered in an open-ended fashion, by inviting respondents to identify impacts and the mechanisms through which these impacts took place, rather than by providing them with a checklist. In addition to the household surveys, the team conducted interviews with local officials to obtain village-level information. It also conducted two focus group discussions to validate information provided in the interviews. The focus group in Nakhon Ratchasima involved six women, drawn from the women's group and the first aid volunteer group in two adjacent sample communities. In Nakhon Si Thammarat, it involved six employees of one district office, five men and one woman.

Sample Community and Household Characteristics

The rural sample communities in Nakhon Ratchasima ranged in size from 50 to 500 households, or 200–1,650 people. Most were farm households, although many households have multiple sources of income. About three fourths of all households owned their own land, and about 10% were renters. Some both rent and own land. Almost all grew maize and/or sweet corn, while about 15% on average also grew commercial crops like cassava and sugar cane. A relatively small percentage of households raised livestock. In Nakhon Ratchasima, 65% of survey respondents reported their occupation as "farmer," and 30% as "laborer." Other occupations included stock raising, retail trade, and public employees. Within the survey sample, 26% of households in Nakhon Ratchasima were poor (including 16% ultra-poor), and 74% were nonpoor.

A similar pattern prevailed in Buri Ram. The sample villages ranged from 80 to 250 households, or 280–1,450 residents. The smallest, most remote communities grew only rice and depended on earnings from wage labor. The better-off farmers in more connected communities added livestock and vegetables; however, wage labor was still an important source of income. Seventy-six percent of respondents from Buri Ram reported their occupation as farmer, and 15% as laborer. Livestock raising was more important as a primary occupation in Buri Ram, engaged in by 8% of respondents. However, poverty was much more widespread in Buri Ram, affecting 71% of the sample (57% ultra-poor).

The seven sample villages in Nakhon Si Thammarat ranged in size from 65 to 135 households, or 350–700 residents. More than half of all households relied exclusively on agriculture, gaining their cash income from rubber cultivation. They also had more diversified farm holdings, with fruit orchards and livestock. These communities seemed more fully integrated into the cash economy, since they reportedly did not cultivate seasonal crops. Only one community (Ban Si Fai) had a high percentage (40%) of households depending on rented land. Slightly over half (53%) of the sample households in Nakhon Si Thammarat were poor (33% ultra-poor), while 47% were classified as nonpoor. Thus, among the three rural sites, Buri Ram was the poorest, Nakhon Si Thammarat occupied a middle position, and Nakhon Ratchasima had the lowest incidence of poverty in the study sample.

The rural survey sample was selected in such a way that approximately equal numbers of households lived in villages with poor road conditions, moderate road conditions, and good road conditions. This stratification was applied in each province, so there was little variation in this distribution across provinces in the study sample. However, the household questionnaire also looked at the quality of immediate road access enjoyed by each sample household; 63% of the households were served by laterite roads, 20% by paved roads, 8% by concrete roads, and 10% by earth roads or tracks. Thus, most of the rural sample had immediate access to motorable roads.

For electricity, the household survey examined the method of connection and the length of time that a household had been connected. Only 33 of the rural sample households (4%) had no electricity; 84% of the sample had a direct connection, and 12% were connected through their neighbors. These proportions did not vary significantly across the three provinces. About 23% of the sample had had electricity for more than 10 years, 33% were connected 5–10 years ago, and 20% became connected within the last 5 years. Twenty percent did not report the date when they were connected, and as reported above, 4% of the sample did not yet have an electrical connection.

For the urban sample, the measures of exposure to transport and electricity were as reported above. The study also classified the urban sample households by occupation. About 39% of the sample were wage laborers; 17% were salaried employees, 26% were engaged in petty trade and commerce, and 17% were "garbage collectors." Only 1% of the survey respondents (two individuals) reported themselves as unemployed.

The analysis conducted by the Thai study team focused on evaluating the impacts of rural transport and energy improvements on rural poverty in two ways: first, by conducting an econometric analysis of survey data to determine the relationship between such changes and changes in household income, expenditure, and educational levels; and second, by examining the differences between poor and nonpoor households in their perceptions of a variety of impacts. The urban household survey data were examined separately for perceived impacts.

Findings

Econometric Analysis

The team ran regressions of various transport and energy variables available from the village and household surveys against measures of (current) household income and expenditure and aggregate household educational assets (average school years of all household members) as a measure of "wealth," for all households and for poor households. The independent variables tested included the following:

- Number of roads to district offices in 1992 and 2001, and change in this number between 1992 and 2001;
- Length of paved roads to district offices in 1992 and 2001, and change;
- Length of laterite roads to district offices in 1992 and 2001, and change;
- Average travel time to district offices in 1984, 1992, and 2001, and changes in 1984–1992, 1992–2001, and 1984–2001;
- Percentage of households in the village with electricity in 1992 and 2001, and change;
- Years since a household gained immediate road access;
- Years that a household has had electricity; and
- Annual amount paid by a household for electricity.

The first five variables were taken from the Nrd2c database for villages and attributed to the sample households, while the last three were taken directly from the household surveys. Village dummy variables were also introduced into the analysis to account for other situational factors that might have influenced changes in income, expenditure, or education. Ordinary least square regressions with stepwise selection were run for the entire rural sample and for poor households separately. The regressions do not have a very good fit (values of R^2 on the order of 0.1-0.3), as is common in cross-sectional regressions using household data.

Only one of the regressions yielded significant results ($p<0.05$) with respect to household income, both for the entire sample (Table 6.4) and for poor households (Table 6.5). This was the length of paved roads to the district office in 2001. In addition, the household electricity bill in 2001 was linked to household income for all households, but not for poor households. Village dummies also yielded significant results in both cases, indicating that factors other than transport and electricity were probably more important in determining income variations. As with all cross-sectional comparisons, it was impossible to determine the direction of causality.

The fact that the length of paved roads to district offices was significantly positively related to household income in both regressions has three implications:

- More paved roads are associated with higher incomes, for both poor and nonpoor households. This could be because paving roads helps increase incomes, but it could also be that better-off households (for other reasons) are more likely to attract road paving projects. Unfortunately, the variables that could have introduced a time dimension into this analysis turned out not to be significant.
- If improving roads generates income benefits, these accrue to the village as a whole rather than to individual households, since the length of time that a household has had immediate road access is not significant in

Table 6.4. Road and Electricity Impacts on Income for All Rural Households
(R^2 = 0.328; n= 683)

Independent Variable	Coefficients	Standard Errors	Probability
Constant	8.422	0.073	0.000
Transport Variables			
Number of Roads to District (1992)			NS
Number of Roads to District (2001)			NS
Increase in Number of Roads			NS
Length of Paved Roads to District (1992)			NS
Length of Paved Roads to District (2001)	0.035	0.003	0.000
Increase in Length of Paved Roads			NS
Length of Laterite Roads to District (1992)			NS
Length of Laterite Roads to District (2001)			NS
Difference in Length of Laterite Roads			NS
Average Travel Time to District (1984)			NS
Average Travel Time to District (1992–2001)			NS
Average Travel Time to District (1984–2001)			NS
Change in Travel Time (1984–1992)			NS
Change in Travel Time (1992–2001)			NS
Change in Travel Time (1984–2001)			NS
Years of Household Immediate Road Access			NS
Energy Variables			
Percent Village Households Electrified (1992)			NS
Percent Village Households Electrified (2001)			NS
Change in % of Village Households Electrified			NS
Years Since Household was Electrified			NS
Annual Electricity Bill	0.002	0.000	0.00
Village Dummy Variables	(various)	(various)	<0.05

n = number of households participating; NS = not significant (p>0.05).

Note: The econometric analysis used data only from those households and villages that provided information on all the parameters used in this analysis.

[a] Dependent variable R^2 is a logarithm of total household income.

Source: Nrd2c database for villages; Thailand study team field survey.

explaining income differences once the paved road length to the village is included in the regressions.

- Apparently, improving from laterite roads to paved roads helped raise incomes more than improving from earth to laterite roads, since none of the intervention variables concerning laterite roads is significantly related to incomes, either for all households or for poor households.

For all households, the positive relationship between electricity bills and household income could mean either that higher electricity use enhanced incomes, or that higher income permitted more electricity use. However, the degree of electricity penetration in 2001 was negatively correlated with the income of poor households. This was not the expected outcome, since it was hypothesized that the availability of electricity should open up more income-earning opportunities for the poor. This result may reflect an incipient inequality problem within the more electrified rural communities. In fact, poor households in these more "modern" villages were even poorer than the

Table 6.5. Road and Electricity Impacts on Income for Poor Rural Households
(R^2 = 0.183; n = 337)[a]

Independent Variable	Coefficients	Standard Errors	Probability
Constant	8.422	0.073	0.000
Transport Variables			
Number of Roads to District (1992)			NS
Number of Roads to District (2001)			NS
Increase in Number of Roads			NS
Length of Paved Roads to District (1992)			NS
Length of Paved Roads to District (2001)	0.035	0.003	0.000
Increase in Length of Paved Roads			NS
Length of Laterite Roads to District (1992)			NS
Length of Laterite Roads to District (2001)			NS
Difference in Length of Laterite Roads			NS
Average Travel Time to District (1984)			NS
Average Travel Time to District (1992–2001)			NS
Average Travel Time to District (1984–2001)			NS
Change in Travel Time (1984–1992)			NS
Change in Travel Time (1992–2001)			NS
Change in Travel Time (1984–2001)			NS
Years of Immediate Road Access			NS
Energy Variables			
Percent Village Households Electrified (1992)			NS
Percent Village Households Electrified (2001)			NS
Change in % of Village Households Electrified			NS
Years Since Household was Electrified			NS
Annual Electricity Bill	0.002	0.000	0.00
Village Dummy Variables	(various)	(various)	<0.05

n = number of households participating; NS = not significant (p>0.05).

Note: the econometric analysis used data only from those households and villages that provided information on all the parameters used in this analysis.

[a] Dependent variable R^2 is a logarithm of total household income.

Source: Nrd2c database for villages; Thailand study team field survey.

poor households in less "modern" ones; otherwise the regression coefficient for electricity penetration would not have been negative for poor sample households. Further work needs to be done to determine whether this phenomenon was unique to the study sample.

When household expenditures were used as the dependent variable, more intervention variables became significant (Tables 6.6 and 6.7). The length of paved roads to the district remained the most significant determinant of household expenditures for all households. The change in length of paved roads was significant for all households and also for poor households. Interestingly, the length of laterite roads to the district office in 1992 also had a significant effect on household expenditures for all households (but not for poor households) in 2001. This may reflect the effects of prior improvements from earth to laterite roads, which stimulated growth in commerce and farmer involvement in the cash economy. Recent reductions in average travel time to the district center were

Table 6.6. Road and Electricity Impacts on Expenditure for Poor Rural Households
(R^2 = 0.241; n = 623)[a]

Independent Variable	Coefficients	Standard Errors	Probability
Constant	8.732	0.128	0.000
Transport Variables			
Number of Roads to District (1992)			NS
Number of Roads to District (2001)			NS
Increase in Number of Roads			NS
Length of Paved Roads to District (1992)			NS
Length of Paved Roads to District (2001)	0.035	0.003	0.000
Increase in Length of Paved Roads			NS
Length of Laterite Roads to District (1992)	0.009	0.005	NS
Length of Laterite Roads to District (2001)			NS
Difference in Length of Laterite Roads			NS
Average Travel Time to District (1984)			NS
Average Travel Time to District (1992)			NS
Average Travel Time to District 2001)			NS
Change in Travel Time (1984–1992)			NS
Change in Travel Time (1992–2001)	0.013	0.002	0.000
Change in Travel Time (1984–2001)			NS
Years of Household Immediate Road Access			NS
Energy Variables			
Percent Village Households Electrified (1992)			NS
Percent Village Households Electrified (2001)			NS
Change in % of Village Households Electrified	0.003	0.001	0.018
Years Since Household was Electrified	0.012	0.005	0.013
Annual Electricity Bill			NS
Village Dummy Variables	(various)	(various)	<0.05

n = number of households participating; NS = not significant (p>0.05).

Note: The econometric analysis used data only from those households and villages that provided information on all the parameters used in this analysis.

[a] Dependent variable R^2 is a logarithm of total household expenditure.

Source: Nrd2c database for villages; Thailand study team field survey.

associated with higher expenditures, both for all households and for poor households.

Increasing the percentage of households with access to electricity had the effect of inducing higher spending by both poor and nonpoor households. Since it did not have a similar effect on incomes for either group, this finding suggests that such spending was related to consumption rather than productive investment. In fact, the household interviews and focus group discussions showed that households tended to imitate others' consumption patterns when it came to electric goods. For example, it was common for families to want to own a television set when their neighbors owned one. Higher expenditures for all households were also correlated with the length of time that a household had been electrified. Again, village dummies produced significant results.

With respect to education, both the number and increasing length of paved roads linking the village to the

Table 6.7. Road and Electricity Impacts on Expenditure for Poor Rural Households
(R^2 = 0.192; n = 327)[a]

Independent Variable	Coefficients	Standard Errors	Probability
Constant	8.814	0.087	0.000
Transport Variables			
Number of Roads to District (1992)			NS
Number of Roads to District (2001)			NS
Increase in Number of Roads			NS
Length of Paved Roads to District (1992)			NS
Length of Paved Roads to District (2001)			NS
Increase in Length of Paved Roads	0.044	0.006	0.000
Length of Laterite Roads to District (1992)			NS
Length of Laterite Roads to District (2001)			NS
Difference in Length of Laterite Roads			NS
Average Travel Time to District (1984)			NS
Average Travel Time to District (1992)	–0.010	0.001	0.000
Average Travel Time to District (2001)			NS
Change in Travel Time (1984–1992)			NS
Change in Travel Time (1992–2001)	0.006	0.002	0.0
Change in Travel Time (1984–2001)			NS
Years of Household Immediate Road Access			NS
Energy Variables			
Percent Village Households Electrified (1992)			NS
Percent Village Households Electrified (2001)			NS
Change in % of Village Households Electrified	0.006	0.001	NS
Years Since Household was Electrified			NS
Annual Electricity Bill	0.002	0.000	0.00
Village Dummy Variables	(various)	(various)	<0.05

n = number of households participating; NS = not significant (p>0.05).

Note: The econometric analysis used data only from those households and villages that provided information on all the parameters used in this analysis.

[a] Dependent variable R^2 is a logarithm of total household expenditure.

Source: Nrd2c database for villages; Thailand study team field survey.

district center predicted higher average years of education per household in 2001 (Tables 6.8 and 6.9). For poor households, the number of roads was significant, even though the length of paved roads was not. This result may be explained by the fact that poor households were not usually located near village centers, and thus may have benefited from having more alternative routes to places outside the village. A lower average travel time to the district center in 1992 also predicted higher average years of education per household in 2001, for all households but not for poor households. This parameter may reflect the opportunity to access higher education, which may only be available in the district centers.

Statistically significant relationships with educational levels existed for the increase in the share of households electrified, the number of years that a household had been

Table 6.8. Road and Electricity Impacts on Education for All Rural Households
(R^2 = 0.154; n = 694)[a]

Independent Variable	Coefficients	Standard Errors	Probability
Constant	3.504	0.354	0.0
Transport Variables			
Number of Roads to District (1992)			NS
Number of Roads to District (2001)	0.438	0.150	0.000
Increase in Number of Roads			NS
Length of Paved Roads to District (1992)			NS
Length of Paved Roads to District (2001)			NS
Increase in Length of Paved Roads	0.065	0.016	0.000
Length of Laterite Roads to District (1992)			NS
Length of Laterite Roads to District (2001)			NS
Difference in Length of Laterite Roads			NS
Average Travel Time to District (1984)			NS
Average Travel Time to District (1992)	–0.005	0.002	0.000
Average Travel Time to District (2001)			NS
Change in Travel Time (1984–1992)			NS
Change in Travel Time (1992–2001)			NS
Change in Travel Time (1984–2001)			NS
Years of Household Immediate Road Access			NS
Energy Variables			
Percent Village Households Electrified (1992)			NS
Percent Village Households Electrified (2001)			NS
Change in % of Village Households Electrified	0.012	0.003	0.000
Years Since Household was Electrified	0.038	0.013	0.000
Annual Electricity Bill	0.003	0.000	0.00
Village Dummy Variables			NS

n = number of households participating; NS = not significant (p>0.05).

Note: The econometric analysis used data only from those households and villages that provided information on all the parameters used in this analysis.

[a] Dependent variable R^2 is a logarithm of average years of schooling of household members.

Source: Nrd2c database for villages; Thailand study team field survey.

electrified, and expenditure on electricity bills. This confirmed the hypothesis that electricity helps to enhance educational attainment. For poor households, however, the only significant variable in this cluster is expenditure on electricity. Given the respective time frames, it seems likely that more education encouraged greater use of electricity by the poor, rather than the other way around.

The study team also ran transport and energy intervention variables, along with other household-level variables, against satisfaction scores given by respondents on changes that had occurred over the past 10 years in family income, family well-being, family convenience, and family happiness, as well as in the village economy and society (Table 6.10). The main finding was that households with more assets were more likely to report positive changes

Table 6.9. Road and Electricity Impacts on Education for Poor Rural Households
(R^2 = 0.114; n = 337)[a]

Independent Variable	Coefficients	Standard Errors	Probability
Constant	4.097	0.267	0.000
Transport Variables			
Number of Roads to District (1992)			NS
Number of Roads to District (2001)	0.438	0.150	NS
Increase in Number of Roads			NS
Length of Paved Roads to District (1992)			NS
Length of Paved Roads to District (2001)			NS
Increase in Length of Paved Roads	0.065	0.016	0.000
Length of Laterite Roads to District (1992)			NS
Length of Laterite Roads to District (2001)			NS
Difference in Length of Laterite Roads			NS
Average Travel Time to District (1984)			NS
Average Travel Time to District (1992)	–0.005	0.002	0.040
Average Travel Time to District (2001)			NS
Change in Travel Time (1984–1992)			NS
Change in Travel Time (1992–2001)			
Change in Travel Time (1984–2001)			NS
Years of Household Immediate Road Access			NS
Energy Variables			
Percent Village Households Electrified (1992)			NS
Percent Village Households Electrified (2001)			NS
Change in % of Village Households Electrified	0.012	0.003	0.000
Years Since Household was Electrified	0.038	0.013	0.000
Annual Electricity Bill	0.005	0.001	0.000
Village Dummy Variables			NS

n = number of households participating; NS = not significant (p>0.05).

Note: The econometric analysis used data only from those households and villages that provided information on all the parameters used in this analysis.

[a] Dependent variable R^2 is a logarithm of average years of schooling of household members.

Source: Nrd2c database for villages; Thailand study team field survey.

over the last 10 years. Access to television and telephones had a particularly positive effect on all facets of family life. Ownership of radios and plows was linked to a positive perception of changes in the village economy and society, respectively. With respect to transport changes, results were largely not significant. However, the average traveling time in 1992 and the current number of roads to the district office were associated with a perception of greater family happiness. A greater length of laterite road in 1992 was associated with positive changes in family well-being, and a greater length of paved road in 1992 with greater family convenience. The current length of paved roads is correlated with perceptions of positive changes in the village economy and society.

Other factors possibly influencing people's perceptions of change were their occupation, their status as natives of

Table 6.10. Factors Affecting Perceptions of Change Over 10 Years

Factor	Family Income	Family Well-Being	Family Conven--ience	Family Happiness	Village Economy	Village Society
Asset Ownership						
Stereos	+	+				
Bicycles		+	+			
Refrigerators		+		+		
Gas Stoves	+		+	+		
Televisions	+	+	+	+		
Telephones	+	+	+	+		
Mechanical Plows			+			+
Radio/Cassette Player					+	
Transport						
Travel Time to District Office, 1992				+		
Length of Laterite Road to District Offfice, 1992			+			
Length of Paved Road to District Office, 2001		+			+	+
Number of Roads to District Office, 2001				+		
Other						
Being Farmers			+			
Being In-migrants	–	–				
Amount of Debts	–	–		–		

+ = positive change; – = negative change.

Source: Thailand study team field survey.

the village or in-migrants, or the amount of debts they owed. Being a farmer was correlated with positive perceptions of changes in family convenience, probably due to the mechanization of agriculture over the last 10 years. Being an in-migrant was correlated with a perception that a family's income and welfare had deteriorated over time. Not surprisingly, debts were negatively correlated with perceived changes in family income, welfare, and happiness.

Perceptions of Impacts

Given the policy-oriented focus of the study, the Thailand study team set out to determine if the poor had different views about the impacts of transport and energy changes than the public at large. There were three possible outcomes: (i) the poor benefit more from transport and energy changes than the public at large, (ii) the poor benefit equally with the public at large, and (iii) the poor do not benefit as much as the public at large, and may even be negatively affected by such investments. These outcomes corresponded to positions taken by different stakeholders in national debates over the merits of additional infrastructure investment. The aim of the study was to inform this debate by providing data from the point of view of the poor themselves.

The study examined perceived impacts on occupations, household income and expenditure, the availability of

goods, household debts, education, health care, availability of free time, safety, access to information, access to common resources, within-community (bonding) social capital, and outside-community (bridging) social capital. The main results for roads and electricity are summarized in Tables 6.11–6.12 and discussed in the subsequent paragraphs.

Rural Transport Improvements. The questionnaire formulated this issue in terms of rural road improvements. An analysis of the answers provided by respondents when invited to describe the mechanisms of these impacts showed an implicit assumption that rural road improvements are followed by improvements in transport services and trading activity, as well as greater personal mobility. Table 6.11 shows the percentage of poor and nonpoor households reporting net impacts. Statistical tests using logistic log-linear models shows that, for most impacts, the differences between poor and nonpoor respondents were not statistically significant. Where their views differed, it was sometimes not in the ways that would be expected. A similar result was found for electricity. This would tend to confirm the view that infrastructure, as a public good, benefits all people more or less equally.

Most households reported that rural road improvements had no significant impact on occupational choice (but see Box 6.1). This finding was significantly stronger

Table 6.11. Perceived Impacts of Rural Road Improvements
(Percent)

Impact	Result	Percent of Respondents		
		All Households (n=913)	Nonpoor (n=441)	Poor (n=454)
Occupational Change	No Impact**	87.6	82.1	93.0
Household Income	Increase Income**	50.7	55.7	45.4
	No Impact**	44.2	41.4	47.3
	Decrease Income	5.0	2.9	7.3
Household Expenditure	Increase Expenditure	81.9	80.5	83.1
Goods Availability	More Goods Available	96.5	96.8	96.5
Satisfaction With Goods	Satisfied	92.7	94.1	91.8
Household Debts	No Impact**	90.0	87.8	92.7
Household Education	Improves Education	91.9	90.5	93.1
Household Health	Improves Health**	90.3	93.4	87.0
Free Time Availability	More Free Time*	67.3	69.4	65.3
	No Impact**	25.1	20.9	29.1
Safety	Increase Safety	58.6	56.9	59.9
	Decrease Safety	25.0	28.6	22.0
Access to Information	Information More Accessible	92.7	93.4	92.2
Access to Common Resources	More Accessible**	67.5	63.2	71.6
	No Impact	29.2	34.0	26.4
Bonding Social Capital	Better Relations in Village	90.8	90.5	91.8
Bridging Social Capital	Better Relations Outside Village	91.5	92.3	90.5

* Significant difference between poor and nonpoor households at p<0.05; **Significant difference at p<0.01.

Note: "All Households" includes results from 18 "unclassified" households.

Source: Thailand study team field survey.

for the poor and ultra-poor than for the nonpoor, suggesting that the nonpoor were perhaps better placed to take advantage of the opportunities for occupational change offered by road improvements. However, the general conclusion is that rural people in Thailand, including the poor, were not likely to change their main occupations in response to road improvements. Whether a person classified himself as a farmer, a laborer, a herder, a trader, or a public employee was probably primarily determined by the nature of his economic and social assets, rather than by his transport opportunities. It would have been interesting, however, to explore whether or not road improvements had any impact on the occupational choices of women, or on those of the next generation.

Box 6.1. "Roads and Electricity Changed My Life"

Nud, 30, a villager in Wang Kata *tambon*, Pang Chong District, Nakhon Ratchasima Province, told his life story. He remembered that he was born in this village, but his parents and older siblings migrated in and settled there by clearing land for farming.

When he was young, village paths were for carts only. It was very difficult and took days of travel to reach the *amphoe* (district headquarters). No cars could enter the village, making it very difficult to send out sick people to get health care. Many students had to live with relatives in the amphoe in order to go to school, and were able to see their parents only on holidays. Everyone in the village farmed, but it was difficult to market the resulting produce; Nud and others had to pay high prices to have it transported.

Paths and cart tracks became earthen roads about 10 years ago. Cars began to appear, transporting people to the amphoe and students to school about once or twice weekly. When roads became partly laterite, however, Nud invested in a truck—still the only one in Wang Kata—using it to transport his own and other villagers' products. After realizing that the income from driving his truck was more reliable, Nud left the farming to his wife and now drives to and from the amphoe every morning, earning 25 baht per passenger.

When electricity recently also became available in the village, Nud opened a car repair shop, where he works every afternoon. So electricity has given him *two* additional career opportunities. However, the electricity-related expenses have also increased, and Nud is concerned about his daughter spending too much time watching television.

Nud is grateful for the roads and electricity that have brought new economic opportunities. Things are better than before, and the future for the next generation is even brighter. He foresees that his children will not work in the village anymore, but will seek work further afield.

Source: Thailand study team.

Only about half of all households thought that rural road improvements had increased their household income. Poor households were significantly less likely to think so than nonpoor households. Most of the rest of the respondents felt that road improvements had had no impact on their incomes. However, about 5% of all households, including 7% of the poor and close to 10% of the ultra-poor, felt that road improvements had actually decreased their incomes. Respondents gave many reasons why roads might increase incomes. The most frequently cited were an increase in job opportunities both inside and outside the village, higher sales of local products, and overall economic improvement. Lower transport costs, higher product prices, and more farm-gate sales were also mentioned. When this response was combined with the response about occupational choice discussed above, it seemed clear that most respondents perceived an increase in opportunities for sales or employment that would supplement the activity that they regard as their primary occupation.

Among those who felt that road improvements had reduced their household incomes, the main reasons were the general economic slowdown due to the Asian financial crisis, fewer jobs available, lower product prices, and lower sales. This suggests that, especially among the ultra-poor, a small minority's livelihood strategies cannot stand up to the competition introduced by road improvements. Interestingly, one nonpoor respondent cited higher wages paid as a negative consequence of road improvements, while four respondents (two ultra-poor and two nonpoor) cited an oversupply of labor (migrants from even poorer regions), suggesting that road improvements also introduced greater competition in the local labor market.

A large majority of respondents felt that rural road improvements had caused an increase in their household expenditures. The result was slightly higher for the poor, but this small difference was not statistically significant. The main mechanism identified by respondents was that rural road improvements induced more personal travel. Others felt that they became more likely to spend on consumer goods, and/or that consumer goods became more expensive. A relatively small share of respondents cited increases in the cost of transport or of the factors of production. Individual respondents also mentioned the need to buy more because of negative impacts on natural

resources, increased educational expenses, and the need to pay for road maintenance.

A small minority (about 3% of the sample), predominantly nonpoor, felt that road improvements decreased household expenditure. In these cases, the reasons cited included lower passenger and goods transport costs, decreased need to travel to buy goods, lower product prices, lower expenditures on gasoline, and fewer people at home because of migration to find jobs elsewhere.

Respondents overwhelmingly confirmed that more goods were available in local markets as a result of transport improvements, and that this was a positive impact for both the poor and nonpoor. The primary reason for satisfaction with this result was the reduced risk of shortages, a serious problem for all (but especially for the poor) in remote rural areas. Respondents were also happy to be able to choose from a wider selection of goods. Other reasons mentioned included more shops, cheaper goods, more good-quality food available, and greater convenience (including savings in transport time). The very small minority (less than 2% of the sample) that thought having more goods locally available was not a good thing cited the greater availability of expensive goods and the consequent temptation to overspend.

For survey respondents, road improvements mean more convenient—i.e., faster—travel to health care centers.

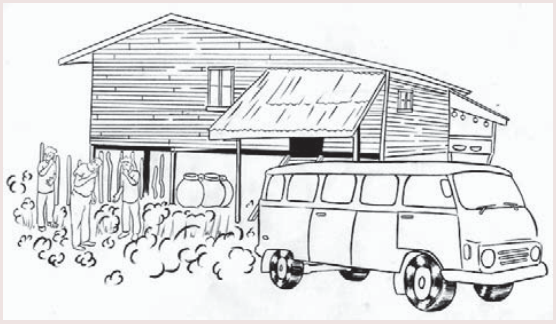
The study team particularly wanted to examine the relationship between rural infrastructure improvements and household debts. According to one popular view in Thailand, poor families are in debt because the country has been following the "Western" development ideology, based on infrastructure investments. In other words, roads and electricity promote a lifestyle that causes overspending by the poor, bringing debts to poor communities. This notion is roundly rejected by the findings of the study. Although about 80% of the surveyed households did indeed have debts, 90% of respondents saw no connection between the debts and rural roads (or electricity). This view was even more strongly expressed by the poor. Most of the household debt reported in the survey was related to investment in agricultural activities. Among the 10% of the sample that thought road improvements did lead to increased household debt, about half attributed this to overspending, 30% to borrowing for investment purposes, and 10% to consumer debt incurred in order to imitate others ("adopt a modern lifestyle").[20]

Respondents had a strongly positive view of the impact of roads on education. Poor households in the survey held this view even more strongly than nonpoor households, although the difference is not statistically significant. Almost all respondents attributed this impact to the greater convenience of travel to school. A few respondents also mentioned the availability of more sources of information and the effects of increased income on household education expenditures. Of those few who did not see a positive impact of roads on education, most felt that they had no net impact.

Similarly, survey respondents strongly viewed road improvements as having a positive impact on family health. In this case, however, the poor were significantly less likely than the nonpoor to report such positive impacts. The main reason given was more convenient traveling to health care centers, followed by "prompt access to health care," which may reflect the greater ability of health care providers to reach their clients in their villages or homes. Interestingly, quite a number of respondents (67, or 8% of the total) mentioned reduction in dust—a result of road paving—as a significant source of positive health impacts. A few respondents also mentioned the effects of increased income on health. About 3% of the sample identified negative impacts, mainly in connection with the dust generated on laterite roads. A few respondents also mentioned vehicular air and noise pollution.

Views about road impacts on the availability of free time were rather mixed, although little variation between the views of the poor and the nonpoor emerged. About two thirds of the sample felt that road improvements resulted in more free time, while about one fourth felt that there was no net impact, and the remainder saw a net negative impact. The main reasons for more free time were

[20] This type of consumer debt may be related to the purchase of television sets, which are widely available in rural Asia. From another perspective, such expenditure could be regarded as an investment in information (see results for electricity on p. 118).



Road paving has a positive health impact by reducing dust.

that people were able to spend less time traveling (implying a saving in travel time on regular trips), and the greater availability of goods in the village (also saving travel time). Among those who saw a negative effect, most felt that they now had to work harder, presumably to meet increased expenditures. Only a very small minority felt that they spent more time traveling after road improvements took place.

Responses were also mixed concerning road impacts on safety. While slightly more than half of respondents (in all categories) felt that roads increased safety, a significant minority (20–30%) felt that the net impact of roads on safety was negative. Interestingly, the ultra-poor were more likely to perceive positive impacts and less likely to perceive negative impacts on safety than either the nonpoor or poor households closer to the poverty line. The main reason that road improvements were perceived as improving safety was the greater accessibility of villages to the police. This reason was particularly important for the ultra-poor, suggesting a new dimension of their vulnerability in isolated rural communities. Less danger from wild animals and fewer accidents due to improved road conditions were also mentioned. Among those who thought that road improvements reduced safety, the main reason given was that more roads induced more traffic accidents. More frequent thefts and easier access of outsiders to the community were also safety concerns. Such concerns were predominantly expressed by nonpoor respondents.

Respondents in all income classes strongly agreed that rural road improvements increased access to information. Those who did not share this view mainly felt that roads had no impact in this area. The main mechanism of impact transmission in this case was overwhelmingly believed to be the greater ease of personal travel outside the community. Only a very small number of respondents mentioned the greater availability of newspapers, postal services, or telecommunications, or the arrival of newcomers bringing new information into the community.

With respect to access to common resources, about two thirds of the respondents perceived a positive impact, with a significantly more positive response among the poor than among the nonpoor. Most of the remaining respondents saw no net impact on access to common resources. The reason given by almost all the respondents was greater road access to common resource areas. Only 3% of the sample saw a net negative impact, and this was mainly attributed to outsiders getting greater access to common resources that were felt to belong to the village. It may be noteworthy that negative road impacts on common resources were mostly perceived by nonpoor respondents.

Respondents agreed overwhelmingly (over 90% in all cases) that rural road improvements led to better social relations, both within rural villages and between those villages and the outside world ("bonding" and "bridging" social capital). About 7% perceived no impact, and only about 2% thought roads had a negative effect on social capital. The main reason given for bonding effects was the greater ease of traveling *within* the village. Other reasons were that road improvements facilitated group meetings and mutual help, as well as providing more free time for social activities.

More convenient travel was cited as the main reason why road improvements facilitated bridging social capital. Having more business connections with outsiders was also mentioned. Those few who felt that roads had a negative effect on social capital (both bonding and bridging) said that generally people had become more selfish, and that having to work harder to meet increased expenditures meant that they had less time for others. Poor and nonpoor households did not differ significantly on this subject.

Rural Electrification. The results for rural electrification, in general, closely parallel those for rural roads (Table 6.12). Like roads, rural electrification was perceived as having little impact on occupational change, particularly for poor households. Only about 40% of all households, somewhat less than for rural roads, believed that rural electricity had helped increase their income. Poor households were slightly but significantly less likely to experience an income increase and more likely to experience an income decrease than nonpoor households. The majority perceived no income impact.

For those who said they had experienced a change, the primary mechanisms were more jobs available both in the

village and outside, and overall economic improvement. Higher product sales was also a reason for improved household income.[21] Only a few respondents cited the possibility of starting a home-based business and receiving higher prices for local products or higher wages. Others mentioned the possibility of working for longer hours. Electric water pumps were also cited as time-saving devices that released household energies for additional production.

The poor and the nonpoor shared these views. However, the nonpoor were distinctly more likely to mention increasing jobs *within* the village as mechanisms for income improvement, and distinctly less likely to mention increasing jobs *outside* the village. This finding suggests that the nonpoor were more likely to be able to invest and capture the benefits of electricity through local businesses, while the poor depended on other investors to create electricity-related job opportunities. Those who said that electricity had a negative impact on their income were predominantly from the ultra-poor group. They attributed this effect to a general economic slowdown and fewer jobs being available (Box 6.2).

In contrast to the limited impacts on income, a higher share of households perceived that electricity increased their household expenditure. This was especially true for the upper range of the poor and for the nonpoor, but less so for the ultra-poor. The main reason, not surprisingly, was higher electricity bills. Ultra-poor households cited shis reason slightly less frequently, presumably because they were less likely to have an electricity connection.[22] Another reason, mentioned by 15% of respondents, was that electricity encourages other spending, presumably on

[21] This may be linked to the ability to use electricity to increase irrigation. See paragraph on access to common resources on p. 120.

[22] In the rural sample, of the 33 households without an electricity connection, 20 were ultra-poor, 2 were poor, and the other 11 were nonpoor.

Table 6.12. Perceived Impacts of Rural Electricity Improvements

Impact	Result	Percent of Respondents		
		All Households (n=913)	Nonpoor (n=441)	Poor (n=454)
Occupational Change	No Impact**	91.4	88.9	94.1
Household Income	Increase Income**	39.6	40.8	37.7
	No Impact**	56.5	57.6	56.0
	Decrease Income**	3.9	1.6	6.3
Household Expenditure	Increase Expenditure	87.3	88.2	86.5
Household Debts	No Impact	86.0	82.8	89.4
Household Education	Improves Education	87.1	88.9	85.8
Household Health	Improves Health	86.2	89.4	86.8
Free Time Availability	More Free Time	68.3	71.7	65.7
	No Impact	25.1	22.2	27.2
Safety	Increase Safety	86.7	86.0	87.1
Access to Information	Information More Accessible**	93.4	95.9	91.1
Access to Common Resources	More Accessible**	55.6	58.9	52.7
	No Impact	41.8	38.4	44.5
Bonding Social Capital	Better Relations in Village	78.6	81.4	75.6
Bridging Social Capital	Better Relations Outside Village	78.9	78.0	79.3

* Significant difference between poor and nonpoor households at p<0.05; **Significant difference at p<0.01.

Note: "All Households" includes results from 18 "unclassified" households.

Source: Thailand study team field survey.

Box 6.2. "It is Easier to Earn Income Now"

Uncle Tong Luan, 50, a villager in Klong Muang *tambon*, Pak Chong District, Nakhon Ratchasima Province, is now herding milk cows, a career he started about 10 years ago when electricity first came to the village and brought benefits to the villagers. The privately owned "milk center", which uses electricity to extract milk from the cows, was established at the village entrance. Villagers like Tong Luan started raising milk cows and now earn a higher, more stable income. Moreover, raising cows is not hard work, so even older people like Tong Luan can earn a decent income.

Before, he was a farmer, just like everyone else. But Klong Muang also lacked roads, so farming was not very lucrative: much time was consumed in transporting products, and if transport was lacking, the villagers had to sell their products at the same time, the time when outsiders came to buy the products. That led to depressed prices and less income. So roads helped to raise selling prices.

When the roads came, the villagers had more options for selling their crops and selling prices rose. Realizing the benefits they had gained, the villagers always worked together to ensure that road maintenance is carried out. However, Tong Luan feels that the government should improve the condition of the roads, since earthen and laterite roads cannot withstand heavy rains.

Roads also interact with electricity. Tong Luan notes that better roads make transporting milk easier, especially for him, because he lives far from the village center. He was one of the last villagers to get electricity because he lives so far away; Tong Luan believes that the better-off families in the village have benefited more from electricity, since they were electrified earlier.

Source: Thailand study team.

appliances. A smaller group felt that electricity caused goods to become more expensive. Only a few individuals felt that electricity lowered costs. Half of them mentioned the cost of lighting, and the others did not specify the costs concerned.

As with road improvements, survey respondents generally rejected the suggestion that electricity improvements had anything to do with their debts. However, a minority (about 14%) did feel that electricity had increased their debts. This effect was more often felt among the nonpoor than among the poor. This finding suggests that the poor (and especially the ultra-poor) were more careful about incurring consumer debt than are the nonpoor, who can afford to take greater risks and spend a larger share of their income on nonessentials.

Respondents clearly felt that electricity improvements had a positive effect on household education. The main reason, cited by 72% of respondents, was the availability of light for doing homework in the evening. While no significant difference emerged on this point between the poor and the nonpoor, the impact on the ultra-poor was slightly less marked than the impact on the nonpoor and the less poor. Most other respondents felt that electricity had no net effect on education. About one fourth of all respondents mentioned getting more information from television and radio. Others cited more modern educational equipment, the ability to acquire computer skills, the ability to translate time saved on household tasks into time spent on education, and the ability to spend more time reading. Among the few who felt that electricity had a negative educational effect, the great majority of those who gave a reason blamed this effect on children watching too much television.

The survey respondents also agreed that electricity had a positive impact on family health. This impact was perceived somewhat more strongly by the nonpoor and less strongly by the ultra-poor. Again, most of those who did not share this view felt that electricity had no net impact on health. The main reason given for a positive impact was that lighting is good for eye health. Better food preservation through refrigerators was also an important consequence. Others mentioned the effects of increased income on health, reduced heat stress through use of electric fans, and less indoor air pollution. Secondary effects of better lighting include reduced dangers from poisonous animals and the ability to provide better care to the elderly and ill during the night. As for the few individuals (half of them ultra-poor) who felt that electricity had negative effects on health, the main reasons were insufficient sleep and eye problems from watching too much television, and health care opportunity costs due to over-spending on electrical appliances and the need to spend more time working.

The survey results regarding impacts of electricity on education and health generally seemed to confirm the hypothesis that positive effects were associated with access to electricity for both the poor and the nonpoor. The fact that the ultra-poor seemed to benefit somewhat less may result from the fact that fewer of the ultra-poor households in the rural survey sample had access to electricity.

About two thirds of all respondents said that electricity provided them with more free time. Poor households were somewhat, but not significantly, less likely to per-

Lighting, both in individual houses and on village streets, is perceived to discourage thieves and wild animals.

ceive a positive impact on free time than nonpoor households. Most respondents who did not share this view perceived no net impact on free time. Those who felt that electricity increased free time mainly mentioned the time savings achieved by using electrical and electronic devices. Those who felt that electricity reduced free time mainly said that they spent more time working, which suggested that "free" time was being put to productive use.

The perceived impact of rural electricity on safety was considerably stronger than that of rural road improvements. Lighting, both inside individual houses and on village streets, was the primary cause for this impact. Lighting is believed to discourage thieves and wild animals and to increase the safety of walking in the village at night. Where electric lights had replaced candles, the danger of house fires was also reduced. Poor and nonpoor households shared these benefits equally. Those few people who perceived safety hazards associated with electricity mentioned the danger of short circuits, fires, and hazards to children.

A very strong relationship was noted between electricity and better access to information across all socioeconomic groups, but this effect was significantly stronger for the nonpoor than for the poor. By far the most important mechanism for this effect was getting the news on television. Other mechanisms mentioned include radio news, village news centers, and getting information by telephone. Hardly any respondents saw a negative impact in this area, but those who did cited the need to work harder (as a reason for not spending time listening to the news), and spending too much time watching television soap operas.

More than half of all respondents felt that electricity had improved access to common resources. Most of the rest felt that there was no net impact on common resources. This effect was more often mentioned by the nonpoor than by the poor, although the difference was not statistically significant. The predominant reason for this effect was the use of electrical pumps, which enable water capture both for irrigation and for domestic uses. A few respondents also cited the use of lights for night hunting and for getting water at night. As with roads, the main negative impact identified was that outsiders could also get access to the village's common resources.

Respondents generally perceived a positive impact of electricity on social capital, although not as strong a relationship as for road improvements. Again, this perception was about equally distributed, though it was slightly less important for the ultra-poor than for the nonpoor and the poor who were close to the poverty line. Several reasons were advanced for the contribution of electricity to better social relations, both within the village and with outsiders: it enables night meetings and facilitates group activities; it encourages mutual help activities to improve economic status. Furthermore, it encourages visiting at night, talking and watching TV together, and talking on the telephone. Reasons why electricity might have a negative effect on bonding and bridging social capital were not different from those given for road improvements: people are more selfish now and they have to work harder, and thus have less time for others. It seemed that this was a generalized perception of a few people who have been disappointed by development. However, this is the view of only a small minority.

Distribution of Impacts. Because increasingly inequitable income distribution is now one of the more worrisome aspects of poverty in Thailand, the study team wanted to assess the perceptions of their sample regarding the distribution of benefits from road and electricity improvements. To their surprise, a majority of the sample households maintained that the benefits of road and electricity improvements are equally distributed to all villagers. The proportion holding this view is slightly higher for roads (87%) than for electricity (82%). About 10% of respondents felt that road benefits go disproportionately to the rich, and about 12% felt that way about electricity. However, more of the ultra-poor households, and fewer of the nonpoor households, tended to believe that benefits go disproportionately to the rich. The poor households closer to the poverty line tended to mirror the responses of the entire sample.

Electric water pumps like these in Wung Kata District, Nakhon Ratchasima Province, raise agricultural productivity.

Finally, respondents were asked if they wanted more investment in roads and electricity in their areas. For roads, the question was asked separately for new construction and upgrading. About two thirds of the respondents believed that their villages needed more roads, and the proportion was higher for poor households. A much higher proportion (96.5%, with very little variation across socioeconomic groups) was in favor of upgrading existing roads. Further, about 70% of the respondents wanted their villages to be more electrified. This seems to conflict with the fact that electricity was already widely available within the villages. However, it can be interpreted as reflecting a view that electricity is an entitlement that should be available to everyone. The need for more electricity was expressed slightly more strongly by the poorer households.

These results suggest that, if the benefits of rural infrastructure in fact accrue more to better-off households than to the poor, this may be, at least in part, because rural infrastructure does not yet serve every household equally (i.e., markets are not saturated). The answer to this dilemma is not to provide less rural infrastructure but to provide more of it. The marginal returns to poverty reduction will *increase* as the physical limits are approached.[23]

Following the national and international review of the draft report, the Thai study team undertook further analysis of the characteristics of, and effects on, respondents who perceived negative income impacts or none at all from rural roads or electrification. Those households that saw no net income impact represented 60% (roads) and 50% (electricity) of the rural sample, while those who perceived a negative impact on incomes represented 4% and 5%, respectively. Those who perceived a positive impact were more likely in both cases to be nonpoor, while those who perceived a negative impact were dramatically more likely to be poor (Table 6.13).

The team examined whether respondents who did not perceive positive income impacts did experience other impacts. Table 6.14 shows only those impacts for which a discernible difference existed between the responses of those who perceived a positive income effect and those who did not. Impacts that are not included in this table, such as impacts on health, free time, access to information, access to common resources (roads), or safety (electricity) are those that were experienced equally in rural areas regardless of income effects. As we shall see, the pattern turned out to be different in urban areas.

Generally, survey respondents did not report occupational change as a result of road or electricity improvements; however, almost all of those who did report such

[23] Though, of course, the marginal economic returns to investment will decrease. This concept requires a new economic calculus that explicitly attributes social value to increasing the welfare of the poor.

Table 6.13. Perceived Income Impacts by Poverty Status

Perceived Income Impact	Percentage of Households (Rural)			
	Roads		Electricity	
	Poor	Nonpoor	Poor	Nonpoor
Positive Impact	45.5	54.4	48.4	51.6
No Net Impact	53.9	46.1	49.7	50.3
Negative Impact	71.7	28.3	80.0	20.0
Percentage in Sample	50.6	49.4	50.4	49.6

Source: Thailand study team field survey.

change also experienced positive income impacts. A high proportion of respondents who did not have positive income impacts nevertheless felt that road and energy improvements had contributed to improving their educational status, though the proportion was even higher among those who perceived positive income impacts. Those whose incomes had not increased, and especially those who saw a net negative income impact, were markedly less likely to believe that road improvements had increased their safety. They were also less likely to feel that electricity enhanced their access to common resources or their opportunities for social participation. However, a substantial share of the respondents did feel that they had experienced such benefits, even though they had not shared in income gains. As to benefit distribution, those who saw no net income impacts generally shared the common view that benefits were equally distributed, while the small group who believed they had experienced negative income impacts were sharply more critical of the pattern of benefit distribution.

The team also examined the characteristics of households noting negative income impacts or no impacts at all in the survey. Such households were slightly more likely to have older members (over 60) and slightly less likely to have young children (under 13). This demographic profile was more marked for those experiencing negative income impacts. Households reporting no income impacts due to road improvements had slightly larger farms than others. They were roughly comparable to others with respect to asset ownership (refrigerators, television sets, electric and gas stoves, bicycles, motorcycles, and telephones). However,

Table 6.14. Impacts Reported by Households with No Income Impact
(Percent)

Other Impacts		Income Impact Category		
		Positive (40%)	**None** (56%)	**Negative** (4%)
Rural Roads				
Occupational Change	Yes	20.6	3.5	8.7
	No	79.4	96.5	91.3
Education	Better	93.9	90.1	80.2
	No Impact	4.1	9.7	15.4
	Worse	1.3	0.2	4.3
Safety	Increase	65.4	52.6	41.3
	No Impact	11.5	21.6	19.6
	Decrease	22.9	25.3	39.1
Benefit Distribution	Equal	88.5	89.3	45.7
	Favors Rich	8.0	7.7	45.7
Rural Electrification				
Occupational Change	Yes	18.2	2.4	2.9
	No	81.8	97.6	97.1
Education	Better	91.9	84.3	80.0
	No Impact	5.9	13.0	17.1
	Worse	2.2	2.4	2.9
Access to Common Resources	Better	59.1	52.1	45.7
	No Impact	34.5	45.8	37.1
	Worse	4.2	1.2	8.6
Bonding Social Capital	Better	83.8	76.2	54.3
	No Impact	7.0	20.2	17.1
	Worse	8.4	3.5	28.6
Bridging Social Capital	Better	87.4	82.1	74.3
	No Impact	8.4	25.7	8.6
	Worse	8.4	25.7	8.6
Benefit Distribution	Equal	86.3	82.1	54.3
	Favors Rich	10.9	11.6	28.6

Source: Thailand study team field survey.

households reporting negative income impacts were distinctly poorer in terms of landownership and somewhat poorer in terms of assets. An examination of travel patterns showed that while most households made daily trips on motorcycles or bicycles, those with net negative impacts from road improvements were more likely to walk.

With respect to electricity, those reporting no income impacts owned and operated smaller farms and were slightly less likely than others to own various assets. Again, those reporting negative income impacts were among the poorest in land and assets.

Urban Transport and Energy. A similar analysis of the household survey responses was conducted for the urban sample of 209 households (Tables 6.15 and 6.16). Many of the results are similar to those obtained for rural households. Responses for households below the national poverty line and households between the poverty line and the sample median were aggregated into one poor category, while households with incomes above the sample median were considered nonpoor. On this basis, statistical tests could not detect any significant differences between the results for the two groups. This may be partly due to the relatively small size of the urban sample.

A larger share of the urban sample than of the rural sample (though still a minority, less than one fourth) reported changing their occupation in response to transport improvements. Reasons given for occupational change were increased mobility providing access to jobs over a wider area, more business opportunities developing in the community, and greater ease in finding jobs.

Table 6.15. Perceived Impacts of Urban Transport Improvements
(Percent)

Impact	Result	Percent of Respondents		
		All Households (n = 209)	Nonpoor (n = 98)	Poor (n = 111)
Occupational Change	Change	23.4	22.4	24.3
	No Impact	76.6	77.6	75.7
Household Income	Increase Income	55.0	62.2	48.6
	No Impact	37.3	31.6	42.3
	Decrease Income	7.7	6.2	9.1
Household Expenditure	Increase Expenditure	50.2	51.0	49.5
	No Impact	45.9	43.9	47.7
Goods Availability	More Goods Available	95.2	94.9	95.5
Satisfaction with Goods Availability	Satisfied	89.0	86.7	91.2
Household Debts	No Impact	97.6	96.9	98.2
Household Education	Improves Education	73.2	69.4	76.6
	No Impact	25.4	28.6	22.5
Household Health	Improves Health	78.0	75.5	80.2
Free Time Availability	More Free Time	60.8	62.2	59.5
	No Impact	36.8	35.7	37.8
Safety	Increase Safety	70.8	71.4	70.3
	Decrease Safety	18.2	26.7	11.8
Access to Information	Information More Accessible	82.8	81.6	83.8
Access to Common Resources	More Accessible	36.4	34.7	37.8
	No Impact	63.2	64.3	62.2
Bonding Social Capital	Better Relations in Community	76.6	75.5	77.5
Bridging Social Capital	Better Relations Outside Village	73.2	72.4	73.9

Source: Thailand study team field survey.

Table 6.16. Perceived Impacts of Urban Electricity Improvements

Impact	Result	Percent of Respondents		
		All Households (n = 209)	Nonpoor (n = 98)	Poor (n = 111)
Household Income	Increase Income	28.7	30.6	27.0
	No Impact	71.3	69.4	73.0
Household	Increase Expenditure	62.7	60.2	64.9
Expenditure	No Impact	33.5	34.7	32.4
Household Debts	No Impact	96.2	96.9	95.5
Household Education	Improves Education	56.5	57.1	55.9
	No Impact	42.1	41.8	42.3
Household Health	Improves Health	59.8	61.2	58.6
	No Impact	38.3	37.8	38.7
Free Time Availability	More Free Time	49.3	48.0	50.5
	No Impact	49.8	51.0	48.6
Safety	Increase Safety	71.3	76.5	66.7
	No Impact	23.0	19.4	26.1
Access to Information	Information More Accessible	76.6	80.6	73.0
Bonding Social Capital	Better Relations in Community	46.4	45.9	46.8
	No Impact	53.1	53.1	53.2

Source: Thailand study team field survey.

More than half the urban respondents (55%) found that transport improvements had helped increase their incomes. The effect was more marked for the nonpoor households in the sample, and considerably less marked for the poorest. The main reasons given for increased income included ability to work over greater distances, greater availability of jobs, higher sales of products, and overall economic improvement. Only 8% of the sample felt that their incomes had been negatively affected—by lesser job availability, lower product sales, and an overall economic slowdown (Box 6.3).

All respondents showed strong agreement that road transport improvements increased the availability of goods in local markets. Almost all of them felt that this was a good thing, primarily because they appreciated being able to choose among a variety of products. Reducing the risk of shortages was also an important reason. It is interesting to note that the risk of shortages was more salient for households just above and below the sample median than for the very poor or for the well-to-do. Other reasons cited were greater convenience in obtaining goods, lower costs, and travel cost savings. Only a few respondents felt that having more goods available was not a good thing, and these mainly felt that it caused overspending. Urban respondents also strongly agreed that road improvements had nothing to do with household debts.

About three fourths of the survey respondents felt that road transport improvements had a positive impact on household educational levels, and almost all the rest felt they had no impact. These views were evenly distributed across income groups, with a slightly higher proportion of poor households holding positive views. More convenient travel to school was the main reason cited. Other reasons included access to more information sources and increased income, making it possible to spend more on education. A few respondents also mentioned that teachers (NGOs) could visit the slum communities more often. An even more positive response was provided with respect to health impacts, and in this case, the strongest positive effect was reported by the poorest group in the sample. Again, more convenient travel to health care centers was the main reason, followed by shorter travel times ("prompt access to health care"). Other reasons mentioned included increased income allowing for more health

expenditures, reduced road dust, more frequent visits from doctors, more convenience in visiting health clubs, and a generally better psychological environment. Of those who perceived a negative impact on health, almost all attributed this effect to an increase in vehicular air pollution.

About 60% of the urban sample felt that transport improvements contributed to having more free time. This effect was more important for the well-to-do and the very poor, and less so for households close to the poverty line (both above and below). All these respondents attributed this effect to savings in travel time. Most of the rest felt that road improvements had had no impact on free time. The small number who felt there had been a negative impact cited the need to work harder, presumably as a result of increased transport expenditures.

Nearly all respondents in household surveys said that transport improvements had increased their ability to earn an income.

As to safety, about 70% of the sample felt that road transport improvements had a net positive effect; about 18% felt that they had a net negative effect. Again, the well-to-do and the very poor had a more positive perception, while those close to the poverty line were somewhat less likely to perceive positive impacts. By far the most important reason for improved safety was better access to communities by the police. Another reason mentioned by a number of respondents was decreased danger from wild animals. Road improvements were also thought to discourage burglary and theft, contribute to reducing road accidents, and make urban communities more accessible to firefighting services. Respondents who felt that road improvements decreased safety mostly cited the likelihood of increasing road accidents.

Over 80% of urban respondents felt that road transport improvements helped make information more accessible; this positive impact was slightly (but not significantly) more marked among the poor. The main reason was greater personal mobility and improved communication with the outside world. However, a number of respondents also cited the greater availability of newspapers, and a few also mentioned easier access for postal services.

In contrast, only about one third of the respondents felt that transport improvements provided better access to common resources, while the rest saw no impact. Those who saw a positive impact attributed it to the greater convenience of transporting goods extracted from common resources (e.g., fuelwood). However, the concept of "common resources" proved difficult to define in the urban

Box 6.3. The Ironic Impacts of Roads and Electricity

Uncle Sorn, a resident of Thepleela communities in Bangkok, migrated to the capital in 1975 to work as a general laborer. He got married and had four children. After the roads became better and more people moved to the area, Sorn and his wife decided to make and sell desserts. They put the desserts in a pushcart, and pushed it around the communities and markets to reach their customers. When sales picked up, they decided to sell in two shifts, morning and evening. They used a simple electrical machine to slice the coconuts, the main ingredient of their desserts. This machine helped them greatly; they would not have been able to sell in two shifts without it. Electricity in the form of electric light also allowed them to prepare their products late into the nights and in the early mornings. The improved roads that brought them their customers also made travel to the market to buy ingredients much more convenient and time-saving.

Ironically, while roads were good to Uncle Sorn and his family, they also caused their greatest loss: Sorn's wife died in a road accident the preceding year. She was waiting to cross the road when a fast-moving car hit and killed her. "The wider road tempted the driver to go fast and we lost her," Sorn said. "It's fate, though, it's not the fault of the road."

Source: Thailand study team.

context, and it is not clear what meaning, if any, can be attributed to these findings.

Finally, urban slum households generally endorsed the view that road transport improvements have a positive impact on social relations, both within the community and between the community and the outside world. Poor households were slightly more likely than nonpoor households to confirm these positive impacts. Those who did not share this view mostly felt that there was no particular impact. In both cases, greater convenience of traveling was the major reason given to explain this effect. In the case of within-community relations (bonding social capital), a few respondents also mentioned that transport improvements facilitated getting together in groups, whereas in the case of outside-community relations (bridging social capital), a secondary reason was the ability to have more business connections with outsiders.

As to electricity, less than 30% of urban households believed that access to electricity had increased their income (Table 6.14). The rest reported that it had no effect. (Of course, a large share of sample households in Nakhon Ratchasima—77 households, or 37% of the entire urban sample—did not have access to electricity.) Incomes were slightly more likely to increase for the well-to-do and for the below-average households, while the poorest were least likely to benefit. Those respondents who saw a positive impact attributed it largely to overall economic improvement, more jobs, and higher product sales. A few also mentioned longer working hours and higher product prices.

In contrast, 63% of households felt that electricity had increased their household expenditures. This effect was less noticeable for the well-to-do and for the poorest, and more important for the households close to the poverty line. The most important reason cited was higher electricity bills. Some respondents also mentioned induced overspending and increases in the price of consumer goods. Those few respondents, all from the poorest group, who felt that electricity had lowered household expenditure, cited the lower cost of lighting. Respondents across all income groups agreed that electricity did not bear any relation to household debt.

About half the urban respondents felt that electricity had helped to improve their educational status. This was especially true for the nonpoor households and those close to the poverty line, but considerably less so for the poorest (probably due to the high proportion of very poor households—in Nakhon Ratchasima—without electricity). Most of the rest of the sample saw no impact on education. The main reasons for perceived positive impacts were better information from television and radio, and the effects of lighting in enabling students to complete their homework. Only three respondents saw a negative effect, and only one of these gave a reason: that children watch too much television. The response was stronger with respect to impacts on health, showing no significant differences across income groups. Most of the respondents who did not share this view saw no impact of electricity on family health. The major benefit cited was that of lighting for eye health, followed by better food preservation. A few respondents also mentioned increased income permitting more health care expenditures, and reduced heat stress due to the use of electric fans. The very few who saw a negative impact on health attributed this to watching too much television.

Only about half of all households in the urban sample felt that electricity contributes to having more free time. Poor and nonpoor households did not vary significantly in their responses. Poor households close to the poverty line were somewhat more likely to feel that electricity contributed to free time, while the poorest households were somewhat less likely to do so, possibly because they were less likely to have an electricity connection. Most of the rest thought that there was no impact on time availability. Practically all the respondents who saw a positive impact attributed it to the use of time-saving electrical appliances.

With respect to safety, a sizable majority of respondents, both poor and nonpoor, felt that electricity had a positive impact. However, this view was less widely shared by the poorest households. Only 6% of the sample felt that electricity had a net negative impact on safety. Positive effects on safety were largely attributed to street lighting. In-home lighting was also believed to be a deterrent to thieves. A few respondents cited less danger from wild animals. Those who saw a negative impact mainly referred to the danger of short circuits and house fires.

About three fourths of the sample felt that electricity increased their access to information. This view was more strongly held among nonpoor households and the poor close to the poverty line, and markedly less so among the poorest. The main mechanism for this impact is getting news from television and radio. However, the role of electricity in enabling the creation of community news centers was also seen to be important.

Less than half of the urban sample felt that electricity had a positive effect on building social capital within the community. Households close to the poverty line were more likely to have a positive view, whereas the poorest households were distinctly less likely to share this view. Those who did not see a positive impact mainly reported no impact. Among those who saw positive effects, the role

Improved transport made it easier to get to school and thus helped increase educational attainment.

of electricity in facilitating group meetings was seen as the most important mechanism for building social capital. Enabling mutual help to improve economic status, and enabling night meetings, were also important, while one respondent mentioned having more opportunity to talk on the telephone. The urban survey did not explore the impacts of electricity on social capital building outside the community.

As to the distribution of benefits from transport improvements, the urban sample confirmed the findings from the rural areas. A large majority (83% in urban areas) feel that transport benefits are equally distributed to the poor and the nonpoor. However, the urban sample had a more negative view on electricity than did the rural sample. While a small majority (56%) did feel that the benefits were equally distributed, over 35% of the urban respondents felt that the benefits of electricity accrue disproportionately to the nonpoor. This result probably reflects the fact that while transport improvements were accessible to all households in the sample, a significant share of households in the urban sample did not have access to electricity. It also suggests that rural electrification has been more successful in reaching the poor than urban electricity systems, and that greater attention might now be paid to ensuring that the urban poor also have access to these systems.

A majority of the urban sample households were satisfied with the current level of roads and road transport services. However, a significant minority (37%) felt that more urban roads should be built. The poorest households (53%) were particularly likely to hold this view, and the nonpoor (33%) were less likely to do so. In addition, 29% of all respondents felt that more transport services were needed, and 35% felt that the quality of public transport services should be upgraded. These views were more common among the nonpoor and households close to the poverty line than among the poorest households, which are mostly satisfied with the current level of transport services. On electricity, 85% supported an increase in electricity supply in urban areas, a view shared across all income groups.

In the urban areas, the Thai team also explored in more detail the effects of transport and energy improvements on those who did not report any income effects, or negative income impacts. As with the results in rural areas, poor households were more likely than nonpoor to report no impact or negative effects on income (Table 6.17).

In the urban context, the perception of other impacts appeared to be more closely correlated to income impacts, probably reflecting the fact that in urban areas, income is a more important determinant of quality of life than in rural areas. The benefits to education, safety, and social capital are much more strongly related to income changes in urban areas than in rural areas. In addition, income benefits appeared to be related, in an urban context, to the effects of transport and energy improvements on health care, free time, and access to information (Tables 6.18 and 6.19). In other words, benefits that were widespread and freely shared in rural communities in Thailand had a more restricted and income-dependent distribution in urban areas. As in the rural situation, respondents in urban areas who believed they had experienced net negative income impacts from road improvements shared distinctly less than others in other types of benefits, and were more likely to believe that the benefits of urban road improvements are skewed toward the rich. No urban households believed electricity had had a net negative impact on their incomes.

Relatively little difference in travel patterns was observed between urban households that perceived a posi-

Table 6.17. Perceived Income Impacts by Poverty Status

Perceived Income Impact	Percentage of Households (Urban)			
	Roads		Electricity	
	Poor	Nonpoor	Poor	Nonpoor
Positive Impact	47.0	53.0	50.0	50.0
No Net Impact	60.3	39.7	14.4	45.6
Negative Impact	62.5	37.5	0.0	0.0
Percentage in Sample	53.1	46.9	53.1	46.9

Source: Thailand study team field survey.

tive income impact of road improvements and those that perceived negative impacts or none. Almost all trips were work trips, and the greatest share were made by walking, followed by own motorcycles and public transport. However, a strikingly higher percentage of those who reported negative income impacts travel on motorcycles, while a remarkably low percentage of this group walked to work. This suggests that there may be something about urban road improvements that inhibits motorcycle transport.

The demographic data show that households perceiving positive income impacts from roads were slightly more likely to have young children and slightly less likely to have aged members, but the differences are small and probably not significant. Interestingly, households with negative perceptions of income effects from road improvements had higher average incomes than either of the other two groups. They also had the most assets and the highest debts, and gained a higher share of their income from driving cars for hire. They were less likely than others to be employed in the formal sector.

Table 6.18. Road Impacts Reported by Urban Households with No Income Impact
(Percent)

Other Impacts		Income Impact Category		
		Positive (55%)	None (37%)	Negative (8%)
Education	Better	82.6	65.4	43.8
	No Impact	15.7	34.6	50.0
	Worse	1.7	0.0	6.2
Health	Better	84.3	73.1	56.3
	No Impact	7.8	20.5	25.0
	Worse	7.8	6.4	18.8
Free Time	More	71.3	50.0	37.5
	No impact	25.2	48.7	62.5
	Less	3.5	1.3	0.0
Safety	Increase	81.7	59.0	50.0
	No Impact	3.5	20.5	18.8
	Decrease	14.8	20.5	31.3
Access to Information	More	91.3	76.9	50.0
	No Impact	8.7	23.1	50.0
	Less	0.0	0.0	0.0
Bonding Social Capital	Better	87.8	65.4	50.0
	No Impact	10.4	34.6	50.0
	Worse	1.7	0.0	0.0
Bridging Social Capital	Better	81.7	61.5	68.8
	No Impact	18.3	38.5	31.3
	Worse	0.0	0.0	0.0
Benefit Distribution	Equal	87.0	80.8	68.8
	Favors Rich	11.3	14.1	31.3

Source: Thailand study team field survey.

Table 6.19. Electricity Impacts Reported by Urban Households with No Income Impact
(Percent)

Other Impacts		Income Impact Category		
		Positive (29%)	None (71%)	Negative (0%)
Education	Better	86.7	44.3	0
	No Impact	11.7	54.4	0
	Worse	1.7	1.3	0
Health	Better	85.0	49.7	0
	No Impact	13.3	48.3	0
	Worse	1.7	2.0	0
Free Time	More	71.7	40.3	0
	No Impact	28.3	48.3	0
	Less	0.0	2.0	0
Safety	Increase	88.3	64.4	0
	No Impact	1.7	31.5	0
	Decrease	10.0	4.0	0
Information	Better	98.3	67.8	0
	No Impact	1.7	32.2	0
	Worse	0.0	0.0	0
Bonding Social Capital	Better	70.0	36.9	0
	No Impact	30.0	62.4	0
	Worse	0.0	0.7	0
Benefit Distribution	Equal	76.7	47.7	0
	Favors Rich	23.3	41.6	0

Source: Thailand study team field survey.

The picture that emerged was one of an entrepreneurial, upwardly mobile minority (this category had only 16 households, but the patterns were remarkably similar) that perceived road improvements as a barrier rather than an aid to income growth. More research is needed to fully understand this result.

The demographic picture for urban households perceiving no income impacts from electricity improvements was similar to that for urban households perceiving no or negative income impacts from road improvements. In this case, however, the households perceiving positive income impacts earned, on the average, considerably more than the households not perceiving such impacts. They were more likely to be employed in the formal sector or in commerce, including petty trading, while households that had not felt income impacts were more likely to be daily wage workers, informal employees, drivers of hired cars, or garbage collectors (ragpickers). Households with positive income impacts from electricity were more likely to have assets of all kinds, and also to have higher debts. These findings are not surprising, but may reflect factors other than lack of access to electricity that characterize poor urban households, especially in the Bailey slum of Nakhon Ratchasima.

Long-distance Transport (Road and Rail). In Thailand, both poor and nonpoor households frequently undertake long-distance trips. Most of this travel takes place on the interregional transportation networks, both road and rail. Long-distance travel was defined for this study as travel crossing provincial borders. Tables 6.20–6.22 summarize the trip purposes, destinations, and modal choices reported by the rural sample of households for long-distance travel.

The three main reasons why people travel long distances are to work or seek work, to visit relatives or friends, or for pleasure. Poorer households were more likely to travel for work purposes, while nonpoor households were more likely to travel for social reasons. Interestingly, the poor (though not the poorest) were slightly more likely than the nonpoor to engage in travel for pleasure. At least half of the travel undertaken by ultra-poor households was for work-related purposes. Bangkok was the major destination for long-distance travel, especially for ultra-poor households. About 60% of all trips to Bangkok were reportedly work-related.

Public buses or coaches were by far the most commonly used mode of transport for long-distance travel.

Table 6.20. Purpose of Long-Distance Travel by Rural Households

Other Impacts	Percent of Respondents			
	All Households[a] (n = 913)	Nonpoor (n = 441)	Poor (n = 136)	Ultra Poor (n = 318)
Work or Seek Work	36.4	28.3	30.9	48.7
Seasonal Jobs	1.8	1.1	1.5	2.8
Tourism or Pleasure	11.0	12.9	16.9	6.3
Visit Relatives or Friends	29.8	34.7	28.7	23.9
Attend School	1.8	1.4	2.2	2.2
Social Gatherings	3.7	4.8	3.7	2.5
Participate in Group Activities	1.1	1.6	0.0	0.9
Visit Doctors/Hospitals	1.1	2.0	0.7	0.0
Other	0.2	0.0	0.0	0.6
Reason Not Given	13.3	13.2	15.4	11.9

[a] Includes 18 "unclassified" households.

Source: Thailand study team field survey.

Table 6.21. Destination of Long-Distance Travel by Rural Households

Trip Destination	Percent of Respondents			
	All Households[a] (n = 913)	Nonpoor (n = 441)	Poor (n = 136)	Ultra Poor (n = 318)
Bangkok	50.7	34.0	36.0	50.0
Other Provinces, Other Region	19.8	24.7	14.0	16.7
Other Provinces, Same Region	26.8	28.3	34.6	21.7
No Answer	13.0	12.9	15.4	11.6

[a] Includes 18 "unclassified" households.

Source: Thaland study team field survey.

Table 6.22. Mode of Long-Distance Travel by Rural Households

Mode of Travel	Percent of Respondents			
	All Households[a] (n = 913)	Nonpoor (n = 441)	Poor (n = 136)	Ultra Poor (n = 318)
Public Bus or Coach	50.7	46.7	41.9	59.1
Personal Car/Motorcycle	11.5	14.3	11.8	7.5
Train	7.7	7.3	6.6	9.1
Hired Car or Truck	8.8	9.3	14.0	6.3
Ride with Others	3.9	5.7	5.1	1.3
Employer-Provided Transport	3.9	3.4	5.1	4.4
Other	0.0	0.0	0.0	0.1
No Answer	13.4	13.4	15.4	11.9

[a] Includes 18 "unclassified" households.

Source: Thailand study team field survey.

Almost 60% of the ultra-poor households used buses as the primary mode, while the number for all rural households was just over 50%. The second most important transportation mode was by personal car or motorcycle. Cars were more likely to be used by the nonpoor, while poorer households primarily undertook long-distance travel on motorcycles. Trains were used by only 7.7% of all rural households, but by a slightly larger share of ultra-poor households.

Both urban and rural households were asked to evaluate the net impacts of interregional roads. A majority of both groups gave a positive evaluation (Table 6.23). In rural areas, the poorest households and the nonpoor were even more strongly in favor of interregional roads than the simply poor. This difference may be explained by the fact that the poorest rural households depended more on livelihood strategies involving migration for employment, while the rural nonpoor were somewhat more likely to engage in long-distance travel for business or pleasure. In contrast, a slightly higher proportion of urban nonpoor households, compared with urban poor households, was in favor of interregional roads. This may perhaps indicate more extensive use of interregional roads by urban nonpoor households.

In Thailand, rail and bus service offer alternatives for long-distance passenger transport, for poor and nonpoor households alike.

Few rural households considered changing from one transport mode to another. Only 7% of the respondents said that they had considered such a change. Ultra-poor households were even less likely to do so. Those who had thought about making a change were primarily motivated by considerations of convenience and speed (time saving). Cost savings were not an important motivation for change.

Although only 7.7% of the rural households currently use trains, about 16% said that they planned to use trains sometime in the future, and about 13% of urban households also planned to do so (Table 6.24). However, a majority had made no decision on this question. Ultra-poor households in rural areas were slightly more likely than other rural households to plan on using the trains, while the poorest households in urban areas were notably less likely to express this intention than other urban households. Urban households with incomes close to the poverty line, however, had the highest expressed intention of using trains in the future. The main reasons that respondents, both urban and rural, thought they might use the train were low cost, convenient stops, convenient ride, and safety, as well as a few who said they "just want to try it." In giving reasons why they would not use the train, most rural respondents felt that train stations were not conveniently located in relation to their final destinations. Others simply felt they had no need to travel by train. In urban areas, the importance of these two reasons was reversed.

The study team interpreted these findings in light of the fact that most train stations are in the middle of towns and cities. Train travel was therefore more likely to be preferred by those whose destinations were in those locations, such as people traveling to work or to look for work in Bangkok. For those traveling to periurban, suburban, or rural destinations, however, train travel would not be the best choice.

Policy Impact

Conclusions and Recommendations

Infrastructure construction in Thailand has historically been aimed at promoting general economic development, both for the country and for the targeted areas. Up to now, little attention has been given to the question of whether this infrastructure is serving the poor. It has

Table 6.23. Evaluation of Interregional Roads, by Income Groups

Trip Purpose	All Households[a] (n = 913)	Nonpoor (n = 441)	Poor[b] (n = 136)	Ultra Poor[c] (n =318)
	Percent of Rural Respondents			
Net Positive Impact	86.5	88.2	84.6	87.4
No Net Impact	5.5	3.6	7.4	6.3
Net Negative Impact	1.4	1.6	2.9	0.6
Do Not Know	6.6	6.6	5.1	5.7
	Percent of Urban Respondents			
	All Households[a]	**Nonpoor**	**Poor[d]**	**Ultra Poor[e]**
Net Positive Impact	89.0	92.9	89.6	76.5
No Net Impact	3.3	1.0	5.2	5.9
Net Negative Impact	0.5	1.0	0.0	0.0
Do Not Know	7.2	5.1	5.2	17.6

[a] Includes 18 "unclassified" households; [b] households with incomes below but within two standard deviations of the rural poverty line; [c] households with incomes lower than two standard deviations below the rural poverty line; [d] households with incomes above the urban poverty line but below the sample median; [e] households with incomes below the urban poverty line.

Source: Thailand study team field survey.

Table 6.24. Planned Use of Trains, by Income Groups

Will Use Trains?	All Households[a] (n = 913)	Nonpoor (n = 441)	Poor[b] (n = 136)	Ultra Poor[c] (n = 318)
	Percent of Rural Respondents			
Yes	15.7	15.4	15.4	16.4
No	21.5	17.2	23.5	26.4
No Answer	62.8	67.3	61.0	57.2
	Percent of Urban Respondents			
	All Households[a] (n = 209)	**Nonpoor** (n = 98)	**Poor[d]** (n = 77)	**Ultra Poor[e]** (n = 34)
Yes	13.4	11.2	19.5	5.9
No	14.4	16.3	14.3	8.8
No Answer	72.2	72.5	66.2	85.3

[a] Includes 18 "unclassified" households; [b] households with incomes below but within two standard deviations of the rural poverty line; [c] households with incomes lower than two standard deviations below the rural poverty line; [d] households with incomes above the urban poverty line but below the sample median; [e] households with incomes below the urban poverty line.

Source: Thailand study team field survey.

been assumed that high economic growth would necessarily promote poverty reduction. While the positive impacts of infrastructure are largely taken for granted, their potential negative impacts have recently been the subject of discussion. Concern over the unequal division of benefits from past economic development has generated resentment among some groups, which reflects on infrastructure improvements as part of the overall development program. Some arguments have been advanced implying that poor people actually suffer from the expansion of infrastructure put in place at both the national and subnational levels.

In this study, poor people (and others living in relatively poor communities, having emerged from poverty in recent years) were asked to identify the links between road and electricity improvements and their own lives, assessing the net impacts of this infrastructure from their own viewpoints. Following are some of the main conclusions of the study:

- Most of the poor people in this study (close to 90%) believed that roads and electricity had net positive impacts on their lives. The benefits came in various ways: through increased income, improved health care and education, allowing more free time, greater safety and security, more social participation, etc.
- Electricity was viewed as being less closely related to occupational change than road improvements. However, focus group discussions and casual observations revealed that electricity could provide additional sources of income.
- Contrary to popular beliefs, respondents did not view roads and electricity as being related to household debts.
- However, a minority of respondents viewed the infrastructure negatively. Both opinion surveys and case study methods obtained such results. More study is needed to investigate in detail how these negative outcomes were possible.
- The urban poor are more likely than the rural poor to have negative evaluations, although only a minority of respondents hold these views.
- Most interviewed households did not see the distribution of benefits as biased, toward either the poor or the nonpoor.
- In the econometric study, it was found that the availability of good-quality (paved) roads contributed the most toward raising income of both poor and nonpoor households.
- Household-level road access did not seem to provide additional influence on household incomes beyond that which came about with village road access.
- Household expenditure increased with income as well as other factors, such as higher transportation expenses (which were offset by reduced traveling time). Access to electricity also induced higher expenditure, presumably through the purchase of electric appliances and payment of electricity bills.
- The impacts of roads and electricity were sometimes felt differently according to gender. The most obvious difference was their positive effects in increasing travel and transportation safety for women. Women's educational opportunities and income-generating capacity increased as a consequence (Box 6.4).
- For the poor, the purpose of long-distance travel was mostly job-related; they travel either to look for jobs or to visit their hometowns. For the nonpoor, visiting relatives or friends was more frequent. Bangkok was by far the most important destination.
- Convenience and speed were major considerations in modal choice for long-distance travel, more important than the expense. This means that the time savings, comfort, and convenience associated with road travel,

Most poor people in this study believed that transport and energy contributed to poverty reduction, and that roads contributed most of all.

in comparison with rail, had real value, for both the poor and the nonpoor.

The Thailand study team concluded that the most important research result with policy significance was that poor people, in areas that have benefited from improved access to transport and electricity, perceive important benefits from the construction and upgrading of these infrastructure services. This conclusion was confirmed both by the econometric analysis and by the subjective evaluation provided by local people. This finding is important in a context where concern is increasing over the possible negative impacts of such infrastructure on the poor.

Although the econometric analysis does not provide strong evidence in favor of the poor getting equal or disproportionately greater (income and wealth) benefits from road and electricity improvements, it does support the hypothesis that the poor share in these benefits. The fact that the poor believe that they share equally in these benefits is an important social (and political) fact in itself, and warrants further research to explore whether it is really true.

Given that the study findings support the expanded delivery of transport and energy services in both rural and urban areas, the study team made the following recommendations to improve the poverty focus in implementing national infrastructure programs:

- *Target areas more carefully in infrastructure planning.*

Although Thailand now has almost universal coverage of rural villages with roads and electricity, some small areas are still underserved. The Wung Kata district selected for this study is a good example. It is located in the mountain foothills and thus has less good road access than other areas. The study has also showed that even in villages that have been reached by roads and electricity, some households have more difficult access to these services than others. Also, the Nakhon Ratchasima urban sample shows that even if electricity is readily available in the community, some households may not be connected. Thus, targeting may need to go below the village level and ensure that "pockets of poverty" within communities are reached.

At a more general level, poverty reduction policy in Thailand is now becoming more area targeted. Because the absolute poverty level is now below 10 percent, it is perhaps approaching a "chronic poverty level." The chronically poor are by definition those small groups of poor who are not benefiting from favorable economic conditions, and therefore remain, or are "trapped," in poverty. In order for chronic poverty to endure, some kind of structural impediment must prevent these people from receiving the fruits of economic growth. Although some would argue that social exclusion is the main cause of chronic poverty, lack of communication with the outside world, due to limited road and/or electricity access, can be seen as a form of such exclusion.

- *Decentralize the management of public resources for roads and electricity construction and service provision.*

The study did not conclusively find that the benefits from roads and electricity were distributed disproportionately in favor of either the poor or the nonpoor. However, it is a general fact that both roads and electricity were often provided to the better-off households in the villages before the rest of the villagers (see Box 6.2 for the viewpoint of a villager in Nakhon Ratchasima). This happens for both economic and political reasons. For efficiency reasons, the first village road and first electricity connections almost always reached the "village centers," where

Box 6.4. Gender Aspects of Roads and Electricity

The Thai study found some interesting gender-related impacts of the road and electricity interventions. For one, safety considerations play an important role in gender-specific behavior. Typically, Thai family heads place a high priority on the safety of women family members when deciding whether they can take up activities outside the home, including travel to work or to school.

In rural areas, better roads, reduced travel time, and more streetlights have increased safety. This has permitted women to gain access to more education, as higher education is often only available by traveling to the city or town centers.

In urban areas, women discovered more income-earning opportunities, also due partly to increased transportation safety. Less concerned about traveling after dark, Somsri, a resident of Thepleela community in Bangkok, can now work overtime. She said pickpocketing is now much less frequent. Men can also now sell noodles as late as midnight and earn extra income.

Women also benefited more than proportionately from the increased social interaction that road safety has promoted. Rural women participated in more group meetings and stayed at meetings longer due to better lighting conditions. More convenient and safer travelling to city and town centers also allowed women to "open their eyes" and see more of the outside world.

Source: Thailand study team.

economic activities are concentrated. Moreover, those with local political power would want to grant priority to their constituents in road access and electricity.

One way to enhance access by the poor to infrastructure is through fiscal decentralization to the local authorities. Although putting public money directly into local hands is not entirely free of local politics, some evidence shows that a properly designed decentralization makes services work better for the poor than centralized planning and service delivery. With the growing awareness of "citizen power" and "grass-roots movements," local governance can be improved with more participation from both the poor and nonpoor members of the local communities.

The availabiity of good-quality paved roads contributed most toward raising incomes—and makes it easier to sell ice cream as well.

- *Consider considerations in planning infrastructure interventions.*

Although little evidence emerges from this study concerning gender inequality in gaining benefits from roads and electricity, one of the focus group discussions indicated that in some ways women might benefit more than men from better availability of this infrastructure. The prime example is that women benefit more from increased safety when traveling along lighted roads, instead of through farm fields or jungles. This is not to say that women are now safer then men are, but rather that in the past, without lighted roads, women have suffered more from lack of safety than men did. Providing more lighted roads thus enhances gender equality. The policy implication is that street lighting should be provided as part of any package of road improvements in populated areas.

Other areas may emerge where infrastructure project designs can be made more responsive to the specific needs and concerns of women. For this reason, consultation with local women's groups in planning new infrastructure investments is strongly recommended.

- *Ensure equitable access to services for all.*

Thailand is a country approaching universal access to roads and electricity infrastructure. Consideration is now shifting toward the question of how to ensure universal access on an equitable basis. Urban poor families are still paying higher unit costs for electricity than the rural poor (and nonpoor), and the rural poor are still paying higher unit costs for both transportation and electricity than their nonpoor neighbors. One reason for this is that the poor often have to obtain these services by buying them from their nonpoor neighbors, paying a premium over the true costs.

It is the obligation of the Government to eliminate any man-made barriers to access that discriminate against the poor. Some regulatory constraints should be removed or modified to ensure equal access. For example, the requirement that the houses of the urban poor be registered with the Ministry of Interior before electricity connections are allowed should be compromised. This is being done in some areas on a pilot basis, but not yet as a matter of consistent policy. Subsidies to electricity connection costs for the poor should continue, and should be granted even to the poorest of the poor. Once connected, even the poorest households have demonstrated the ability to meet their electricity consumption costs.

The poor should be presented with transportation options with varying costs. This is not as much a problem in urban as in rural areas. In urban areas, low-cost transportation is readily available to the poor. In these areas, the quality of the service is of greater concern. The rural poor, however, normally have limited options and face high transportation costs, especially when in urgent need, such as when rushing seriously ill family members to get proper medical attention. While providing regular low-cost transportation to the rural poor nationwide may be prohibitively costly, rural emergency services should be initiated.

- *Increase competition in infrastructure service provision.*

Transportation services in Thailand are mostly competitive. However, some sections of the transportation network are still protected by monopoly power. For example, furnishing some modes of interprovincial transportation requires government licenses that are limited by quotas. Within these quotas, licenses may be acquired through procedures that do not necessarily allow for open and transparent competition among service providers. This lack of full competition unnecessarily raises transport costs. On the other hand, in some areas no regulatory monopoly exists, but forms of private monopoly have arisen from the complex power structure of local politics, or "gun power." In these areas, the Government may want to promote greater competition, possibly by providing public transportation alternatives. As to electricity, power generation is still in the hands of a single state monopoly, which is not operating at peak efficiency, due mainly to the lack of competition. Although moves have been made in the past to encourage private generators (IPPs and SPPs), the results are still less than satisfactory. Room for improvement certainly exists in this area.

While Thailand now has almost universal coverage of roads and electricity, some small areas, like this slum in Nakhon Ratchasima, are still underserved, and targeting is needed to reach these "pockets of poverty."

Priorities for Future Research

The Thai study team identified the following topics calling for additional research, based on the findings of this study.

- *Replication of the surveys in more developed areas.*

As one of the participants in the national seminar pointed out, the results from the survey in this study can only be regarded as relevant to the areas under study. Generalizations must be made with care. Although the survey sites were somewhat different in terms of poverty status (the southern site, for example, was less poor), they were all the poorest districts in their provinces. Similar surveys in more affluent areas may yield different findings. Repeating surveys of this scale is costly, however, and should only be done with careful design.

- *Detailed study on impact mechanisms (at micro and macro levels).*

The findings on impact mechanisms in this study were obtained from interviewees, and are subjective by nature. The econometric analysis was limited by available data on the magnitude of impacts and did not allow for a study of the mechanisms by which these impacts might be achieved. More objective research should be implemented on the impact mechanisms, in order to either accept or reject the study findings on the subjective mechanisms reported by local people. The methodology might include setting up either micro or macro models that test different channels of impact mechanisms, using time series data drawn from a panel of households.

- *Distribution of benefits.*

Perhaps the most interesting research would go more deeply into the distribution of benefits from infrastructure construction and service provision. It should be a firm conclusion by now that the poor do benefit from infrastructure, but how much they benefit and whether they could benefit more than they do are important and relevant questions. Research on the distribution of benefits can be done simultaneously with the study of impact mechanisms mentioned above. The poor and nonpoor may benefit through different channels (albeit connected): for example, the nonpoor may enjoy higher crop prices, while

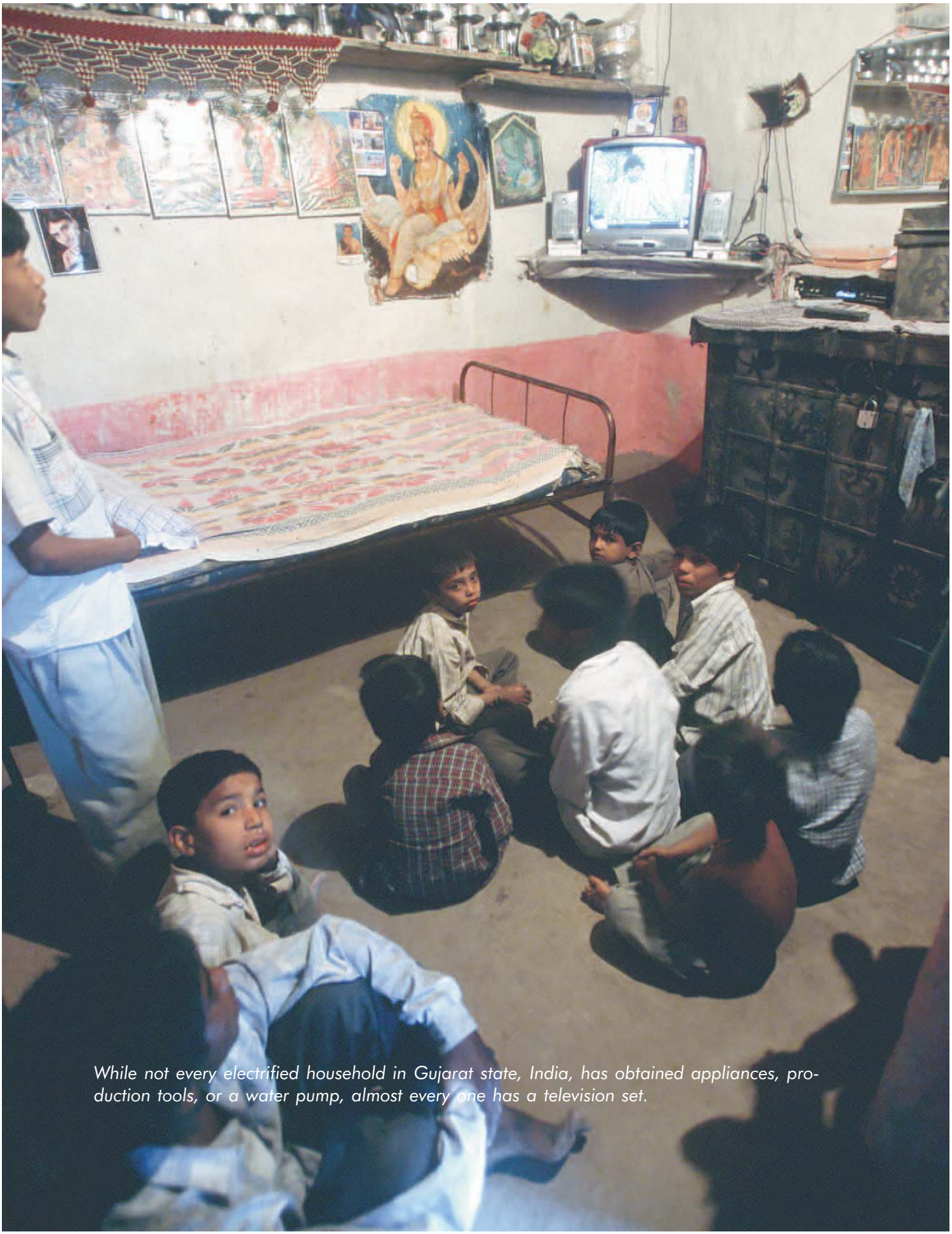
the poor gain higher wages from working for the nonpoor. The use of a computer generated equilibrium model could ensure that the distribution of benefits was well defined and clearly measured.

- *Study of cross-subsidization in public electricity provision.*

The electricity provision system in Thailand features cross-subsidization from the residents of Bangkok to others, and also from urban residents to rural residents. This cross-subsidy violates efficiency criteria, and abolishing this system and introducing marginal cost pricing has been discussed. However, the universal provision principle may require cross-subsidy if financing for the poor from the central government budget is not an option. Research is needed to find a socially acceptable balance between the efficiency principle and the principle of universal access, through the use of social preference functions.

- *Role of the private sector.*

In Thailand, except for some road transportation services, the Government plays an active role in both the construction of transport and energy infrastructure and the provision of transport and energy services. To date, with the exception of road transport services, only limited contributions have come from the private sector. For some services, the provision of public goods must be addressed, as it can be costly in practice to internalize the economic benefits from the private use of infrastructure (for instance, collecting tolls for every road section). However, room for greater private sector participation certainly exists. More research is needed to determine a suitable model for private sector participation. For instance, what segments of the transport and energy infrastructure (construction and services) should be delegated to the private sector and at what prices/fees? What level of regulation is needed to guarantee the quality of services? More important, the implications of private sector participation for poverty and the life of the poor should be highlighted. Such research could become the basis for the formation of future policy on private sector participation.



While not every electrified household in Gujarat state, India, has obtained appliances, production tools, or a water pump, almost every one has a television set.

Chapter 7

INDIA COUNTRY STUDY

National Context

India is a very large country with a population of more than 1 billion, representing approximately one third of the population served by ADB and one sixth of the world population. Its gross national income per capita in 2001 was about $460, equivalent to $2,450 at 1993 purchasing power parity.[24] This places India among the lowest-income countries in the world. The country is densely populated (about 350 persons per square kilometer [km^2]), and still predominantly rural. According to 1997 data, 44 million people in India were living below the international "extreme poverty" line of $1 per day, and 86 million people were living on less than $2 per day. Inequality in India is slightly higher than in other South Asian countries, with a Gini index of 37.8. Social welfare indicators are moderate: the average life expectancy is 63 years and the adult illiteracy rate is 43%.

A balance of payments crisis in 1991 temporarily slowed India's economic growth and triggered a process of widespread economic policy reform. This process relied heavily on privatization of public enterprises and reduction of public expenditures and public debt. The impact of these reforms on poverty reduction is the subject of much discussion. Many of the reforms were not fully implemented, and public revenues declined along with expenditures. The response of the private sector was not as strong as expected. India now needs to achieve rates of more than 7% annual real gross domestic product (GDP) growth in order to sustain progress in reducing poverty. The target for the Tenth Five-Year Plan (2002–2007) is an annual GDP growth rate of 8%.

Poverty Reduction

India has made steady progress in reducing poverty since the mid-1970s, paralleling the growth of agricultural output and public investment in infrastructure and human capital development (World Bank 2000b, updated in World Bank 2003c). In the last decade, however, the rate of poverty reduction has slowed, notably in the rural areas where over 70% of the poor population live, and especially in the poor states of India's Northeast. These states have experienced slower growth, fiscal problems, inappropriate incentive frameworks, and problems in governance, all of which have reduced the maintenance of infrastructure and the provision of social services and poverty programs to the poor. Agricultural subsidies, which in the past have promoted growth, now seem less effective, while their costs are limiting the ability of states to support social spending. The proportion of people living on less than $1 a day declined from 46% in the early 1990s to 39% in 1999–2000.

Because of its size, domestic research capacity, and good socioeconomic data, India has always been of great interest to students of development. Much of the thinking that helped development planners to shift from considerations of economic growth alone to a greater focus on poverty reduction originated in India. Concern about the relationship between growth and poverty reduction stimulated a major World Bank study covering India's 15 major states and using data from 20 household surveys conducted between 1960 and 1994 (Ravallion and Datt 1999). The study measured the elasticities of poverty in relation to farm yields, nonfarm output, and development expenditures in different sectors. The study showed that the effects on poverty of changes in agricultural productivity did not differ significantly from one state to another. The effects on poverty of changes in nonfarm (urban and rural) output, however, varied considerably, depending in part on rural infrastructure endowments. The growth process in states with lower farm productivity, greater disparity between urban and rural living standards, and lower literacy rates was less pro-poor.

A follow-up paper (Datt and Ravallion 2002) compared progress on poverty reduction in the prereform and postreform period to ask why India's success in economic

[24] Data in this paragraph are taken from World Bank (2003a).

growth has not done more for the poor. An answer was found in the sector and geographical distribution of growth, which has not taken place in the states where it would have the greatest impact on poverty. States with relatively low levels of rural infrastructure endowments and education were less able to translate growth into poverty reduction. Thus, future investments should focus on redressing current inequalities between urban and rural infrastructure and investment in human capital.

A recent ADB review, using India's national poverty line, estimates that the number of poor in India declined during the 1990s from about 287 million in 1993–1994 to about 274 million in 1999–2000, including 210 million in rural areas and 64 million in urban areas (Sundaram and Tendulkar 2001). These figures correspond to a decline in the headcount ratio from 34% to 29% in rural areas and from 26% to 23% in urban areas during the reform period. This study suggests that more poverty reduction took place during the reform period than in the 10-year period immediately preceding it, when rural poverty was reduced but urban poverty increased, so that the absolute numbers of the poor remained about the same. Another positive development in the postreform decade has been a widespread increase in adult literacy, although more so for men than for women.

India's poverty reduction strategy includes more and better-targeted spending on education and health care services for the poor, as well as on rural infrastructure, accompanied by regulatory reforms to improve the climate for investment and encourage employment of the poor. The strategy explicitly proposes cuts in irrigation and energy subsidies and privatization of the power sector to reduce the unsustainable debt of the poorer states and to release funds for social and infrastructure spending. The possibility of seeking greater private sector participation in infrastructure investment has also been raised in this context.

At the national level, three different poverty alleviation programs are targeted to the rural poor. Two are labor-based, employment-generating public works programs; the third provides finance for self-employment in small enterprises. These programs are complemented by a policy environment that is intended to promote private investment in labor-intensive enterprises in agriculture, industry, and services. In addition to these central government initiatives, India's different states play an active part in creating the policy environment and providing public investment for economic growth and poverty reduction. Significant variation in performance at the state level may be related to significant variation in poverty reduction outcomes across the states.

Transport Sector Policy

In the past, India's public sector made most infrastructure investments, including both central and state governments. However, poor asset management and maintenance, as well as the inability to recover the costs of supplying these services from the users, led to large inefficiencies and large losses in these sectors. Despite some initiatives to attract private sector participation in infrastructure investment, such participation remains low. The key problem preventing the private sector from investing is the lack of an appropriate regulatory framework that allows for cost recovery through user charges while keeping services affordable to the poor.[25]

Recent major programs in road development include the "Golden Quadrilateral" project to upgrade trunk roads connecting the four major metropolitan areas of Delhi, Mumbai, Chennai, and Kolkata; the National Highways Development Project; and the Prime Minister's Rural Road Program. ADB and the World Bank have been supporting each of these programs. A Central Road Fund was created in 2000, funded by taxes on gasoline and diesel fuel. The diesel fuel tax is allocated to the development and maintenance of national highways, state roads, rural roads, bridges, and railway lines, including safety work on unmanned railway crossings. A model concession agreement has been developed for large privately funded road construction projects.

India has one of the largest railway systems in the world, with a network of over 63,000 km. Railways are constructed, maintained, and operated by Indian Railways. Like any other public utility, Indian Railways runs some uneconomic operations due to social obligations (second-class passenger service and movement of essential commodities). These activities are cross-subsidized by profit earned through freight services and higher classes of passenger travel. Partly due to this cross-subsidization and increases in administrative expenses, Indian Railways has experienced an increasing financial burden and a decline in transport sector market share. As a result of these problems, the Ministry of Railways has established a reform program with a view to operating railways on more commercial lines, modernizing the railway system, and expanding its capacity to serve the emerging needs of the growing economy.

India has a long coastline (about 7,000 km) and many ports of entry: 12 major ports and 184 intermediate and minor ones. Given the dominant role of containers in

[25] This discussion is based on Government of India (1996).

international trade, the capacity to handle container traffic is central to the future of India's ports. The majority of containers that move through the country are transshipped through the ports of Colombo (Sri Lanka), Singapore, Dubai, and Salalah (Oman). This results in delays and much higher transaction costs. Therefore, it is proposed to develop hub ports on the east and west coasts of the country and an international container transshipment terminal in Cochin.

Current policy encourages private participation in new port construction and operation, either in joint ventures with state or national authorities or as a completely private operation. Many initiatives have been taken to attract

India has a massive program for providing rural habitations with all-weather road connectivity.

private sector investment in ports. More than 40 projects involving an investment of over Rs1 trillion are at various stages of development. To corporatize major ports, the Major Port Trusts Amendment Bill (2001) was introduced in the Parliament.

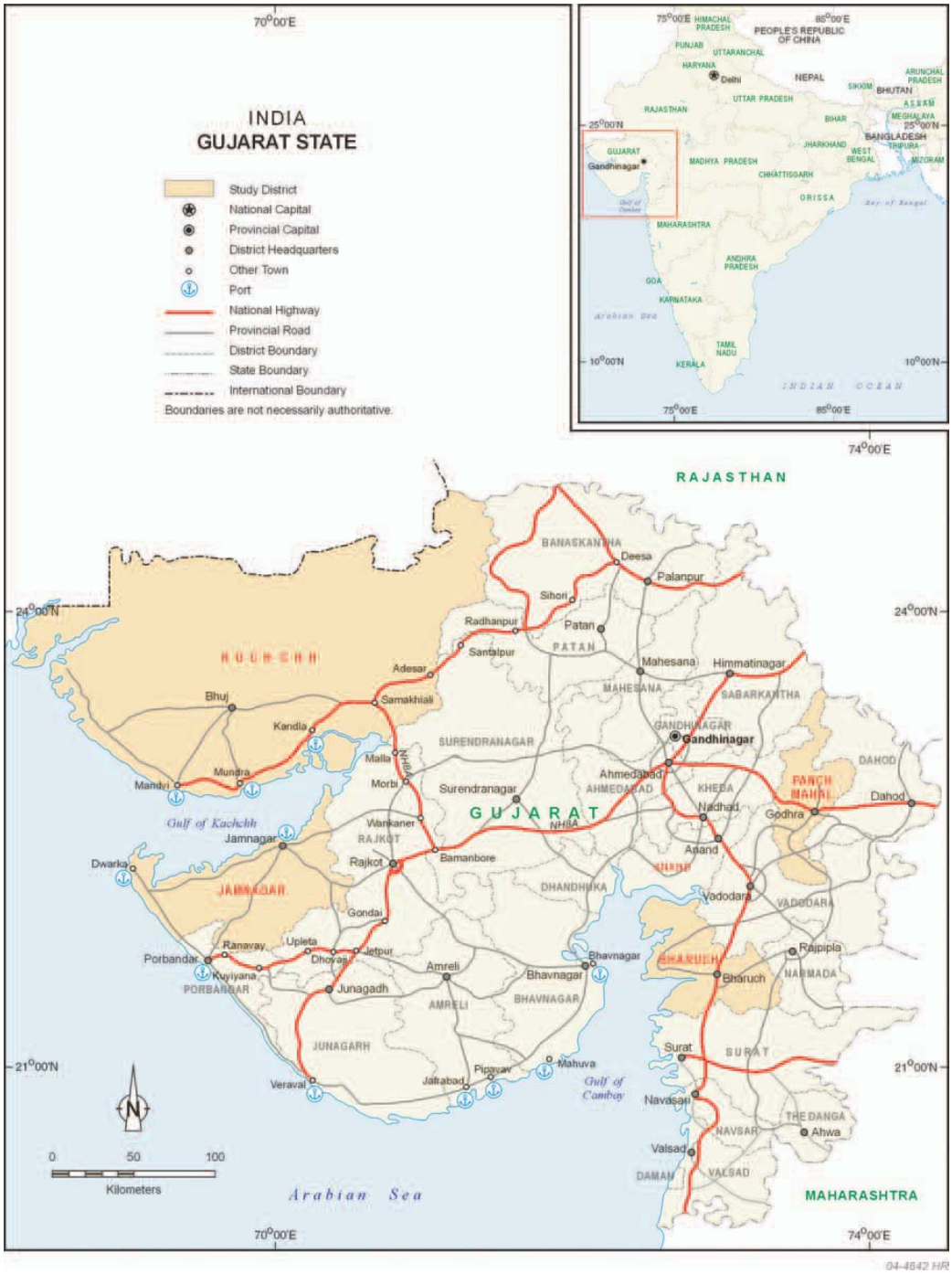
Energy Sector Policy

In the past, the Government of India has invested heavily in electricity infrastructure and in subsidizing service to agricultural and domestic consumers. Electricity services, from power generation through transmission and distribution, were provided by State Electricity Boards (SEBs). These boards were often subject to local political influence. Consequently, they found it difficult to collect revenues or to charge rates that would recover their costs. Excessive borrowing in the energy sector by both the central and state governments was a contributing factor in the economic crisis of the 1990s. Following the crisis, the central Government set up an Expert Group on Power to review the situation and make policy recommendations. The main lines of the proposed reform included unbundling energy services and privatizing them where possible. The role of the SEBs was to be transformed into a regulatory commission ensuring that the public interest is served by privately operated utilities.

State-level regulatory commissions were created in 22 states, and a scheme was developed to resolve cross-debts between the states and the central utilities. To provide financial assistance to states for undertaking renovation and modernization programs, a new plan known as the Accelerated Power Development Programme was launched. State governments are being encouraged to sign memoranda of understanding with the central Government on energy sector reform. At the time of writing, 21 state governments had agreed to undertake reforms in a time-bound manner. However, the SEBs continued to be subject to political influence, so that tariff orders issued by the regulatory commissions were not always fully implemented. The central Government's objective was to provide "Power for All" by 2012, by progressively connecting smaller villages to the network.

Case Study Context: Gujarat State

Gujarat is one of India's more progressive states. It has a successful record of poverty reduction. Located in the northwest part of the country, Gujarat has a strong entrepreneurial tradition and a history of being open to external trade and private investment. Being on the coast, it offers a variety of possibilities for study of different transport and energy interventions (road, rail, ports and shipping, rural electrification) that have taken place over the last 10 years. It also has a strong tradition of cooperative action and community initiative. Gujarat was the home state of Mahatma Gandhi, India's moral leader during the struggle for independence. Recently, however, it has



been torn by ethnic violence and by political and religious strife between Muslims and Hindus, mainly concentrated in the urban areas. In rural areas, Hindus and Muslims generally manage to live together peacefully.

The total area of the state is about 196,000 km^2, with a population of about 50 million. The population density, at 255 per km^2, is significantly lower than for the country as a whole. About 63% of the population lives in rural areas, compared with the national average of more than 72%.

Adult literacy is close to 70%, for both men and women, which is above the national average of 65%. Considerable variation can be found within the state in terms of terrain, population density, and production patterns. The northern part of the state bordering Pakistan is a near-desert. Scheduled tribes live in the northeastern foothills. In the central and southern parts of the state, however, are found a densely developed transportation network and intense economic activity, including both agriculture and industry in a rapidly urbanizing environment.

Gujarat State is the sixth largest state in India in net domestic product. In per capita income, however, the state ranks fourth, behind Maharashtra, Punjab, and Haryana. Only 17% of the state domestic product is accounted for by the primary sector, mainly agriculture. Only 34% of the cropped area is irrigated; the rest relies on the monsoon rainfall. As a consequence, dryland crops (groundnuts, cotton, and coarse cereals) dominate the state's cropping pattern. In recent years, the share of the primary sector has declined in favor of the secondary (industry) and tertiary (services) sectors. The state ranks first nationally in the production of cotton and groundnuts, and second in the production of tobacco. It is also known for ushering in the dairy revolution in the country. The industrial structure of the state is diversified, including chemicals, petrochemicals, fertilizers, engineering, and electronics. Chemicals, chemical products, and textiles dominate industrial output. The state is a major producer of inorganic chemicals such as soda ash and caustic soda, as well as phosphate fertilizers About 60% of the country's salt production takes place in Gujarat. The state also has the country's largest petrochemical complex, located in Jamnagar district.

In the past, the state invested heavily in infrastructure. The share of transport and energy investment in the Sixth Five-Year Plan (1980–1985) was 35% of all public investment; in the Seventh Plan (1985–1990) it was 31%, and in the Eighth Plan (1990–1995), 29% . More recently, however, a shift in emphasis has taken place toward providing social services. In the Eighth Five-Year Plan (1992–1997), only 17% was allocated for transport and energy investment, and in the Ninth Plan (1997–2002) the amount came down to 14%. This, however, still represented an investment of about Rs48 billion (more than $1 billion). Almost all of the villages in the state have been connected to the electricity grid for more than 10 years; about 94% are also connected by roads to the state and national highway network.

At present, private participation in infrastructure investment is being encouraged. The Gujarat Infrastructure Development Board has prepared a master plan for the state, in order to match supply with forecast demand in nine sectors: roads, rail, ports, airports, urban infrastructure, industrial parks, water, gas grids, and telecommunications. About 383 projects have been identified, involving a projected investment of Rs11.7 trillion ($252 billion), a major share of which is expected to come from the private sector. Some road projects were already being constructed under public/private partnerships, including the widening of the Vadodara-Halol and Ahmedabad-Mehsana roads from two to four lanes, and the construction of bridges across the Narmada and Mahi rivers. Roads leading to industrial locations were also being upgraded, with significant financial participation by the beneficiary industries.

Rapid growth in motor vehicle ownership is straining the Gujarat state government's capacity to maintain and enhance the road network.

Transport

Road policy in Gujarat focuses on imparting connectivity to all villages by all-weather (*pucca*) roads, and developing an adequate and efficient road system to meet all transportation needs. Gujarat had 73,600 km of roads in 2000/01, up from 67,100 km in 1990/91, an average growth rate of about 700 km per year. State and national highways accounted for 29% of the network, district roads

for 43%, and village roads for 28%. These shares did not change significantly over the 10-year period. A remarkable increase also took place in the number of registered motor vehicles in the state, from 1.84 million in 1990 to 5.58 million in 2001. About 70% of these vehicles were two-wheelers (motorcycles and mopeds). This rapid growth in vehicle ownership has strained the government's capacity to maintain and enhance the core road network. Congestion is rising, and although Gujarat's existing road network is qualitatively rated as the best in the country, it is insufficient to meet present demand and is in need of major upgrading. To tackle the various problems, the government formed the Gujarat Roads Development Corporation, to undertake construction and maintenance of roads and bridges throughout the state.

In 2000, the Gujarat State Road Transport Corporation (GSRTC) and private bus companies provided passenger transport services, while all trucking was privately owned. In March 2000, the share of the private sector in the bus fleet was about 74%, with GSRTC accounting for the rest. GSRTC, with 58,000 employees, operates 9,000 buses and runs large annual losses. In addition to being overstaffed, GSRTC was constrained to operate on uneconomic routes, often on unimproved roads that impose high operating costs. Revenues have not permitted timely repairs or renewal of the vehicle fleet. Consequently, most of the state buses were old and unreliable, if not actually unsafe.

Gujarat has a coastline of about 1,600 km. It has a major port, Kandla, and about 40 intermediate and minor ports that process 80% of the tonnage handled by the country's intermediate and minor ports. The Gujarat Pipavav Port Limited at Pipavav in Saurashtra district and Gujarat Adani Port Limited at Mundra in Kuchchh are the country's first "green field" ports, developed in joint venture between the public and the private sector on a build, own, operate, and transfer (BOOT) basis. The state's port policy, established in 1995, identified 10 more potential sites, four of which were being developed under public-private partnerships and six of which were to be exclusively for the private sector. Imports accounted for the bulk of the traffic passing through ports in the state, but exports also accounted for a significant share. The volume of cargo handled by Gujarat's ports has grown rapidly, although this growth was temporarily interrupted in 2001 by the consequences of a severe earthquake. Alang, one of the largest ship-breaking yards in the world, is also located in Gujarat State.

Energy

Gujarat was one of the first states in India to establish an Electricity Regulatory Commission, in 1999, although other states have been more proactive in implementing power sector reforms. A plan to restructure and unbundle the services provided by the Gujarat Electricity Board (GEB) was drawn up. As a step in this direction, a separate transmission company was incorporated as a GEB subsidiary. ADB has supported these reforms through the Gujarat Power Sector Development Programme. Gujarat announced a new power policy and a Power System Master Plan, which was to encourage further private sector participation in generation, transmission, and distribution. Installed electrical capacity in the state was 8,600 MW by the end of March 2001, nearly twice the installed capacity 10 years previously. Gross generation of electricity more than doubled during the period. GEB generated about half of this amount; the rest came from central and private sources. Since 1997, the private sector has significantly increased its share in installed capacity and power generation.

Gujarat, which has a coastline of 1,600 miles, has acquired two new privately owned ports, one of which is at Mundra.

About 45% of the electricity generated was reportedly consumed by the agriculture sector. This share may be overstated, however, as substantial subsidies were provided for agricultural power and its use was not metered; hence, utilities underreported the system's actual distribution losses by ascribing a significant portion of nontechnical losses and thefts to agricultural power supply. Industry consumed about 29%; the remaining 12% went to domestic uses. The backlog of applications for agricultural connections was large and growing. A scheme was developed to give priority to applicants who accept the installation of meters. About three fourths of all agricultural connections were being installed under this scheme.

The state has reached its goal of 100% electrification of rural villages.[26] In fact, practically all villages had been reached by electricity before 1991, i.e., before the beginning of the period covered by this study. Unserved hamlets in some villages were being electrified under the Tribal Area Sub Plan, financed by the state, and Rural Electrification Corporation schemes. The state was also providing grant funding for electrification of border areas in Kuchchh, Banaskantha, and Patan districts. Under the Jyoti Gram Yojana community development program, villages could choose to invest their block grants in a local energy supply system. Given the difficulties of assuring a reliable supply of grid electricity in rural areas, the Gujarat Energy Development Agency undertook to promote new and renewable sources of energy. It had an Integrated Rural Energy program providing parts of the state with a range of energy-efficient technologies.

Poverty

Gujarat witnessed a significant decline in poverty over the past two-and-a-half decades. Between 1973/74 and 1999/2000, poverty ratios in the state dropped from 52.6% to 15.6% (urban) and from 46.4% to 13.2% (rural). Much of this decline took place between 1987/88 and 1999/2000. As a result, the state had the fourth best record of poverty reduction in the country, behind Jammu and Kashmir, Kerala, and Rajasthan. Gujarat also ranked sixth among the states in terms of the Human Development Index, which captures other dimensions of socioeconomic welfare. Significantly, urban poverty is now more widespread than rural poverty in Gujarat. This can be attributed to the migration of poor rural households within the state and from other states in search of employment, especially to urban centers from drought-prone areas with little hope of improving agricultural productivity (Kundu 2000). Gujarat still shows significant rural-urban disparities in per capita consumption expenditure, life expectancy, infant mortality, and formal education.

Study Districts

An analysis of poverty reduction performance at the district level was conducted to determine the districts to be covered by this study. Based on data from the National Sample Survey (NSS) conducted in 1987/88, 1993/94, and 1999/2000, districts were classified into three groups: those that had achieved significant poverty reduction over the period, those with a persistently low incidence of poverty, and those with a persistently high incidence of poverty. State poverty lines for urban and rural areas were used to determine the poverty "headcount ratio" for each district.[27] Sample districts were then selected from each group in consultation with state government officials. Three districts were selected for the study: Jamnagar, which achieved very high poverty reduction in both periods; Bharuch, where poverty was relatively low at both the beginning and the end of the decade; and Panchmahal, the only district in the state with persistently high poverty. Kuchchh District, where significant poverty reduction took place mainly between 1993/94 and 1999/2000, was added to the sample in order to include a port project in the study.

Jamnagar. Jamnagar District is located on the southern side of the Gulf of Kuchchh. The district is made up of a low coastal plain broken by hills and sand dunes. It receives only limited rainfall. Historically, Jamnagar was one of the most important of the princely states in Saurashtra. It is predominantly Hindu but also has a population of Muslims, Jains, Christians, Sikhs, and Buddhists. A relatively small share of the population belongs to "scheduled castes" (untouchables), and "tribals" are virtually absent. The district is home to more than 1 million people, about half of whom live in Jamnagar City and 15 major towns. The other half live in about 700 rural villages. The main language spoken is Gujarati, but Kachchi speakers are

[26] With the exception of 88 "nonfeasible" villages in remote areas, with periodic flooding, heavy forest cover, and so on. Clearly these are also poor, disadvantaged, and vulnerable communities.

[27] The Gujarat state poverty lines for 1999/2000 were Rs318.94 per capita per month for rural areas, and Rs474.41 per capita per month for urban areas, corresponding to $82 (rural) and $122 (urban) in annual consumption expenditure.

also present (about 5%). Jamnagar District has a 200-km coastline and is well endowed with infrastructure. It has the country's largest petrochemical complex, as well as local industries such as brass works and textiles. The poverty level in Jamnagar District was 32% in 1987/88. By 1993/94 it had dropped to 16%, and by 1999/2000 it was less than 5%.

Bharuch. Bharuch District is located in the southern part of the state, in a densely populated and agriculturally productive area. Bharuch City is one of the oldest seaports in India, located at the mouth of the Narmada River on the Gulf of Khambat. It became an important Buddhist center in the 7th century, and under the Rajput dynasty (750–1300 C.E.) it was the chief port of West India. Exports include cotton, wheat, and timber, as well as industrial products such as textiles and other manufactured goods. Poverty levels in Bharuch District were already low in 1987/88 (14%), and by 1999/2000 had been reduced only slightly further (to 11%).

Panchmahal. Panchmahal District is located in the eastern part of the state, on the border with Rajasthan. The topography is hilly to mountainous and soils are relatively poor, although rainfall is usually adequate for dryland agriculture. A relatively high proportion of the population comes from hill tribes and has limited access to agricultural land. Panchmahal is the only district in Gujarat where poverty is still very high (38%, or nearly three times the state average in 1999/2000). Although Panchmahal has received some infrastructure investments recently, the rate of poverty reduction in this district is still very low.

Kuchchh. Kuchchh District is located on the north side of the Gulf of Kuchchh. It has an extensive coastline and has become the site of new port development, including the port of Mundra, whose impact is assessed in this study. Much of Kuchchh District receives low and irregular rainfall; access to water is always a problem. To the north it is bordered by the Rann of Kuchchh, a semi-desert area known for its wildlife refuge. Kuchchh is another district that achieved a good performance in poverty reduction over the past decade. In 1987/88 poverty in Kuchchh District was over 40%; by 1999/2000 it had been reduced to 16%. However, Kuchchh suffered more than other districts in Gujarat from the effects of the 2001 earthquake, which disrupted transport services and posed problems for the delivery of emergency assistance.

Methodology

Definition of Poverty

The case study employed the definition of poverty used in national surveys in India. The poverty line was determined based on normative food intake levels, equivalent to 2,435 calories per day for the rural population and 2,095 calories per day for the urban population. Equivalent values of food expenditure, plus an allowance for basic nonfood expenditures, were calculated from data collected during the 1972/73 NSS. These norms were updated to current years by applying changes in the Consumer Price Index of Agricultural Laborers for rural areas and the Consumer Price Index of Industrial Workers for urban areas. Since 1993/94, the poverty line has been calculated separately for each state on the basis of state-specific prices, adjusted for interstate price differentials.

For the purposes of this study, the India team calculated three measures of poverty for each subgroup within the sample: (i) the headcount index (proportion of people below the poverty line), (ii) the poverty gap index (average distance of household income from the poverty line, a measure of the depth of poverty), and (iii) the squared poverty gap index (a measure of the severity of poverty). The poverty line used in this study was Rs342.13 per month, corresponding to an annual per capita income of Rs4,105 or about $88 in 2003. The Gini index was also calculated for each subgroup within the sample to measure inequality.

Transport and Energy Interventions

Based on consultations with district officials in the selected districts, the study team identified four case study locations, defined as clusters of villages around recently improved district-level roads. Some villages are located close to the improved roads, while others are some distance away on unimproved roads or tracks. From each of the selected districts, one district road completed in the mid-1990s was chosen to form the basis for the study sample. The sample district roads range in length from 10 to 18 km.

In Jamnagar District, the sample road was Bagadhra-Butavodar-Mandason in Jamjodhpur *taluka* (block), which was completed in 1997–1998. The road length is about 18 km. It provides six villages in the block with access to block and district headquarters by connecting them to the state highway system. The distance from these villages to

block headquarters ranges from 20 to 40 km; the city of Jamnagar is 60–75 km away. All of the villages had primary schools located in the village, and most had post and telegraph services not very far away. Two of the six villages had middle schools and one had a girls' school, but other services, such as secondary schools, health services, marketplaces, and police and railway stations were generally located in block headquarters, or more than 10 km away from the villages.

In Bharuch District, the selected sample road is the Kalak-Madafar road in Jambhusar *taluka*. This road is 10.8 km in length and was completed in 1997–1998. The road connects six villages to block headquarters on the state highway. The villages are 5–13 km by road from block headquarters. The distribution of services was similar to that in Jamnagar district, but distances to service locations were generally shorter than in Jamnagar.

The sample road for Panchmahal district was the Palla-Padhora-Bakrol road in Ghoghamba *taluka*, also built in 1997–1998. The road is 13.3 km long and serves 13 villages. The distances from the villages to block headquarters range from 1 to 18 km. The distribution of services was similar to that in the other districts, except that the nearest railway station was much farther away, from 45 to 60 km depending on the location of the village.

In Kuchchh, Mundra Port, built on a BOOT basis by Gujarat Adani Port Limited, was selected for the study. Mundra Port, which began operating in 1998, is an all-weather port, well connected to the national road and rail networks.[28] It is a joint venture project of the Gujarat Maritime Board and the Adani Group. The port is capable of handling dry and liquid cargo and container ships up to 80,000 dead-weight tons. In approximately 4 years since port operations began, it has handled over 8 million tons of bulk cargo. Because of the advantages offered by the port, two new industries have located in the area. Five villages were selected for the study, located 18–25 km from the port itself and 2–9 km from block headquarters. Except for being far from district headquarters and the railway station at Kuchchh, most other services were located in or near the villages.

Research Methods

The study had two main objectives: (i) to evaluate the impact of interventions in transport and energy infrastructure on poverty reduction at the community, household, and individual levels; and (ii) to identify the direct and indirect mechanisms that produce these impacts on poverty. To achieve these objectives, the study used a combination of approaches, including village-level information, interviews with key informants from service agencies, household interviews with questionnaires, limited participatory focus group discussions, and supplementary secondary data analysis.

The National Council of Applied Economic Research (NCAER) study team prepared a detailed village questionnaire and filled it out in all 30 villages in the sample frame through interviews with key informants. The questionnaire covered economic and social infrastructure, with an emphasis on electricity, transport, health care, and education. The team also obtained information on distance from the road, distance from the main centers of activity, proportion of households with electricity, caste composition, and major economic activities. Basic household information was collected from all households in the sample frame. The list of households was then stratified into four groups in terms of distance from the *pucca* road (more or less than

Village residents in Bharuch district, Gujarat, exchange views with members of the study team.

[28] Pipavav, Gujarat's other privately operated port, has been less successful, due to its lack of a direct connection to the nation's rail network.

0.5 km) and household access to electricity. A total of 7,931 households were in the sample frame, about half of whom had electricity and half did not. About one third of the sample frame lived less than 0.5 km from the improved road; two thirds lived more than 0.5 km away.

A sample size of 2,600 households was selected, about one in three households in the sample frame. The sample size for each district was determined in proportion to the total number of households in the sample frame for each district. From each of the four strata, then, the household survey sample was drawn using systematic random sampling. When a selected household was not present or did not respond, replacement households were selected from the same district list by matching characteristics with the original household, including access to roads and electricity, caste, religion, primary occupation, and landownership. A detailed household questionnaire was designed to collect household and individual impact data as well as data on constraints experienced by the beneficiaries in accessing transport and energy services. Local field interviewers were recruited and trained by the NCAER survey team. A total of 2,591 households responded to the survey.

Gujarat has reached its goal of 100% electrification of rural villages, but has a long way to go before it reaches 100% of households.

In the four districts, in-depth focus group discussions were also carried out in selected villages. The aim of these discussions was to better understand the nature of the interventions, changes brought about by such interventions, and constraints in accessing services provided by the interventions. Ten of the 30 villages in the sample frame were selected for this purpose, with the aim of covering a variety of ethnic and economic groups. Two villages each were selected from Jamnagar, Bharuch, and Kuchchh districts, and four villages from Panchmahal district. During these discussions, a few individuals were also selected for profiling as individual case studies.

Sample Household Characteristics

As Table 7.1 shows, the sample design produced a set of households approximately equally distributed between the four groups of households with good road and electricity access, households with good road access but no electricity, households with electricity but poor road access, and households with neither electricity nor good road access. Slightly more than half (54%) of the electrified households also lived close to the *pucca* roads, while slightly more than half (53%) of the nonelectrified households lived more than half a kilometer from the *pucca* roads. Similarly, 51% of the households with good road access were electrified, while only 45% of the households with poor road access had electricity. Sample households were most likely to have both good road and electricity access in Jamnagar District, and least likely to have either in Panchmahal District. Households in Bharuch District had good road access but less access to electricity, while those in Kuchchh occupied a middle position.

Based on household survey data, the incidence, depth, and severity of poverty were calculated for the four subsamples at each site and for the four subsamples as a whole (Table 7.2). The results show a much higher incidence of poverty than the estimates made at the state level. The average poverty level for the entire sample was 64%. For sample households in Jamnagar, the poverty ratio was 32%, ranging from 29% (for electrified households near the road) to 40% (for nonelectrified households far from the road). In Bharuch, the average was 35%, but the results for subgroups varied from 18% to50%, being much higher for nonelectrified households (37–50%) than for electrified households (18–25%). In Kuchchh, the overall ratio was 52%, and poverty among the different subgroups varied from 42% to 58%. The poverty ratio was highest in Panchmahal (91%), ranging from 89% to 93% among the subgroups. Taken together, the study found a poverty level

of 48% among sample households with both good road access and electricity, 62% for households with electricity but not close to a good road, 68% for households without electricity but living close to a good road, and 76% for households that had neither good road access nor electricity.

What can explain these exceptionally high estimates? First, the locations studied have only recently been provided with good road access, and perhaps poor access has prevented poverty reduction from taking place sooner. It is also true that aggregate statistics can easily mask block-specific and village-specific variations in poverty, although it is difficult to imagine that the selected district road improvements would have served exceptionally poor villages in all cases. A third possible explanation may be the poor rainfall that the state received for the years prior to the field study.[29]

Average household and per capita incomes were also calculated for the poor and the nonpoor in each district and each subsample. Because of variations in household size (poor households tended to be larger), the differences in household income were less marked than the differences in per capita income. Results by district are summarized in Table 7.3.

With respect to religion, Hindus made up a large majority of sample households. In Jamnagar and Panchmahal, Hindus accounted for over 90% of the sample. In Kuchchh they accounted for almost 80%, and in Bharuch, the sample was about 60% Hindu. Most of the rest were Muslims, but each district also had a very small minority of Sikhs and Jains. Among the poor households, Hindus predominated slightly.

In Jamnagar and Bharuch, general category households and scheduled castes dominated the caste composition among the selected households. In Panchmahal, "scheduled tribes" and "other backward castes" constituted a large majority. The study area was predominantly a tribal area with scheduled tribes constituting more than two thirds of the sample households. In Kuchchh District, other backward castes made up the majority, with close to two thirds of the sample households, followed by scheduled castes, which are the second major caste group in Kuchchh.

The sample data suggest that caste is linked to the probability of being

Table 7.1. Sample Households by District and Access to Roads and Electricity

District	Access to Electricity	Road Access: Up to 500 m	Road Access: >500 m	Total
Jamnagar	Electrified	243 (45.8%)	134 (25.3%)	377 (71.1%)
	Nonelectrified	101 (19.1%)	52 (9.8%)	153 (28.9%)
	Total Jamnagar	344 (64.9%)	186 (35.1%)	530 (100.0%)
Bharuch	Electrified	74 (24.3%)	54 (17.8%)	128 (42.1%)
	Nonelectrified	110 (36.2%)	66 (21.7%)	176 (57.9%)
	Total Bharuch	184 (60.5%)	120 (39.5%)	304 (100.0%)
Panchmahal	Electrified	173 (14.65%)	263 (22.2%)	436 (36.8%)
	Nonelectrified	307 (25.9%)	443 (37.4%)	750 (63.2%)
	Total Panchmahal	480 (40.5%)	706 (59.5%)	1,186 (100.0%)
Kuchchh	Electrified	183 (32.0%)	122 (21.4%)	305 (53.4%)
	Nonelectrified	120 (21.0%)	146 (25.6%)	266 (46.6%)
	Total Kuchchh	303 (53.0%)	268 (47.0%)	571 (100.0%)
Total	Electrified	673 (26.0%)	573 (27.3%)	1,246 (51.9%)
	Nonelectrified	638 (24.6%)	707 (22.1%)	1,345 (51.9%)
	Total Sample	1,311 (50.6%)	1,280 (49.4%)	2,591 (100.0%)

Source: India study team field surveys, 2002.

[29] The results for the entire sample may also have been somewhat skewed by the relatively high proportion (46%) of responses from Panchmahal District.

Table 7.2. Incidence of Poverty in Sample Households
(Percent)

District	Close to Road		Far from Road	
	Electrified	Nonelectrified	Electrified	Nonelectrified
Jamnagar				
Head Count Index	28.4	36.7	29.6	40.0
Poverty Gap Index	5.0	7.3	6.1	7.9
Severity of Poverty	1.3	2.0	1.9	2.1
Gini Coefficient	30.4	22.1	30.5	27.7
Bharuch				
Head Count Index	24.9	50.1	17.6	36.8
Poverty Gap Index	3.8	9.7	3.6	8.4
Severity of Poverty	0.8	2.5	1.1	3.6
Gini Coefficient	29.6	23.7	19.3	21.6
Panchmahal				
Head Count Index	92.8	90.2	89.3	92.1
Poverty Gap Index	44.3	41.6	43.1	44.7
Severity of Poverty	24.0	22.8	23.9	24.8
Gini Coefficient	22.6	27.2	31.2	25.7
Kuchchh				
Head Count Index	42.1	56.7	57.7	56.0
Poverty Gap Index	16.9	25.7	25.0	32.6
Severity of Poverty	4.5	5.7	6.6	6.3
Gini Coefficient	33.1	25.7	28.3	27.8
Entire Sample				
Head Count Index	48.4	68.4	62.1	75.7
Poverty Gap Index	16.9	25.7	25.0	32.6
Severity of Poverty	8.1	12.6	12.9	17.1
Gini Coefficient	35.8	31.2	36.2	31.9

Source: India study team field surveys, 2002.

Table 7.3. Sample Average Annual Income by District

District	Average Annual Income (rupees)			
	Household		Per Capita	
	Poor	Nonpoor	Poor	Nonpoor
Jamnagar	17,411 ($377)	27,446 ($590)	2,968 ($64)	6,687 ($144)
Bharuch	20,896 ($449)	25,653 ($552)	3,265 ($70)	6,108 ($131)
Panchmahal	18,430 ($394)	16,912 ($364)	2,547 ($55)	4,832 ($104)
Kuchchh	20,611 ($443)	27,558 ($593)	3,747 ($81)	8,351 ($180)
Entire Sample	18,868 ($406	25,928 ($558)	2,816 ($61)	6,823 ($147)

Source: India study team field surveys, 2002.

poor or nonpoor. Whereas 70% of the general caste households were nonpoor, and more than half of the scheduled caste households were also in the nonpoor category, about 60% of the households from other backward castes were poor, and nearly 90% of those from scheduled tribes were poor, predominantly those still living in Panchmahal district. However, the econometric analysis conducted for this study did not show caste as a variable significantly affecting the probability that a household would be poor.

Illiteracy rates were higher among women than among men, and higher among poor households than among nonpoor households. Illiteracy appeared to be lowest in Jamnagar district, around 22% for men and 33% for women in poor households and somewhat higher for men (26%) and women (43%) in nonpoor households. Illiteracy appeared to be higher in Bharuch district among poor households, around 35% for men and 53% for women, while in nonpoor households it ranged from 31% for men to 56% for women. Illiteracy rates for men in Kuchchh district were comparable with those in Jamnagar, while for women they were worse (43% for poor women and 56% for nonpoor women). Illiteracy rates were highest in Panchmahal district (about 47% for men and about 62% for women, regardless of poverty status).

A majority of sample households in three of the four districts were employed in the agriculture sector. In Jamnagar district, 40% of the poor households and 57% of the nonpoor households were farmers, while 39% of the poor households and 24% of the nonpoor households were agricultural wage laborers, and 17% of the poor households and 10% of the nonpoor households were nonagricultural wage earners. In Bharuch district, only one fourth of the households had their own farms, and more households depended on agricultural wage labor. In Panchmahal District, a majority were farmers, but nonagricultural employment was also important, especially among the nonpoor. In Kuchchh, less than one fourth of the sample households had their own farms, and nonagricultural employment was more prevalent than agricultural wage labor. In all districts, occupations other than farming, agricultural labor, and nonagricultural labor represented only a very small minority of the sample, although Kuchchh district showed a slightly more diversified occupational profile (Table 7.4).

The average size of landholdings among the sample households was 2.4 hectares (ha) for poor households and 3.4 ha for nonpoor households (Table 7.5). The difference between poor and nonpoor households in the share of farmland irrigated was not significant. Among the four sites, sample households in Kuchchh had the smallest average farm size, while sample households in Bharuch had the largest landholdings. However, the sample farm households in Kuchchh had a higher irrigation intensity, especially electrified households. Given the small size of landholdings, the average household in all four sites would fall in the category of marginal and small farmers. On the average, poor households had smaller landholdings than nonpoor households in Jamnagar and Bharuch, but in Panchmahal and Kuchchh districts the poor households had larger landholdings than nonpoor households.

Because Gujarat is largely an unirrigated state, crops that can be grown in dryland areas dominate the cropping pattern (Table 7.6). The major crops in Jamnagar were groundnuts and cotton, which together account for 100% of the cropped area of poor households and 97% of the cropped area of nonpoor households. In Bharuch district, the pattern was dominated by a single crop, cotton, accounting for 83% of the cropped area of poor households and 82% of the cropped area of nonpoor households. The second most important crop in Bharuch district was wheat. Among the poor sample households of Panchmahal district, maize accounted for about 82% of the cropped area, followed by groundnuts. This pattern was even more strongly shown among nonpoor households. Sample households in Kuchchh had a more diversified cropping pattern: *bajra* (pearl millet) had become the dominant crop, with significant areas also devoted to wheat and cotton, and smaller areas to a variety of other crops, including fodder.

About three fourths of the poor sample households and about half the nonpoor households owned livestock (cows, buffaloes, and poultry). Livestock ownership was most prevalent in Panchmahal District, where the poor were even more likely to have livestock than the nonpoor, mainly because buffaloes were still being used for transport. In Kuchchh District, the poor were also distinctly more likely than the nonpoor to own livestock. In the other two districts, no great difference emerged between the poor and the nonpoor in patterns of livestock ownership.

Sales of farm products were the most important source of income for the sample households, followed in most cases by agricultural wages (Table 7.7). In Jamnagar District, farm sales and agricultural wages contributed over three fourths of total income for both poor and nonpoor households. In Bharuch, they accounted for about 60% of all income, but the share of wage income was much higher, consistent with the occupational pattern. Farm income was important for the poor in Panchmahal, but relatively little came from agricultural wages. This pattern was even more marked for the nonpoor in Panchmahal, who derived only 38% of their income from agriculture, relying more heavily

on nonagricultural wages and government salaries. In Kuchchh, only 43% of the income of poor households and 23% of the income of nonpoor households came from agriculture. Nonagricultural wages, salaries (especially in nonpoor households), and business and trade accounted for the majority of household income in Kuchchh.

Table 7.4. Distribution of Sample Households by Occupation
(Percent)

	Jamnagar		Bharuch		Panchmahal		Kuchchh	
Occupation	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**
Farmer	40.2	56.5	17.0	28.1	66.4	52.3	21.0	21.0
Farm Laborer	38.6	23.6	47.3	32.3	11.1	4.6	12.1	12.1
Nonfarm Laborer	17.4	10.3	22.3	19.3	11.6	23.9	35.3	35.3
Government	0.8	3.0	3.6	5.2	4.5	10.1	2.6	2.6
Nongovernment	0.8	0.5	5.4	6.3	1.5	1.8	11.0	11.0
Business	0.0	2.5	0.0	4.7	2.0	1.8	1.8	1.8
Self-employed	1.5	1.5	2.7	2.1	1.8	3.7	12.1	12.1
Other	0.8	2.0	1.8	2.1	1.0	1.8	4.0	4.0

Source: India study team field surveys, 2002.

Table 7.5. Distribution of Sample Households by Size of Landholding
(ha)

	Jamnagar		Bharuch		Panchmahal		Kuchchh	
	Poor	**Nonpoor**	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**
Average Farm Size	2.4	4.6	2.6	5.2	2.4	1.3	2.0	1.4
Percent Irrigated	14.1	11.2	0.7	0.6	0.0	0.0	74.0	78.3

Source: India study team field surveys, 2002.

Table 7.6. Distribution of Sample Cropped Area by Crop
(Percent)

	Jamnagar		Bharuch		Panchmahal		Kuchchh	
Occupation	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**	**Poor**	**Nonpoor**
Cotton	40.2	44.8	83.3	82.3			10.1	13.3
Groundnut	59.8	52.1			9.7	2.8		
Wheat			13.2	11.1			23.5	23.3
Maize					82.2	95.0		
Bajra (Pearl Millet)							48.8	46.3
Others	0.0	3.1	3.5	6.7	8.1	2.2	17.6	17.1

Source: India study team field surveys, 2002.

Table 7.7. Sample Household Income by Sources
(Percent)

Source of Income	Jamnagar		Bharuch		Panchmahal		Kuchchh	
	Poor	Nonpoor	Poor	Nonpoor	Poor	Nonpoor	Poor	Nonpoor
Sale of Farm Products	40.3	56.4	23.9	32.6	52.2	34.1	27.2	15.3
Agricultural Wages	36.8	18.8	39.0	26.1	10.4	3.9	15.4	7.3
Nonagricultural Wages	17.1	8.2	20.4	13.7	13.1	19.8	29.4	24.1
Government Salary	1.0	6.9	6.4	9.7	9.6	25.7	4.8	5.7
Nongovernment Salary	0.3	0.5	5.9	7.5	3.1	4.0	3.2	26.8
Business/Trade	0.0	2.2	0.0	5.0	3.1	4.9	0.0	3.3
Other	4.5	6.9	4.5	5.6	8.5	7.5	18.9	17.5

Source: India study team field surveys, 2002.

In general, the size of poor households was larger than that of nonpoor households in all districts. Poor households averaged 6.7 persons, while nonpoor households averaged 3.8 persons. The average number of income earners ranged between 1.1 and 1.4 for all categories of households. The number of earners in poor households was slightly higher than in nonpoor households for all districts except Jamnagar.

Findings

Community-Level Impacts

At the community level, changes were measured over the 6 years from 1997 to 2002. Since all the villages were electrified before 1997, changes over this period could be largely attributable to recent district road improvements. However, they might also represent delayed effects of village electrification. Since there are no "without-service" villages in the sample, the study could measure only changes that occurred after both electrification and road improvements had taken place. Consequently, it was not possible to separate transport effects from energy effects at the village level.

Changes in cropping patterns occurred in each of the sample sites. It seems likely that these changes were made mostly in response to changing prices. Trends suggested a shift away from food crops and toward commercial crops, providing greater market integration and higher incomes along with an acceptable level of risk. Some changes also had to do with expansion of the area under irrigation, especially in Kuchchh district.

In Jamnagar district, groundnuts continued to be the dominant crop. Cotton was also still important. Significant changes in allocated areas occurred for cereals, such as wheat, maize, and millet; pulses, such as gram and pigeon pea; and sesame, an oilseed crop. A decline took place in area under millet, but the other areas have expanded. The site in Bharuch district saw a significant expansion in areas under cotton, pigeon pea, sesame, and gram. The area under wheat remained the same, but the area allocated under sorghum showed a significant decline. In Panchmahal, the area under maize remained approximately the same, but areas under pigeon pea and rice significantly increased. A remarkable expansion (about five times) occurred in the area under vegetables. In Kuchchh, the cultivation of bajra declined in favor of a significant expansion of the area under sorghum, cultivated in both dry and rainy seasons. Growing of wheat, green gram, and cotton also decreased, while the area under dates, vegetables, maize, and sesame increased.

These changes were consistent with a pattern of increasing reliance on the market and taking advantage of price differentials for perishable crops, which were an important advantage of transport improvements. In Jamnagar district, the market price of millet declined substantially, while the price of gram similarly increased. The sample villages of Bharuch district witnessed a considerable increase in the real prices of wheat, sorghum, cotton, and *desi ghee* (a dairy product). The change in the price of cotton, in particular, was reflected in a change in the area allocated. In Panchmahal district, with the exception of maize, real prices of dryland crops decreased over the study period. However, real prices of vegetables, pulses, and fodder increased. In the sample villages of Kuchchh

district, the prices of milk and milk products increased in real terms; this explains the significant increase in area under fodder and fodder substitutes. The real prices of other products decreased. Household interviews and focus group discussions confirmed that the prices of key crops had improved due to better connectivity of the villages to nearby markets.

To test this hypothesis, the changes in cropping patterns and prices that occurred in the sample villages were compared with overall changes reported at the district and state level. The comparison certainly suggested that the effects experienced in the sample villages differed from the norm and could be attributed, at least in part, to the recent infrastructure improvements. For example, in Jamnagar District, production of all crops except bajra and fodder increased substantially in the sample villages, while, except for groundnuts and sesame, they declined overall at the district and state levels. For groundnuts and sesame, the growth in production in the sample villages considerably exceeded the growth at the state level (Table 7.8).

In Bharuch, a moderate increase occurred in the production of millet, gram, pigeon pea, sesame, and cotton, while millet, gram, and pigeon pea production declined at the district and state level, and cotton production, though slightly increasing within the district, also declined at the state level. In Panchmahal, the production of staples, such as sorghum, bajra, gram, groundnut, and sesame, declined substantially as cultivable land was shifted to the production of rice, pigeon pea, vegetables, and fodder. In Kuchchh, a remarkable expansion occurred in the sample villages in sorghum, maize, and sesame production, as well as vegetables and fodder, at a time when sorghum production was declining in the state as a whole. (Data were not available for all crops either at the district or the state levels.)

A comparison of the prices reported for different crops and livestock products in the sample sites with the real wholesale price indices for these crops on a national level supports, to a certain extent, the statements of respondents that farmgate prices increased as a result of the road improvements. Generally, prices paid to farmers in the sample villages increased, while wholesale prices on the national market were falling or in some cases rising more slowly. This was particularly true for ghee in Jamnagar; wheat, sorghum, cotton and ghee in Bharuch; maize in Panchmahal; and milk in Kuchchh. In other cases, prices paid to farmers declined, but not as much as the wholesale price index.

Information from key informants in the sample sites also showed that the real prices of important inputs had generally decreased since the completion of the road. The average prices of fertilizers used in the sample villages declined by about 1.4% after road construction; the prices of pesticides, which are used quite extensively in the area on commercial crops such as cotton and groundnut, declined 1% to 9%. The prices of agricultural equipment, such as carts, diesel engines, electric motors, and other agricultural tools, also showed a significant decline, particularly in the sample villages of Panchmahal District. These changes cannot be attributed to transport changes alone, as macro policies also have a bearing on the prices of these inputs. However, farmers in the sample villages were of the opinion that these changes at least partly reflected the greater availability of seeds, pesticides, and agricultural tools that results from an improvement in transport infrastructure. Farmers also noted the greater ease of traveling to markets to buy these key farm inputs.

Transport improvements allowed farmers to take advantage of price differentials for perishable crops.

Changes in the prices of farm inputs in the sample villages were also compared with changes in the wholesale price index for these inputs. While the cost of inputs generally declined due to overall macroeconomic policy, some of the sample districts recorded much more dramatic declines in the price of some inputs. The price of fertilizers to farmers did not decline as much as the national index, suggesting that intermediaries, rather than farmers, were capturing the benefits of the change in national policy as well as part of the benefits of the road improvement. In the case of pesticides, farmers in Jamnagar and Kuchchh districts did not get the full benefit of national price declines, but those in Bharuch and Panchmahal experienced price declines in excess of changes in the national index, indicating that they were capturing a share of transport cost

Table 7.8. Change in Cropping Patterns, 1997/98–2001/02
(Percent change)

Crops	Jamnagar		Bharuch		Panchmahal		Kuchchh		
	Sample Villages	District Level	Sample Villages	District Level	Sample Villages	District Level	Sample Villages	District Level	Gujarat State
Cereals									
Rice					14.9	–15.8			–1.9
Wheat	544.4	–27.9	0.7	–71.4			–27.4	–23.4	–58.8
Sorghum	96.5	–67.1			–86.9	–76.4	346.7	—	–36.5
Millet	–58.3	–25.2	75.3	–32.6	–61.6	–47.7	–84.7	–60.5	–14.2
Maize	1,511.4	–70.4			–2.3	–3.2	490.0	—	10.0
Pulses									
Green Gram	4.7	—			–93.6	—	–43.0	—	—
Gram	615.4	–92.8	35.3	–70.4	–17.6	–94.7			–86.2
Pigeon Pea	278.6	–32.2	86.4	–25.3	63.1	–45.1	26.2	—	–16.0
Oilseeds									
Groundnut	10.2	4.8			–56.3	–73.9	–100.0	–31.9	–0.5
Sesame	72.2	11.3	47.5	11.8	–58.8	–66.7	569.2	–9.4	28.4
Other Crops									
Cotton	25.9	–13.7	62.1	21.2	–45.7	–4.2	–38.4	–60.2	–17.8
Vegetables	95.6	—			494.0	—	89.0	—	44.3
Fodder	–50.0	—			35.0	—	–39.1	—	—

Blank cells = column does not apply; — = data not available.
Note: The changes in the district level data are for 1997/98–2000/01.
Source: India study team field surveys, 2002.

savings as well as sharing in the overall price reduction. In Panchmahal District, the cost of agricultural tools and machinery declined in real terms, but not as much as the national index, while in the other three districts, costs to farmers mainly increased in real terms, despite the decline in the national price index. These differences in the extent to which the benefits of transport improvements were passed on to farmers probably reflect various imperfections in the markets for these different types of inputs.

Another important change that took place in the sample villages was an increase in the value of land. This increase ranged from 70% over 5 years in the sample villages of Panchmahal Dstrict, to a nearly 3,000% increase (2,889%) in Kuchchh District. Land price increases in Jamnagar District (77%) were slightly higher than those in Panchmahal, while land prices in Bharuch District more than doubled (153%). The remarkable increase in the value of land in Kuchchh District is due not only to the provision of *pucca* roads, but also to the construction of Mundra port. The port developers bought land to build residential colonies for their employees and to create health and education facilities. Furthermore, two factories were established: the Adani-Wilmar refinery in Dhrab and Jindal Saw Pipes Limited in Nana Kapaya, the two sample villages located close to the port. Commercial activity flourished in the vicinity of the port, which led to a significant increase in the value of land and buildings. For example, local people rented out between 100 and 150 rooms to factory workers.

The village data also reflected significant increases in wages over the study period, due to the increase in labor demand for both agricultural and nonagricultural work. Wages in general were highest in the sample villages of Kuchchh and lowest in the sample villages of Panchmahal. Between 1992 and 1997 (i.e., before the transport intervention), real wages remained approximately stable in the sample villages of Bharuch District, while they declined in both Jamnagar and Kuchchh. Only in Panchmahal District were wages on the increase before the road improvement. After the road improvement, however, wages increased in all districts, in both dry and rainy seasons. In Panchmahal district, the increase was particularly marked

for workers, especially for women. The increase was even more dramatic when compared with real wages at the state level, which decreased by 4.3% for both men and women over the same period.[30] The pattern of these increases is consistent with the hypothesis that road improvements reduce the imperfections in labor markets that prevent labor from being allocated efficiently and perpetuate rural poverty (see, for example, Yao [2003]).

Interviews with the villagers showed that transport improvements made it possible for them to travel to nearby towns for wage work (Box 7.1). Contractors from the nearby towns visited these villages with their own vehicles to collect workers. With the road improvement, the villagers found that they were able to commute daily to relatively distant places, where they could find wage work. Employment opportunities within and around the villages also improved.

As to the provision of health care and education services in the sample villages, relatively little change took place after completion of the road. The number of public health centers near the sample villages and the number of doctors available increased in the Panchmahal and Kuchchh study locations. The main improvement seen by the villagers, however, was better access to hospitals in the nearby towns, both public and private. Since the villages had very few primary health centers, residents appreciated very much being able to access medical care in case of emergencies. Also, regular antenatal and postnatal care improved because the ANM (primary public health center nurse) visited more frequently.

In two of the four sites, Panchmahal and Kuchchh districts, road improvements were followed by an increase in the number of primary schools in the villages. Primary schools in the Panchmahal site went from 21 to 29, and in Kuchchh from 6 to 8. The number of primary school teachers increased everywhere except in Jamnagar District, with quite dramatic increases in Kuchchh (63%) and Panchmahal (50%). Correspondingly, enrollments of both boys and girls increased everywhere except for boys in primary school in the Jamnagar site (where enrollments declined), and in the secondary schools serving the Panchmahal site (where enrollments remained about the same). The increase in both boys' and girls' school enrollment in the Kuchchh sample villages was markedly higher than in the other three locations. Enrollment in Kuchchh increased by 50% for boys and 100% for girls at the primary

[30] State-level data represent averages for both peak and lean seasons and are provisional. These numbers may be revised as additional data are received from the different blocks and districts.

Box 7.1. Reconciled with the Future Promise for Children

Fathimabhen, aged 55, has been a resident of Methan Village in Jamrudpur *tehsil* of Jamnagar District for more than 40 years, ever since she tied the wedding knot to Umarbhai Lakhaja. They have four children, three daughters and a son. Up until a few years ago, when the rainfall was normal, they used to grow pulses, *bajra* (pearl millet), and wheat on their 7 *bigha* (approximately 0.14 ha) of land, which the family had inherited. This was sufficient for the family's livelihood. But because of severe drought conditions in the area over the last few years, growing crops is not feasible. Under such conditions, the only option left for Fatima and her husband is to seek wage work. Fatima's husband has taken up wage work through a contractor in a "relief work camp" provided by the Government, but Fatima cannot work because of a chronic backache problem.

For about 2–3 weeks' work, Fatima's husband receives wages of Rs45 per day, less Rs5–6 that he receives every day from the contractor for his out-of-pocket expenses. The current situation has left them much worse off than before, when the farm supported all six family members. Their lifestyle clearly reflects their present poverty. They live in a mud-walled hut built with a thatched/straw roof. This is lighted by an electric bulb connected through a wire extended from the neighborhood, for which she pays Rs100 per month because she cannot afford a separate connection. The kitchen is outside, in a corner at least 8–10 feet away from her living space. The kitchen is also covered on top with straw/thatch; its two sides are protected by the mud wall that demarcates the boundary of their home.

Meanwhile, her husband walks home from his workplace, which is about 3–4 km from the house. Asked about why he did not come by bus, he replied that the fare is Rs4 per trip, which they cannot afford. Fatima also added that private bus operators do not allow passengers to carry their work materials on the bus for fear of damage to the bus.

Fatima's only consolation is that all her children are settled in Jamnagar Town, which is just 20 km from the village. Thanks to the road, it has been possible for her children to visit their parents frequently. In Fatima's words, "Because my son is employed in the forest department, though on a temporary contract, he earns well and sends us Rs500 regularly." This, together with the wage income, adds up to somewhere around Rs7,000–8,000 annually. Asked about the uncertainty of her son's job, Fatima replied, "He is in town, and in town, even if one job is gone, one can find another job. There is no problem."

For Fatima, on the whole, although the family income is low due to bad monsoons in the region, the impact of road construction has been positive in providing alternative sources of employment and strengthening family ties.

Source: India study team.

In the areas of Gujarat studied, road improvements resulted in greatly increased school enrollments for both boys and girls.

level, and by 33% for boys and 100% for girls at the secondary level. Although the number of teachers also increased, the dramatic growth in enrollments resulted in higher pupil-teacher ratios in the Kuchchh primary schools.

Data from the participatory discussions showed that both road improvements and electricity contributed to the villagers' confidence in sending their children, especially girls, to school. They said electricity had also improved educational opportunities for adults. Schoolteachers often lived in towns and commuted to their village classrooms. With road improvements, teachers now attend classes in the village schools more regularly.

The NCAER team assessed changes in the time taken to visit key locations, including administrative offices, markets, and health care and education facilities, since the road was improved (Table 7.9). Substantial reductions in travel time were reported by village key informants. Time taken to visit block headquarters decreased by 25% in Kuchchh, 35% in Jamnagar, 53% in Bharuch, and 70% in Panchmahal. Time savings to reach other amenities such as markets, post and telegraph offices, police stations, health care centers, and postprimary schools were of comparable magnitude, ranging from 12% to 33% in Kuchchh, from 22% to 59% in Jamnagar, from 53% to 62% in Bharuch, and from 19% (nearby post and telegraph services) to 70% in Panchmahal.

These transport time savings were brought about not only by construction of improved roads, but also by changes in the modes of transport available in the sample locations. The changes basically reflected a shift from slow-moving bullock and camel carts to fast-moving buses, jeeps, trucks, auto-rickshaws, *chakdas* (three-wheelers made from a motorcycle with a carriage-like trailer), taxis, and

Table 7.9. Village Time Savings by District and Destination
(Percent)

Destination	Jamnagar	Bharuch	Panchmahal	Kuchchh
Administrative				
District Headquarters	34	49	40	12
Block Headquarters	36	53	70	25
Police Station	22	57	72	25
Commercial Services				
Post Office	48	61	19	33
Telegraph Office	48	58	19	33
Market (Shops)	37	59	70	25
Agricultural Market	37	59	70	25
Railway Station	39	53	40	12
Health Care Services				
Primary Health Center	27	57	67	22
Government Hospital	31	59	67	25
Private Hospital	29	59	70	25
Veterinary Hospital	30	59	70	25
Pharmacy	38	59	70	25
Education				
Middle School	59	62	50	25
Secondary School	51	59	51	25
Girls' School	44	59	40	36

Source: India study team field surveys, 2002.

"mini matadors" (minivans). All the study locations were served by GSRTC buses, although the service was deemed unreliable and other means of transport were often preferred. Discussions with transport service providers at the sample sites indicate that they had experienced about 10% savings on fuel costs and about 20% savings on vehicle maintenance costs as a result of recent road improvements.

Village-level data also suggested that some changes occurred in infrastructure related to drinking water supply and sanitation, although no change took place in infrastructure related to drainage. With provision of electricity, the sources of drinking water diversified from hand-dug wells and hand pumps to tubewells and public taps in three of the four study sites. The exception is the site in Bharuch District, where the groundwater is saline and the main source of drinking water for the entire study period was a public tap. Drinking water supply in the sample locations also improved through delivery by tankers from block headquarters, which was also facilitated by improved transport infrastructure. Sanitation improved only in Jamnagar and Kuchchh districts, where semi-flush toilets have been installed in a few of the sample villages.

Other changes reported by key informants in the four sample locations included the development of village markets, basically the establishment of two or three shops, which provided commonly used consumer goods for all the villages of each site (Box 7.2). Through radio and television, people were better informed about crops, weather, and daily news. Over the study period, a perceptible change occurred in consumption, for example, in clothing worn, particularly for the nonpoor. In all four sample locations, modern outfits replaced traditional clothes, especially for the younger generation. Contacting administrative staff at block headquarters and maintaining ties with nearby and faraway family members became easier with the improved roads. In addition, laborers were able to work more days in the year due to a wider range of construction activities within and outside the villages. To a certain extent, transport and electricity helped to mitigate the severity of drought for the last 4 years of the study period.

Household-Level Impacts

As noted above, the household sample was stratified into four approximately equal groups according to whether the household had access to electricity and whether it resided close to (less than 0.5 km) or far from (more than 0.5 km) the improved road. Since the household data were collected at only one point in time, transport and energy impacts were evaluated by comparing the performance of groups with and without each improvement separately. Potential synergies were then assessed by comparing the performance of groups having access to both services with groups having access to neither. As noted above, the incidence of poverty in the four sample subgroups was 48% for households having access to both roads and electricity, 62% for households having electricity but poor road access, 68% for households having good road access but no electricity, and 76% for those that had no access to either. Thus, the entire sample is predominantly (64%) poor. The depth of poverty ranged from 17% in the first group to 32% in the last group, and the severity of poverty (squared poverty gap) from 8.1 to 17.1, following the same pattern. Inequality, as measured by the Gini index, was slightly higher among electrified households (about 36) than nonelectrified households (about 32). Relatively little difference in the Gini index could be seen between households closer to and farther from the road.

The study team also divided the sample into poor and nonpoor households and analyzed the data accordingly. The analysis suggested significant differences in household and per capita income between electrified and nonelectrified households, as well as between households close to and households far away from improved roads. The differences were somewhat greater for electrification than for road access. The results for the four subsamples are shown in Table 7.10.

The results suggest significant income differences between electrified and nonelectrified households, both poor and nonpoor. Having immediate access to a good quality road seemed also to make a difference in incomes for electrified nonpoor households, but not for electrified poor households. Road access made more of a difference for nonelectrified poor households. On a per capita basis, less variation emerged, but the patterns were similar. Curiously, nonpoor, nonelectrified households away from the road had higher incomes than those in nonpoor, nonelectrified households living close to the road. Perhaps those farther from the road were more likely to own their own farms, while households depending on wage labor for their incomes, and not having land of their own, were more likely to locate near the road so as to have better access to employment opportunities both within and outside the village.

Situational Factors. As to caste and religion, the data showed that social groups were approximately evenly

Box 7.2. Shahbhai Takes Advantage of Roads and Electricity

Thirty-four-year-old Shahbhai Andhersinh Bariya is a lifelong resident of Goth village in Panchmahal district. He lives with five other members of his family. They have just one *bigha* (approximately 0.14 ha) of land, on which they grow paddy, maize, and pulses for own consumption. This is not sufficient to sustain them. Thus, at the young age of 14 years, Shahbhai, who is primary-level literate, and his brother started working as laborers on people's farms.Even this work was not available regularly, however, due to the bad monsoon in the last few years. So Shahbhai and his brother were forced to migrate to a town temporarily to do construction work to make ends meet. Shahbhai disliked this, as he had to stay away from his family and his earnings were not sufficient both to save or remit home.

It was at this point that Shahbhai got the idea of opening up a small shop beside the village road, near the bus stop. He borrowed some money from his relatives and built a cabin to use as a shop. To begin with he sold items like *pan*, *bidi*, tea, snacks, and the like. Subsequently, because the village was close to Ghogamba town (block headquarters), a police station was set up on the roadside close to Shahbhai's cabin. The increased traffic on this road caused more and more people to start visiting Shahbhai's cabin. Shahbhai's earnings increased to Rs2,500 per month. Gradually, the demand for Shahbhai's services extended to washing and ironing police uniforms. This helped him to earn even more. Last year Shahbhai got his cabin electrified, by extending a connection from a relative's house close by. He pays them Rs100 rent every month. Now he is able to keep the cabin open till late at night for travelers who visit his stall while waiting for the bus.

This trade has helped Shahbhai to improve his standard of living considerably. He feels more secure and happy. His children are studying in a village school. Shahbhai's future plans include sending his children to high school outside the village and getting an electricity connection for his home.

Source: India study team.

distributed in terms of their access to roads and electricity. In Jamnagar District, Muslim households (a small minority) were disproportionately represented among the households that had neither electricity nor good road access. In Bharuch, where greater numbers of Muslim households were located (although still a minority), nonpoor Hindus were slightly more likely than nonpoor Muslims to have both electricity and road access, whereas poor Hindus were less likely than poor Muslims to have such services. Hindus were also disproportionately represented among those households (both poor and nonpoor) that had neither service, while Muslims were predominant among those with either one or the other amenity. This may reflect the fact that Hindu society is more internally stratified than Muslim society. In Panchmahal, Muslims (and other religious minorities) were likely to be among those who were better served, and a similar though less marked pattern held true in Kuchchh.

The illiteracy rate in electrified households was lower than in nonelectrified households over the entire sample,

Table 7.10. Distribution of Sample Households by Intervention and Income

		Average Annual Income (rupees)			
		Household		Per Capita	
		Poor	Nonpoor	Poor	Nonpoor
Electrified	Good Road Access	20,749	32,864	3,192	7,825
		($446)	($707)	($69)	($168)
	Poor Road Access	20,579	27,465	2,781	6,866
		($443)	($591)	($60)	($148)
Nonelectrified	Good Road Access	18,338	17,956	2,958	5,527
		($394)	($386)	($64)	($114)
	Poor Road Access	17,113	18,240	2,517	5,527
		($368)	($392)	($54)	($119)
Entire Sample		18,868	25,928	2,816	6,823
		($406)	($558)	($61)	($147)

Source: India study team field surveys, 2002.

for both males and females. Similarly, the illiteracy rate was higher in poor households living farther from good roads than in households located close to roads. However, males in nonpoor households living farther from a good road had a lower illiteracy rate than those living close to roads. This was also true for females living in nonpoor households with electricity but far from the road, but for females in nonpoor households *without* electricity, road access made no difference in literacy rates. This suggests that electricity might have been a marker of "modernity" among nonpoor households.

Though nonpoor household members (male and female) were more likely than poor household members to continue on to secondary education, the percentages were higher in electrified households than in nonelectrified households for both groups. They were also generally higher in households close to good roads than in households located far from roads. The exception was males living in nonpoor, electrified households far from the roads, who were slightly more likely to have completed a secondary education than males living in nonpoor, electrified households close to the roads. This exception, however, did not hold true for females. Minor variations in these patterns occurred across the four districts.

Occupations. As to occupational structure, in Jamnagar District no major differences were observed in the pattern between poor and nonpoor households. Farm owners, both poor and nonpoor, were disproportionately likely to have electricity. Among households that did not have access to electricity, a disproportionate share were wage earners rather than farmers. Poor households in this category that were located closer to roads were more likely to be agricultural laborers, whereas those located farther from the roads were more likely to be gaining income from non-agricultural employment. In contrast, nonpoor households without electricity were more likely to be agricultural laborers, regardless of their distance from the roads.

Bharuch District showed a similar pattern. Farmers, both poor and nonpoor, were somewhat more likely, and wage earners less likely, to have electricity. However, in the case of Bharuch District, households without electricity located far from the roads were more likely to be involved in agricultural wage work, while households located near the roads, poor or nonpoor, were more likely to be involved in nonfarm occupations. The difference between these two districts may have reflected differences in the structure of their local labor markets.

The data for the site in Panchmahal District were somewhat different. Among poor households, little variation in occupational patterns was related to road or electricity access. Few of the nonpoor farm households had both good road access and electricity, while nonpoor wage earners (who were predominantly nonagricultural) were more likely to have access to both services. Electricity was also important for households engaged in government or nongovernment organization (NGO) activities, trade, or small business. Location near the road was also important for those engaged in business or trade.

In Kuchchh, with its more diversified occupational distribution, it was more difficult to ascertain the relationships between occupation and access to roads and electricity. Among poor households, farmers were more likely than others to have electricity but be located far from the main road. Agricultural wage earners were most likely not to have access either to roads or electricity, while nonagricultural wage earners were more likely to have both services. A similar pattern held among nonpoor households, although the differences between agricultural and nonagricultural wage earners were less marked. Nongovernment employment and self-employment were also important in Kuchchh. Both poor and nonpoor households employed by NGOs were disproportionately more likely to be electrified and to live closer to a good road. Poor self-employed households were less likely to have access to electricity or a good road, while nonpoor self-employed households were likely to have one service or the other, but not both.

Very few households reported changes in occupation due to the provision of transport or electricity. By far the largest number of such households was reported in Kuchchh District. Most of these changes took place in response to the port development. Change affected both poor and nonpoor households, which shifted from agricultural wage work to nonagricultural wage work, petty commerce and small business, and NGO employment. In other districts, the changes were mainly from agricultural wage work to nonagricultural wage work and petty shopkeeping. Both poor and nonpoor households participated in these changes, with the poor slightly more likely to change in response to energy improvements and the nonpoor being slightly more likely to change in response to transport improvements (including the port).

No major differences in the pattern of landholdings were observed among the four subsamples, nor could much difference be seen in cropping patterns or livestock ownership, except that nonpoor electrified households in Panchmahal District were less likely than others to own livestock. This may be because some of them had shifted to nonagricultural occupations. In line with the findings

on occupational structure, agricultural wage income was a more important source of income than farm sales for nonelectrified poor households in Jamnagar District and for all nonelectrified households in Bharuch District. In Panchmahal and Kuchchh, nonagricultural income was more important than agricultural wage income, particularly for electrified households, both poor and nonpoor.

Income. Relatively few households in the Jamnagar sample reported changes in income due to the provision of access to transport (Table 7.11). In Bharuch, more than 10% of the sample households reported such changes. In Panchmahal, the proportion was above 15%, and in Kuchchh it was considerably higher, around 40%. In Bharuch, households living farther from the road were more likely to experience income changes as a result of road improvements, particularly nonpoor households that also had access to electricity. In contrast, in Kuchchh those living closer to the road were more likely to see income benefits. Common factors cited in all locations were improvements in the village economy, better prices for farm products, more product sales, better wages, and more wage-paying jobs both inside and outside the village. In Kuchchh, major impacts also came from the construction of Mundra port and related facilities. These changes benefited poor and nonpoor households in approximately equal proportions.

Transport impacts were recorded both for households living close to the improved road and for households living some distance away, while electricity impacts were recorded only for electrified households (Table 7.12). Electricity made relatively little difference in incomes for both poor and nonpoor households in Jamnagar District. In Bharuch, electricity had some impact on poor households and a somewhat greater impact on nonpoor households far from the improved roads. In Panchmahal, poor households were more likely to have benefited economically from electricity than nonpoor households. The greatest impact of electricity on incomes was noted in Kuchchh District, where the poor were slightly more likely to have benefited than the nonpoor. The quality of road access made little difference in the ability of electrified households to benefit from electricity.

Health. More than half of all sample households in each location (except Jamnagar) thought that improved transport had helped to improve their health, mainly through improved access to health care facilities (Table 7.13). In Jamnagar District, about 35% of the poor respondents and 40% of the nonpoor respondents saw posi-

Table 7.11. Change in Household Income Due to Transport Improvements
(Percent of households in each group reporting change)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	0	4	0	6
Nonpoor	2	0	0	3
Bharuch District				
Poor	11	10	3	21
Nonpoor	9	34	4	17
Panchmahal District				
Poor	18	20	13	16
Nonpoor	0	22	14	20
Kuchchh District				
Poor	39	32	42	31
Nonpoor	50	31	53	43
Entire Sample				
Poor	20	21	15	18
Nonpoor	17	16	17	24

Source: India study team field surveys, 2002.

Table 7.12. Change in Household Income Due to Energy Improvements
(Percent of households in each group reporting change)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	0	4
Nonpoor	2	3
Bharuch District		
Poor	11	10
Nonpoor	7	20
Panchmahal District		
Poor	20	18
Nonpoor	0	15
Kuchchh District		
Poor	33	34
Nonpoor	24	20
Entire Sample		
Poor	20	20
Nonpoor	9	11

Source: India study team field surveys, 2002.

tive health impacts from road improvements. With better transport services, it became easier to take patients to clinics or hospitals in nearby towns. Prenatal and postnatal care also improved, because the district nurse visited the villages more frequently. Poor households, nonelectrified households, and those living farther from improved roads were more likely than others to recognize such positive impacts on health. These views, expressed in the village and household interviews, were reinforced by findings from focus group discussions in the four locations. In the focus groups, participants consistently ranked health care impacts as the most important benefits derived from rural transport improvements.

In the case of electricity, more than half of the sample households in three of the four locations, and 35–40% in Bharuch District, saw a positive impact of electricity on the health of their family members (Table 7.14). Positive health impacts due to electricity were attributed to greater ease in reading, better food preservation, and improved health care facilities, as well as better care of the elderly and children. No significant variation was apparent in the frequency of these impacts depending on whether a household had direct access to an improved road.

Table 7.13. Change in Household Health Due to Transport Improvements
(Percent of households in each group reporting change)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	14	19	66	44
Nonpoor	36	35	57	53
Bharuch District				
Poor	83	90	55	96
Nonpoor	66	98	70	93
Panchmahal District				
Poor	52	68	64	76
Nonpoor	57	85	64	78
Kuchchh District				
Poor	63	51	58	54
Nonpoor	50	39	45	49
Entire Sample				
Poor	50	61	62	72
Nonpoor	45	54	58	66

Source: India study team field surveys, 2002.

These interventions were instead seen as benefiting the community as a whole.

Education. In the case of education as well, a majority of respondents in all groups agreed that transport investments had a positive impact on education (Table 7.15). The identified mechanisms of transport impact were better access to schools, better access to news and information, greater availability of study materials, and better conditions for girls' education (Box 7.3). This last effect is probably due to improved safety and security of road transport, which came out in the focus group discussions as an important factor affecting girls' access to schooling. These impacts were reported by both poor and nonpoor households and varied little across sample subgroups.

In contrast, relatively few respondents thought that access to electricity had improved educational outcomes (Table 7.16). This lack of educational impact could be attributed to the irregular supply of electricity. Only in Panchmahal District was there a strong positive response: there, the impacts of electricity on education were seen to come mainly from improved lighting, helping students to complete their homework, and from better access to news and information from television and radio. Households living near and far from the roads differed little in their responses to these questions.

Information and Communication. Survey respondents were also asked about the impact of transport and energy improvements on their access to news and information (Table 7.17). Practically all of the respondents felt that road improvements had a positive impact. Road impacts on access to information are largely due to increased personal travel and to the greater availability of newspapers and other sources of information. No significant differences between poor and nonpoor households were seen in the effects of transport improvements on access to information.

Table 7.14. Change in Household Health Due to Energy Improvements
(Percent of households in each group reporting change)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	72	49
Nonpoor	55	35
Bharuch District		
Poor	38	41
Nonpoor	36	46
Panchmahal District		
Poor	59	55
Nonpoor	61	66
Kuchchh District		
Poor	62	58
Nonpoor	40	57
Entire Sample		
Poor	63	52
Nonpoor	50	48

Source: India study team field surveys, 2002.

Box 7.3. A Boost for Girls' Education

Ambitious and smart-looking, Lakshmi, age 12, a resident of Moti Bharad village in Jamjodhpur *taluka* of Jamnagar district, studies at a boarding school in a nearby town. She comes from an upper-caste Patel family. Her mother's only aspiration is to make Lakshmi a doctor. Lakshmi had come home to spend the summer vacation with her family. When the study team visited her village, she was the only woman in the household who could communicate with the team in Hindi, as the local dialect is different from the commonly spoken Gujarati.

Lakshmi narrated the story of her sister, about 6–7 years older than she. Then, the village school had provision for education only up to 7th standard, so, to complete her education up to 9th standard, her sister, along with a few other village girls, used to walk for about 4–5 km to a neighboring, larger town. Every day, the one-way trip took between 40 and 45 minutes. Since the construction of the approach road to Moti+ Bharad, however, buses have started plying the towns. Now, the girls of this village can commute to school by bus, and some, like Lakshmi, are attending a boarding school, avoiding the daily commuting and using the bus to return home for weekends. (Parents like Lakshmi's worry that the bus is not safe or reliable.) All this has been made possible by roads. With improved quality and frequency of transport, the dream of many more Lakshmis can come true.

Source: India study team.

Table 7.15. Change in Household Education Due to Transport Improvements
(Percent of households in each group reporting change)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	76	52	84	44
Nonpoor	68	70	71	76
Bharuch District				
Poor	89	100	80	83
Nonpoor	82	98	80	90
Panchmahal District				
Poor	92	67	67	79
Nonpoor	79	54	54	68
Kuchchh District				
Poor	70	65	65	67
Nonpoor	48	39	39	45

Source: India study team field surveys, 2002.

The impact of electricity on access to information was somewhat less dramatic (Table 7.18). However, electricity provided improved access to information in more than half of electrified households, mainly through television and radio. This effect was particularly marked in the remote areas of Panchmahal and Kuchchh districts. In Jamnagar, direct road access increased the effect of electricity on access to information, while in Bharuch this relationship was reversed. No significant difference between poor and nonpoor (electrified) households was observed in the impacts of electricity on access to information.

Table 7.16. Change in Household Education Due to Energy Improvements
(Percent of households in each group reporting change)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	0	0
Nonpoor	2	0
Bharuch District		
Poor	0	10
Nonpoor	0	0
Panchmahal District		
Poor	63	55
Nonpoor	50	67
Kuchchh District		
Poor	0	0
Nonpoor	2	4

Source: India study team field surveys, 2002.

Security. It was expected that transport and energy changes could lead to an increase in household safety and security, and the study results confirmed the expectation. The positive impacts of transport improvements on safety and security were mentioned by a majority of respondents in all study locations, with a particularly strong response in Panchmahal and Kuchchh (Table 7.19). Relatively little difference was seen between the sample subgroups in the degree to which they perceived this impact, and also little difference between the poor and nonpoor. Safety and security benefits were attributed to improved access to police stations and improved safety from wild animals. Traffic on the improved roads was believed to deter wild animals from visiting the villages.

Electricity also had a significant impact on household safety and security in all the sample districts, according to reports from

Table 7.17. Change in Access to Information Due to Transport Improvements
(Percent of households in each group reporting change)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	96	100	97	100
Nonpoor	99	100	94	100
Bharuch District				
Poor	100	100	100	100
Nonpoor	100	100	100	100
Panchmahal District				
Poor	100	100	100	100
Nonpoor	100	100	100	100
Kuchchh District				
Poor	100	100	100	99
Nonpoor	98	100	100	100

Source: India study team field surveys, 2002.

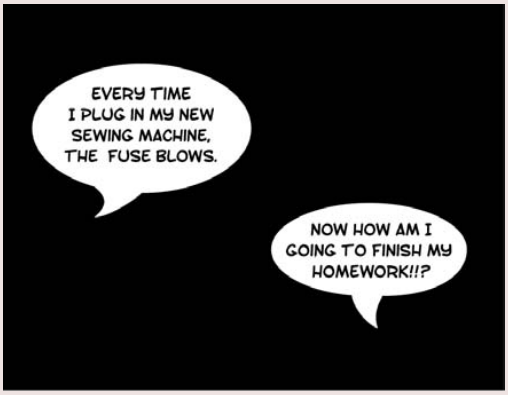
the electrified households (Table 7.20). Unfortunately, the design of the survey foreclosed the option of recording benefits to nonelectrified households. The positive impacts of electricity were attributed once again to reduced danger from wild animals and the effects of lighting in deterring thieves. No significant differences emerged between poor and nonpoor households in their estimation of this impact.

An electric water pump, such as the one shown here in Jamnagar, Gujarat State, is important where water is scarce.

Common Property Resources. Respondents felt strongly that transport and electricity improvements provided better access to common resources, both for villagers and for outsiders (Tables 7.21 and 7.22). This led to a mixed assessment of impacts. On the one hand, better transport facilitated access by the villagers to common resources over a wider radius. On the other hand, it also enabled people outside the village to exploit these same resources. No significant differences emerged in the responses between poor and nonpoor households, or between sample subgroups.

Responses were considerably more mixed with respect to the impact of electricity on access to common resources. Residents of Jamnagar and Kuchchh districts were more likely to perceive a major impact on common resources from electricity provision than residents of Bharuch and Panchmahal districts. The impact derived mainly from the use of electric pumps to appropriate water, both for domestic use and for irrigation. This may explain why the impact was seen as being more important in Jamnagar and Kuchchh, where water is relatively scarce. Little difference in the response to this question emerged between poor and nonpoor households,

or with respect to distance from a road. Focus group discussions showed that households with electricity could use pumps to appropriate most of the water from community piped water systems, leaving little for those households that did not have electric water pumps.



The general conclusion seemed to be that infrastructure improvements were likely, all else being equal, to facilitate the appropriation of common resources by individuals and households, whether they were poor or nonpoor. This underlined the need for better communal management of these resources to ensure both sustainable use and continued access by the poor.

Time Savings. Surprisingly few respondents felt that transport and energy improvements had given them more free time (Tables 7.23 and 7.24). In the case of transport, this was explained by the fact that many activities of daily life were still carried out using slow means of transport, including walking. On average, the same proportion of poor and nonpoor households, about 30%, reported transport-related time savings. When asked how the time savings were used, respondents said that in the case of transport, they spent more time on household tasks, farming tasks, agricultural labor and other wage work, and in the case of electricity, on leisure activities, as well as caring for children and the elderly.

For energy, the relatively modest response can be explained by the frequent shortages and unreliability of the service, as well as the limited penetration of electrical appliances in the study areas. Electricity was mainly used for lighting, not for cooking or other household tasks. Consequently, the time spent by household members in collecting traditional fuels did not change. Only in Panchmahal District did electricity make a significant difference in household time allocation. This difference affected a larger share of poor households than nonpoor households living close to the improved road, while it had an equal effect on poor and nonpoor households living away from the road.

Table 7.18. Change in Access to Information Due to Energy Improvements
(Percent of households in each group reporting change)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	61	30
Nonpoor	40	35
Bharuch District		
Poor	33	50
Nonpoor	36	45
Panchmahal District		
Poor	61	60
Nonpoor	50	57
Kuchchh District		
Poor	79	82
Nonpoor	74	84

Source: India study team field surveys, 2002.

Social Participation. A majority of the sample households reported improvements in social participation, particularly in response to transport changes (Table 7.25). This response was not affected by distance from the road or by household electrification, nor did it vary significantly between the poor and the nonpoor. The mechanisms included participation in local associations, *panchayats* (community councils), community work, and campaigning for elections. In Bharuch and Kuchchh districts, electricity was also seen to facilitate social participation, but in Jamnagar and Panchmahal districts, the participation response to electricity service provision was notably weaker (Table 7.26).

Social Capital. Respondents were also asked about the impact of transport and energy improvements on relations within the village (bonding social capital) and between the village and the outside world (bridging social capital) (Tables 7.27 and 7.28). Transport improvements

Table 7.19. Change in Household Security Due to Transport Improvements
(Percent of households in each group reporting change)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	71	52	50	56
Nonpoor	63	52	48	47
Bharuch District				
Poor	56	40	40	38
Nonpoor	45	66	28	50
Panchmahal District				
Poor	67	65	72	66
Nonpoor	57	78	71	78
Kuchchh District				
Poor	83	93	88	88
Nonpoor	84	88	96	89

Source: India study team field studies, 2002.

had quite a significant impact on bonding social capital, especially for poor households. The impact on bridging social capital was also important, except for the households in Panchmahal District. This may reflect the high proportion of socially excluded people (scheduled tribes and other backward castes) in the sample villages of Panchmahal District. Transport improvements could not help them overcome these social constraints.

In contrast, electricity improvements had very little reported impact on either bonding or bridging social capital, except in Panchmahal District (Table 7.29). Since these answers reflect only electrified households, it may be supposed that an electricity connection conferred a certain social status and thereby helped socially disadvantaged households (whether poor or nonpoor) to improve their relationships with others, both in their villages and with outsiders. It is also possible that the relationship was more direct, if the electrified households were willing to share the benefits of electricity with others.

Social Equity. On balance, survey respondents did not believe that the benefits of transport and energy improvements were distributed equitably (Tables 7.30 and 7.31). Rather, they felt that the well-off benefited disproportionately. With respect to road improvements, only a fourth of the poor respondents and half the nonpoor respondents felt that the benefits were equitably shared. Responses on transport were somewhat more favorable in Jamnagar and Kuchchh districts and only slightly less so in Bharuch District, but the overall results reflect the markedly more negative views expressed in Panchmahal District, where the poor are predominant in the sample. Respondents felt that better crop prices did not translate into higher wages for the poor, and

Table 7.20. Change in Household Security Due to Energy Improvements
(Percent of households in each group reporting change)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	94	100
Nonpoor	97	98
Bharuch District		
Poor	94	96
Nonpoor	93	93
Panchmahal District		
Poor	87	88
Nonpoor	100	88
Kuchchh District		
Poor	100	99
Nonpoor	94	94

Source: India study team field studies, 2002.

Table 7.21. Impact on Common Resources Due to Transport Improvements
(Percent of households in each group reporting impacts)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	96	100	97	100
Nonpoor	99	100	94	100
Bharuch District				
Poor	100	100	100	100
Nonpoor	100	100	100	100
Panchmahal District				
Poor	100	100	100	100
Nonpoor	100	100	100	100
Kuchchh District				
Poor	100	100	100	99
Nonpoor	98	100	100	100

Source: India study team field surveys, 2002.

improved transport services were unaffordable for them. Lack of formal education was also seen as a major barrier to the poor being able to benefit from transport improvements.

Respondents almost universally believed that the benefits of electricity improvements were disproportionately captured by the rich. The only positive views (expressed by a small minority) were found in Kuchchh District. Barriers to the participation of the poor in the benefits of rural electrification were seen as the high cost of electricity and electrical appliances, and the fact that not all households were connected (implicitly, the high cost of connections). In other words, the issue as seen by survey respondents was mainly one of affordability.

Another factor may have been the inadequate and unreliable supply of electricity. Most of the sample locations get electricity for only 4–8 hours a day, with frequent power outages. This forces electricity consumers to buy back-up generators. The focus group discussions revealed that the poor quality of service was indeed a barrier to further electrification of poor households. The high degree of uncertainty about service constituted a risk that was unaffordable to the poor; they would rather pay more for kerosene and be sure of having light when they need it. In addition, participants in the focus group discussions, both poor and nonpoor, felt that electricity billing was arbitrary and unpredictable, bearing no relation to actual consumption. This belief was expressed even by respondents who had metered service.

Table 7.22. Impact on Common Resources Due to Energy Improvements
(Percent of households in each group reporting impacts)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	59	30
Nonpoor	38	33
Bharuch District		
Poor	0	0
Nonpoor	13	11
Panchmahal District		
Poor	14	16
Nonpoor	0	19
Kuchchh District		
Poor	41	36
Nonpoor	52	41

Source: India study team field surveys, 2002.

Table 7.23. Time Savings Due to Transport Improvements
(Percent of households in each group reporting time savings)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	10	19	37	33
Nonpoor	14	28	25	47
Bharuch District				
Poor	22	20	30	13
Nonpoor	20	55	22	33
Panchmahal District				
Poor	19	34	33	38
Nonpoor	0	30	39	40
Kuchchh District				
Poor	41	37	35	33
Nonpoor	48	41	43	34

Source: India study team field surveys, 2002.

Econometric Analysis

The study team analyzed the incidence, depth, and severity of poverty among the four "treatment" groups of respondents, as well as inequality as measured by the Gini index. To assess the impacts of rural electrification, they compared these measures for electrified and nonelectrified households within the two groups defined by access to improved roads. The results from two of the four sample locations, Jamnagar and Bharuch, suggested a consistent pattern of greater poverty among nonelectrified households than among those electrified. In Panchmahal, where poverty was generally very high, the difference between electrified and nonelectrified households was very small, whether they were close to or far from improved roads. In Kuchchh, poverty was lower among electrified households living close to an improved road, but about the same among electrified and nonelectrified households living far from the road. These findings suggest that neither transport nor electricity had had a significant impact on poverty in Panchmahal District, while in Kuchchh rural electrification had had a lesser impact, which could only be felt in conjunction with road improvements.

The pattern was less clear with respect to the impact of road improvements. In Jamnagar, poverty levels are lower among households living close to improved roads, both with and without electricity. The differences are relatively small, however. In Bharuch, poverty levels were *higher* for those living close to improved roads, both with and without electricity. In Panchmahal, relatively little difference was seen between the groups. In Kuchchh, poverty was markedly lower among electrified

Table 7.24. Time Savings Due to Energy Improvements
(Percent of households in each group reporting time savings)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	0	0
Nonpoor	0	1
Bharuch District		
Poor	0	0
Nonpoor	0	2
Panchmahal District		
Poor	28	31
Nonpoor	7	33
Kuchchh District		
Poor	1	0
Nonpoor	2	4

Source: India study team field surveys, 2002.

Table 7.25. Effects on Participation Due to Transport Improvements
(Percent of households in each group reporting increased participation)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	80	61	48	100
Nonpoor	74	100	49	100
Bharuch District				
Poor	100	100	99	98
Nonpoor	99	100	100	97
Panchmahal District				
Poor	80	78	80	78
Nonpoor	78	77	81	74
Kuchchh District				
Poor	100	99	100	100
Nonpoor	100	100	100	99

Source: India study team field surveys, 2002.

households living close to an improved road, while for nonelectrified households, road improvements made little difference. These anomalous results require some explanation. It may be that poor households in Bharuch, depending on wage labor rather than on the productivity of their own farmland, were more likely to locate near improved roads, where they had ready access to jobs over a wider radius. The situation in Kuchchh is also unusual. It appears that only the combination of road and electricity improvements has been successful in helping to reduce poverty there.

Table 7.26. Effects on Participation Due to Energy Improvements
(Percent of households in each group reporting increased participation)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	11	24
Nonpoor	21	30
Bharuch District		
Poor	98	88
Nonpoor	75	92
Panchmahal District		
Poor	25	25
Nonpoor	25	25
Kuchchh District		
Poor	57	65
Nonpoor	59	46

Source: India study team field surveys, 2002.

The poverty analysis provided convincing evidence of the synergistic effects of transport and energy investments in reducing poverty. For the whole sample, poverty among nonelectrified households far from road improvements was 58% higher than in electrified households living close to improved roads (76% compared with 48%). The depth and severity of poverty were twice as great among those households that had not received either service. However, inequality, as measured by the Gini index, was somewhat higher among electrified households and slightly higher among households far from roads. This suggested that transport improvements tended to reduce inequality, but that rural electrification had an overriding effect in increasing it.

To clarify these findings, the NCAER team conducted an analysis of its survey data using a probit model to predict the probability of a household's being poor. The results are shown in Table 7.32. Transport and energy interventions were represented by binary variables reflecting a household's access to electricity (yes/no) and proximity to an improved road (nearer/farther than 0.5 km). The impact of actual distance from the improved road was also tested.

Table 7.27. Effects on Bonding Social Capital Due to Transport Improvements
(Percent of households in each group reporting better relations in village)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	59	25	40	17
Nonpoor	41	35	25	37
Bharuch District				
Poor	24	29	27	70
Nonpoor	32	56	23	48
Panchmahal District				
Poor	51	49	50	54
Nonpoor	52	24	43	43
Kuchchh District				
Poor	46	32	42	27
Nonpoor	36	21	38	25

Source: India study team field surveys, 2002.

Other intervention variables included per capita expenditure on transport and per capita expenditure on energy. Situational variables included in the model were caste, religion, educational level of males, educational level of females, household dependency ratio, per capita landholding, share of nonfarm income in total income, and access to credit (yes/no).

The model showed that access to roads and electricity was significantly (negatively) related to poverty status only in Panchmahal district. In Kuchchh, a significant negative relationship emerged between access to electricity and poverty status, but no significant relationship for road access. In other districts, neither service was significantly related to poverty. Distance to improved roads also had no relationship to poverty status. However, per capita expen-

Table 7.28. Effects on Bridging Social Capital Due to Transport Improvements
(Percent of households in each group reporting better relations with outsiders)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	74	46	47	31
Nonpoor	59	54	28	23
Bharuch District				
Poor	48	53	44	60
Nonpoor	54	53	44	60
Panchmahal District				
Poor	1	1	2	0
Nonpoor	0	0	0	3
Kuchchh District				
Poor	47	36	41	31
Nonpoor	33	28	34	33

Source: India study team field surveys, 2002.

Table 7.29. Effects of Energy Improvements on Bonding and Bridging Social Capital
(Percent of households in each group reporting better relations)

	Relations Inside Village		Relations Outside Village	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	1	0	0	0
Nonpoor	0	0	0	0
Bharuch District				
Poor	0	0	0	0
Nonpoor	0	2	0	0
Panchmahal District				
Poor	40	54	49	59
Nonpoor	49	59	45	44
Kuchchh District				
Poor	0	2	1	0
Nonpoor	0	0	0	0

Source: India study team field surveys, 2002.

Table 7.30. Equitable Access to Benefits Due to Transport Improvements
(Percent of households in each group saying benefits distributed equally)

	With Electricity		Without Electricity	
	Close to Road	Far from Road	Close to Road	Far from Road
Jamnagar District				
Poor	59	41	79	44
Nonpoor	70	52	76	65
Bharuch District				
Poor	28	60	28	63
Nonpoor	35	80	34	69
Panchmahal District				
Poor	14	7	22	10
Nonpoor	21	11	25	3
Kuchchh District				
Poor	55	48	49	56
Nonpoor	59	59	51	51
Entire Sample				
Poor	33	20	32	20
Nonpoor	58	54	51	47

Source: India study team field surveys, 2002.

Table 7.31. Equitable Access to Benefits Due to Energy Improvements
(Percent of households in each group saying benefits go primarily to the better-off)

	With Electricity	
	Close to Road	Far from Road
Jamnagar District		
Poor	98	100
Nonpoor	2	3
Bharuch District		
Poor	100	100
Nonpoor	100	100
Panchmahal District		
Poor	100	100
Nonpoor	100	100
Kuchchh District		
Poor	88	82
Nonpoor	93	88
Entire Sample		
Poor	97	96
Nonpoor	98	98

Source: India study team field studies, 2002.

ditures on energy were significantly related to poverty status in all districts, and per capita expenditures on transport were significantly related to poverty status in all districts except Jamnagar. The results of the model suggest that it is not mere access to these services that leads to poverty reduction, but rather the use of these services, as measured by expenditures.

Contextual variables such as caste and religion did not affect the probability of a household's being poor or nonpoor. Educational levels also had little impact, except for males in Kuchchh District, where educational levels were significantly negatively related to poverty status. Household dependency ratios[31] were negatively related to poverty status in three of the four districts, excluding Jamnagar. Per capita access to land was positively related in three districts, Panchmahal being the exception. The share of nonfarm income in total income was positively related to the incidence of poverty in two districts, Panchmahal and Kuchchh. This reflected the higher share of nonfarm income in total income in these two districts, as well as greater differences between poor and nonpoor households in the share of income from nonfarm sources. Access to credit did not have a significant impact on poverty. In fact, very few households in the survey sample had borrowed money; the poor and nonpoor did not differ significantly in this respect.

The team also used this model to study the effect of transport and energy interventions on household incomes, measured in terms of per capita consumption expenditures. To do this, a propensity score matching technique was used to construct the counterfactual. The probable consumption expenditure for households in each of the subgroups was predicted on the basis of observed situational and intervention variables. The predicted probability (propensity score) was then used to match each comparison group separately (electrified households to nonelectrified, households located near the road to those located away from the road, and households benefiting from both interventions to households without either intervention). The significance of the differences in mean consumption expenditures of matched samples of these subgroups was then tested using t-tests. The resulting differences in mean consumption expenditure reflect the impacts of interventions in energy and transport. The results are shown in Table 7.33.

In Bharuch District, the provision of transport and electricity had a positive and significant effect on per capita expenditures, both severally and jointly. In Panchmahal, the impact of electricity was significant only among households that were located far from improved roads, and the impact of roads was significant only among electrified households. In Jamnagar District, electricity raised per capita expenditures only among households living close to improved roads, and road improvements had no statistically significant effect on expenditures. But the most curious results were found in Kuchchh, where electricity was *negatively* related to per capita expenditures among households living far from roads, and road access was *negatively* related to per capita expenditures among electrified households. Positive synergies between transport and electricity were strongest in Bharuch District, somewhat weaker in Jamnagar and Panchmahal, and statistically insignificant in Kuchchh. The analysis was carried out within each district to control for the effects of situational factors varying across districts. The analysis was not conducted for the survey sample as a whole.

[31] Dependency ratios were defined as the number of income earners in a household divided by the total number of household members; thus, a higher dependency ratio would suggest a higher proportion of income earners (the reverse of higher "dependency").

Table 7.32. Results of Probit Model Testing for Incidence of Poverty

Variable	Variable Signs and Significance			
	Jamnagar	Bharuch	Panchmahal	Kuchchh
Intervention Variables				
Access to Electricity			Negative**	Negative**
Access to Improved Road			Negative**	
Distance to Improved Road				
Per Capita Energy Expenditure	Positive**	Positive**	Positive**	Positive**
Per Capita Transport Expenditure	Negative*	Positive**	Positive**	Positive**
Situational Factors				
Social Group (Caste)				
Relation				
Education (Male)				Negative**
Education (Female)				
Dependency Ratio		Negative**	Negative**	Negative**
Per Capita Landholding	Positive**	Positive**		Positive*
Share of Nonfarm Income			Positive**	Positive**
Access to Credit				

* Results for relationshiips that were significant at $p < 0.10$; ** Results for relationships that were significant at $p < 0.05$.
Source: India study team field surveys, 2002.

Table 7.33. Differences in Per Capita Consumption Expenditures

	Impact of Electricity		Impact of Transport		Interactive Effects
	A	B	C	D	E
Jamnagar District					
Percentage difference	36.1				24.5
t-value	2.3**				2.0*
Bharuch District					
Percentage Difference	3.5	16.7	24.8	7.7	11.1
t-value	2.2**	3.0***	4.5***	1.7*	3.0***
Panchmahal District					
Percentage Difference		8.2	7.0		6.6
t-value		6.1***	4.7***		1.7*
Kuchchh District					
Percentage Difference	3.7	–7.3	–7.9		
t-value	2.9***	–2.7***	–5.8***		

A = column compares electrified and nonelectrified households living close to improved roads; B = column compares electrified and nonelectrified househholds lliving far from improved roads; C = column compares electrified households living near to and far from improved roads; D = column compares nonelectrified house holds living near to and far from improved roads; E = column provides a measure of interactive effects, comparing electrified households close to improved roads with nonelectrified households living far from improved roads.
* Significant at $p < .10$; ** Significant at $p < .05$; *** Significant at $p < .01$.
Source: India study team field surveys, 2002.

Port Improvements

The impacts of the private port at Mundra in Kuchchh were different from the impacts of road and electricity improvements. Although these impacts were also covered by the household survey, the open-ended discussions with focus group participants were particularly valuable in understanding port impacts. Focus group discussions were conducted in two sample villages, one about 12 km from the port and the other about 18 km away. Both villages were located on unimproved roads about 2 km from the main road serving the port.

The village of Nana Kapaya had just under 200 households, almost all of which (96%) are Hindu and the rest Muslim. The main Hindu groups were scheduled castes and other backward castes, i.e., groups of low social status. About 60% of households in this village were poor and got subsidized rice, wheat, and kerosene from fair price shops under the public distribution system. However, the village was electrified in 1987 and most of the houses had electricity connections. About 70% of the households had television sets and 24% had refrigerators. Though the majority of households used wood for cooking, LPG was the main cooking fuel for about 40% of the households.

Since the port began operations, two factories were constructed in the vicinity of this village. However, none of the villagers has obtained a permanent job in these factories (Box 7.4). Only a few residents work there as casual laborers. The port has developed a "township" for its staff in the village. To cater to the needs of the staff, a school and a dispensary were opened. The villagers did not send their children to this school, as they could not afford the fees. The village also had a primary school run by the government. While boys went to Mundra Town to continue their studies beyond the 7th standard, girls were not sent outside the village for reasons of safety and cost. The dispensary provides health services both to families of Adani Port employees and to villagers. In addition, this village had an *anganwadi* (courtyard) center where nonformal education, midday meals, and regular health checkups are provided to the children of poor families. The village also had a private clinic run by a government doctor.

The village of Baroi is close to block headquarters in Mundra town. This village had nearly 600 households, about a third of which are poor enough to be eligible for subsidized commodity distribution. Here, about 40% of the population was Hindu, 40% was Muslim, and about 20% were Jains. The Hindu community included both higher (Brahmin) and lower (scheduled) castes as well as scheduled tribes. The Jain community was active in business; some of them even had businesses in Mumbai. Like Nana Kapaya, this village had a primary school that went up to the 7th standard. Boys and in some households even girls went on to secondary school in Mundra Town. The village had no government health center, but a private clinic was located there, and the village was visited by the ANM nurse. The village had a library, established by Jain Samaj in 1954, and about 15 households had telephones.

The focus group in Nana Kapaya consisted of six women from scheduled castes, aged from 25 to 55. All of them were illiterate and were working as wage laborers. Three of the women had had electricity in their homes for 15 years, two got electricity connections in the last 3–5 years, and one had no electricity connection. While the

India needs more ports to handle container traffic and avoid high transshipment costs; Mundra helps meet this need. But local villagers have derived few benefits, as work has gone to outsiders and traditional livelihoods, such as salt pans, are no longer available.

Box 7.4. Disappointed Expectations at a Gujarat Port

Kishorbhai reflects the feelings of a number of villagers living in the vicinity of the new private port at Mundra (Baroi Village). His story shows how the development of a port in the area raised the expectations of the villagers looking for regular employment and then disappointed them.

Kishorbhai belongs to a poor family. After completing his education up to 7th standard, at age 15 he started working as a casual laborer on the salt farms near his village and continued this work for nearly 3 years. In the salt farms, his daily wage ranged from Rs120 to Rs150. When salt farm work was not available, he travelled to places like Surat and Vadodara in search of employment. When he returned to his village, he discovered that the Mundra Port authorities had acquired the salt farms where he had been working.

At present, Kishorbhai works in the port as a casual laborer through a contractor. After deducting his commission, the contractor pays him only Rs80 per day. According to Kishorbai, the salt farmer was paying him on a weekly basis and sometimes also paid as and when he needed the money, but now he is being paid on a monthly basis. The date of payment is also not fixed, since he gets his wages from the contractor and not directly from the port.

Kishorbhai thinks that his status is now worse than it used to be when he was working on the salt farms. Although he was employed for only 6 months in a year (4 months in summer and 2 months in early winter), he used to work as a casual laborer in other places during the lean period. In the lean season also he used to earn around Rs75–100 a day, for the days he worked.

Like his fellow villagers, Kishorbhai is greatly disappointed: he had hoped that the new port would provide him with direct employment in the port with an assured regular income. This does not seem to be possible, since the port engages workers only through contractors.

Source: India study team.

formal focus group discussion was being conducted with the women, informal interviews were also carried out with men and youth around the village.

Two focus group discussions were carried out in Baroi, one with men and the other with women. Five men from the scheduled tribe community participated in the men's discussion. Only one of the participants was illiterate. Three were working as casual laborers, one was working on a salt farm, and one was a driver. Two of the participants were recent migrants to the village and did not have electricity in their houses. The women's group involved eight participants from scheduled castes, ranging in age from 30 to 70. All were illiterate and were working as casual laborers. Only two of the participants did not have electricity in their homes, while the others had had electricity for the past 8 years.

In general, the villagers felt that they had not benefited from the construction of the port in their area. Unemployment in the villages was high. The daily wage for men was Rs100 and only Rs50 for women, and they did not get jobs throughout the year. The villagers had expected that the establishment of a port in their area would provide jobs for all of them. When the port was being constructed, a large number of people from the villages were employed. These workers tried to form a union and started fighting for better working conditions. As a result, the port stopped employing them directly and instead turned to labor contractors, who brought workers from outside the district and even from outside the state. The reported origins of these workers (Panchmahal district in Gujarat, and the states of Bihar and Uttar Pradesh) indicate that they may be even poorer than the people of Kuchchh district. Thus, although port employment has had little impact on poverty in its immediate vicinity, it may be having a positive impact on poverty on a state and national scale. This is little consolation for the local workers, however.

The villagers recognized that after the port opened, commercial activity increased, especially in Nana Kapaya. Some of the villagers set up shops, public telephone kiosks, etc. The port authorities constructed an improved road leading to their "township," and compensated the villagers for the use of their common property by building a water tank for the village. Some villagers benefited by selling land to the port authority and the factories. The rental value of houses in Nana Kapaya village has also gone up. Some of the villagers whose houses are of fairly good quality, and those who were able to renovate their houses with grants received after the 1991 earthquake, have rented out their houses and are getting a good income. Meanwhile, they have moved into temporary housing constructed on their farms. Clearly, the indirect benefits of the port have accrued mainly to landowners and homeowners, as well as to those in a position to invest in commerce and trade.

The port has also brought about some negative impacts, which were felt mainly by the poorer households that depended on wage labor for their income. Since many of the landowners sold their agricultural land to the port or the factories, fewer job opportunities existed for agri-

cultural laborers. Also, while developing the port, the Adani Group acquired many of the salt farms where villagers were previously employed. As a result, they were also deprived of this source of employment. The growth in commerce and trade increased the prices of some essential commodities, putting further pressure on the limited resources of the poor.

Policy Impact

Conclusions

Based on findings from all the different analytic approaches used in the study, the study team concluded that, both individually and jointly, improvements in transport (roads and ports) and energy infrastructure

- had a significant effect on poverty at the household, village, and community levels;
- led to some increase in income from current activities, the benefits of which accrue to all, including the poor;
- opened up opportunities for new forms of employment that could generate a significant increase in income, the benefits of which could accrue to all, including the poor, providing complementary investments are put in place;
- improved access to health care and education facilities, the benefits of which accrued to all, including the poor;
- improved the availability of news and information to both poor and nonpoor people;
- improved access to common property resources by the poor and increased their personal security; and
- had a positive impact on participation of the poor in social bonding, social participation, and building social capital.

The study team also noted that the time frame for the study did not permit capturing longer-term impacts, in particular the welfare outcomes resulting from the observed short-term effects. Some of the communities covered by this study attained access to transport and energy services only recently, particularly road access. Given the relatively short lag between access and effects, the results are encouraging. The apparently greater impact of electricity compared with transport infrastructure could be due to the longer time lag between the provision of service and the measurement of effects.

Recommendations

The study identified a set of policy recommendations for discussion at a national seminar. These recommendations include the following:

- *Invest more in transport and energy infrastructure.*

The study showed that transport and energy investments have positive impacts on the poor. Rapidly increasing demand for transport and energy services is putting a strain on existing facilities, justifying further investment. In the case of energy, the study noted the difficulties that public utilities were having in meeting the energy needs of the rural sector. Under these circumstances, greater emphasis should be placed on exploiting nonconventional energy sources to provide sustainable solutions at the community level.

- *Invest more in improving access to roads and electricity.*

In addition to expanding infrastructure, governments need to invest more resources in managing infrastructure effectively to insure adequate service to all, including the

Improved transport in Jamnagar district, Gujarat, means that a bride can ride to her wedding in a "limousine".

poor. The study team concluded that the supply of both transport and electricity services in Gujarat was both inadequate and unsafe. Electricity generating plants were running at 20–65% of capacity, with high transmission and distribution losses. Public transport vehicles were seen to be seriously overloaded. The focus group discussions identified other obstacles to the use of transport and energy services, such as dangerous driver behavior, inappropriate charging policies, and discrimination against women. These issues are largely issues of governance.

- *Give household access an equal priority in investment planning for transport and energy services.*

It was evident from the experience of the four sample locations that despite the provision of electricity for more than 10 years and of road improvements for more than 5 years, the benefits were substantially less than could be expected, because only some households have access to these services. Barriers to access should be given greater attention in investment and management planning, particularly those barriers that prevent the poor from accessing the benefits of such services. This would be important to alleviate poverty in a more systematic way. In particular, the study recommended subsidizing the cost of electricity connections for the poor, rather than the cost of delivering power. With improved quality of service and greater transparency in billing, both poor and nonpoor consumers would be more willing to pay the full cost ofelectricity.

- *Support the development of complementary infrastructure and services.*

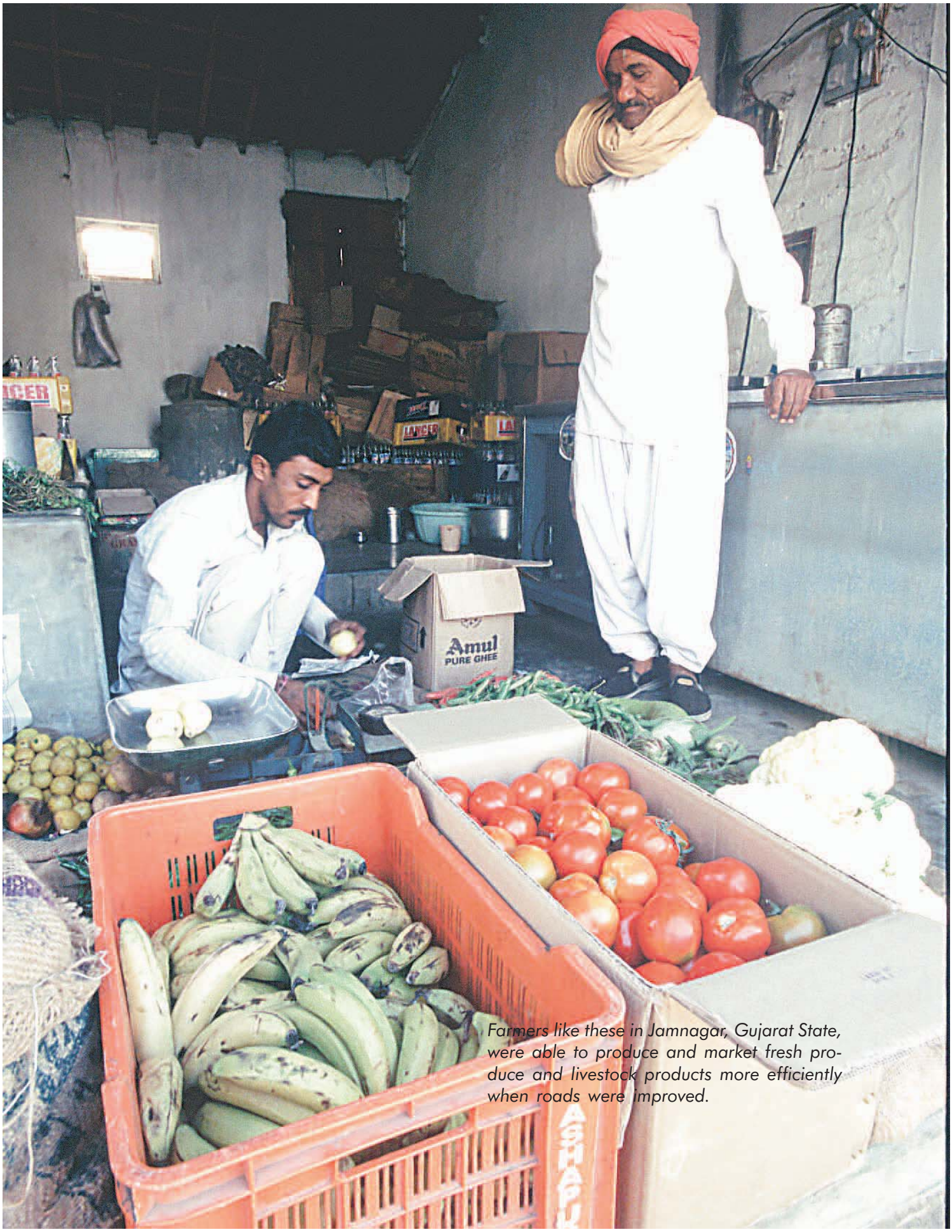
The example of the port in Kuchchh district illustrates how an increase in commercial activity in an area can create additional employment opportunities outside agriculture. Therefore, governments should create an incentive framework encouraging investment in these activities, not necessarily in the villages, but at least in nearby towns. This will create employment opportunities for the villagers. In rural areas, investments should be made in complementary infrastructure that can help to increase farm incomes, such as markets and water harvesting. Without such investments, it is likely that the benefits of transport and energy interventions will remain limited.

- *Create a supportive environment for rural growth and poverty reduction that provides relevant skills and builds on the assets and capabilities of the poor.*

Limited skills often prevent poor households in rural areas from maximizing the benefits of transport and energy interventions. Micro-enterprise advisory services and pro-poor credit opportunities can promote off-farm employment and diversification of production by the poor. The effectiveness of transport and energy interventions will ultimately depend on their integration with other social development programs designed to build human capital and provide alternative means of productive employment to the rural poor.

- *Create an enabling environment for private investment in the provision of transport and energy services.*

Pricing and incentives are the most critical elements of such an environment. A clear and rational policy framework is needed that provides proper signals to all stakeholders. Regulations should be designed to attract more private sector investment, to allow reasonable rates of return to investors, and to improve consumer satisfaction. The performance of service providers and regulators should be evaluated by an independent agency with public participation to improve transparency and diminish the likelihood of capture by political groups.



Farmers like these in Jamnagar, Gujarat State, were able to produce and market fresh produce and livestock products more efficiently when roads were improved.

Chapter 8

FINDINGS AND CONCLUSIONS

This chapter summarizes the lessons learned from the literature review and project review and the three country studies about the effects of transport and energy infrastructure investments on poverty reduction. The following chapters discuss the policy and operational implications of this work and priorities for future research.

Study Parameters

The first goal of this RETA was to contribute to knowledge by identifying gaps in current information and conducting research to fill those gaps in selected areas. The first gap identified was the absence of transport- and energy-related research distinguishing between poor and nonpoor households in the rural population of developing countries. The research that does exist has focused heavily on the impacts of large-scale public infrastructure investments such as rural roads or rural electrification programs. By comparison, relatively little knowledge is available concerning the impacts on the lives of the rural poor of sector policy change, changes in transport or energy service provision, and transport modes other than roads, and energy sources other than (grid) electricity. Finally, research is relatively scarce on the transport and energy needs of the urban poor and the impacts of transport and energy investments in an urban context. Other relatively unexplored areas include the roles of the private and public sectors in poverty reduction, intrahousehold inequities (gender issues), environmental impacts, and institutional reform and governance issues.

The three country case studies have contributed significantly to our knowledge about the participation of the poor, especially the rural poor, in the benefits of transport and energy infrastructure investments. They touch only lightly on the other topics. These areas remain potentially fruitful fields for future research.

Definitions of Poverty

One of the first conclusions that became clear from a review of the literature and the three country studies is that the definitions of poverty and poverty reduction are many and varied. For the purposes of comparative cross-national research, the international poverty line is usually set at a per capita income equivalent to $2 per day ($730 per year) in 1993 purchasing power parity (PPP) terms, and the "extreme poverty" line at a per capita income equivalent to $1 per day ($365) in PPP terms. The Millennium Development Goal (MDG) established by the international community for 2015 is to reduce by 50% the number of people in the world living in extreme poverty, as defined here.

In addition to these definitions, each country sets its own official poverty line, usually based on income, which is relatively easy to measure. In recent years, countries have come to differentiate between urban and rural poverty lines and among regions within countries. These income levels are often, at least initially, calibrated to a consumption level that meets basic food and nonfood requirements. The results may be quite different in dollar equivalents. In addition, national poverty lines may move up or down over time to reflect changes in the perception of relative poverty or in resource availability.

In Thailand, the official poverty line in 2002 was the same in all rural areas, equivalent to about $285 per capita. In urban areas it was slightly higher, and differed by city ($300 in Nakhon Ratchasima, a provincial capital, and $320 in Bangkok, the national capital). The Thailand study team constructed an "extreme poverty" line, based on data for the rural sample, corresponding to a per capita income of about $200. Because of the relatively small number of households in the urban sample that were poor by national standards, the team also used the median urban sample income as a "near-poor" poverty line, equivalent to about $425. The Thailand team also used subjective measures of household poverty, based on how people perceived themselves and were perceived by local

officials. In rural areas, many households that were objectively poor were not seen as being poor in the context of their communities, while in urban (slum) areas, even households that were objectively not poor saw themselves and were seen by others as poor.

In India, the study was carried out in rural areas where the poverty line used was an annual per capita income of Rs4,105 or $88 in 2003. The India team also calculated measures of the depth of poverty (average distance of the per capita income of poor households from the poverty line), the severity of poverty (squared poverty gap), and a measure of inequality (the Gini index) for all groups from the survey data. Though Gujarat state is one of India's better performers in poverty reduction, the incidence of poverty was still high in the sample districts selected for the study. The incidence of poverty in the sample communities was even higher than for the sample districts. This may be a consequence of the sample selection process, which was based on communities only recently served by road improvements in a state where 95% of the rural communities already have good road access.

The study team in the People's Republic of China (PRC) used the national rural poverty line deflated by a local price index, equivalent to a per capita income of about $245 in 2001, as well as the international extreme poverty line ($365), to characterize the sample population. Because income and consumption measures vary significantly in the PRC, the team also assessed impacts on poverty defined as consumption levels of less than $1 a day. Finally, the team calculated the value of household assets for their sample households, and constructed a fourth measure of poverty based on 50% of the sample average value of assets. While income-based poverty was volatile from year to year and households tended to move back and forth across the poverty line, depending on circumstances, asset-based poverty changes more slowly and may be a more reliable means of measuring success in sustaining poverty reduction.

All of the national poverty lines used in this study were lower than the "extreme poor" international standard. Based on these national poverty lines, the proportion of poor households in the rural survey samples varied widely (35% in Thailand, 70% in India, and 40% in the PRC). In the PRC, selected data from a provincial database were also used. The incidence of poverty in this provincial sample was 28% by the national standard. None of these figures should be treated as representative of the countries concerned or even of the study regions. They reflect averages determined for samples that were constructed in order to ensure adequate representation of poor and nonpoor households, in areas that had only recently benefited from transport and energy investments and so might be expected to be poorer than other areas. In both India and the PRC, higher-than-expected levels of poverty were attributed to recent droughts.

The literature review showed that other dimensions of poverty could be significantly affected by transport and energy investments. In addition to economic opportunity, dimensions of security and empowerment were also important to the poor. The research hypotheses selected by the three study teams also investigated the impacts of transport and energy interventions on these aspects of well-being, for both poor and nonpoor groups. The MDGs include not only the reduction of income poverty but also other goals in the areas of education, health care, and environmental protection. This research also looks at the contribution of transport and energy investments to achieving these goals, for the study area populations as a whole, as well as for poor households in particular.

Finally, this study illuminates the importance of economic and social inequality in determining poverty reduction outcomes from the perspective of the poor themselves. In Thailand, people evaluated their poverty status in comparison with their neighbors and the people they see every day—giving a very different result in rural communities and urban neighborhoods. They also tended to see consumption and indebtedness as products of individual circumstances rather than as consequences of government action. In India, landownership, religious affiliation, and gender may influence the extent to which poor people are able to take advantage of opportunities opened up by transport and energy investments. In the PRC, a strong cultural emphasis on equity, reflected in patterns of land distribution and government resource allocation, has facilitated progress in poverty reduction. Current consumption patterns illustrate the importance, even for the poor, of keeping up with their neighbors, for example in the ownership and operation of television sets.

Contextual Factors

Among the three areas selected for this research, less variation than might have been expected was found in national characteristics and sector policy contexts. Thailand has a population of 62 million; India's Gujarat State has 50 million; Shaanxi Province in the PRC has about 36 million. Each study location contains at least one major city, but the majority of the population, especially the poor, is rural. Population densities are not exceptionally high by Asian standards. These locations have been historically important crossroads for international trade and travel.

Entrepreneurial behavior is characteristic of their cultures. Adult literacy rates are high (70–90%) and family investment in education has a high priority. Each of these locations has flourished economically, with only moderate setbacks due to the Asian financial crisis. Each has invested heavily in transport and energy infrastructure, and each has achieved significant success in poverty reduction.

In terms of sector policy, all three countries have a history of publicly providing transport and energy infrastructure and services. With respect to services, they have been more or less open to private provision as well, with the expectation that private services would be more likely to serve the needs of the nonpoor part of the population. Thailand has gone farthest with respect to the private provision of infrastructure, but both India and the PRC are now aiming to increase private participation in infrastructure financing, mainly in partnership with the public sector. In each case, the government retains a regulatory role, and the way in which this role is carried out may influence the possibility of private sector participation, particularly by the poor. For example, in the PRC, passenger transport on agricultural three-wheel tractors, the most commonly available private vehicles in remote rural communities, has been prohibited for safety reasons. High entry fees are also charged for entrepreneurs wishing to engage in long-distance passenger bus transport. In India, the low fees charged for subsidized rural bus services do not generate enough resources to allow for adequate vehicle maintenance, resulting in irregular and sometimes unsafe service. Consequently, even the poor prefer private means of transport when such services are available and affordable.

In the rainy season, unpaved rural roads, like this one in India, are all but impassable.

The literature review in the Appendix of this study (synopsized in Chapter 2) upholds the widespread finding that subsidizing services that the poor are believed to use often produces undesirable results. Subsidies generally do not contribute enough to offset the shortfalls in revenues resulting from regulated tariffs. The inability to charge a commercial rate for public transport and energy services often leads to poor equipment management and maintenance, resulting in hazardous operating conditions and unreliable service delivery. Furthermore, significant "leakage" of such subsidized services often occurs to nonpoor consumers who can afford to pay their full costs.

Transport and Energy Interventions

All the study teams looked at rural road improvements and rural electrification. The Thailand team defined rural road transport improvements in terms of time savings, which means that the actual interventions studied were a mix of road upgrading, new road construction, improvements in transport services, and changes in vehicle mix, particularly in private vehicle ownership. The Thailand team was also the only one to look at transport and energy impacts in urban areas. Urban transport interventions included access to rail transport and other modes of travel in Nakhon Ratchasima and street widening and related change in transport modes serving the settlement in Bangkok.

The India team looked at villages where roads had recently been upgraded to all-weather standards, classifying and comparing households in terms of their distance from the improved roads. The PRC team compared households with and without village road access; it also looked at changes in transport mode and in frequency of travel to different destinations, as well as the impact of employment in road construction and the impact of bus stations on poverty.

In addition to rural roads, the Thailand and PRC teams studied the impact of rail transport on poverty. The India team assessed the impact of a private port project.

Rural electrification, in particular, has been a priority for all three countries. Electricity had reached well over 90% of all villages in the study areas, even before the study period began. In all cases, the selected sample villages were connected to electricity. However, the field research showed that not all households in these villages were connected, and in each case it was possible to divide the sample into those households that were "electrified" and those that were not. In the PRC, only 31 households (3% of the provincial sample) did not have access to electricity in 1998; by 2001, all of these sample households were connected. In Thailand, out of a sample of 913 rural households, only 33, or less than 4%, did not have electricity. In addition, all of the sample households in Bangkok had electricity. However, 73% of the urban sample in Nakhon Ratchasima City had no electricity connection, due to the proximity of the rail line. In India, the sample households were approximately evenly divided between those that had electricity and those that did not.

Research Methods

Each of the three teams carried out household surveys and group interviews in the selected study areas. In general, the selection of the study sites was based on identifying areas that had received recent transport investments, since electricity was already widely available. Within the sites, villages were densely sampled and households were selected within villages in ways that would ensure coverage of both the poor and nonpoor. Each team then used econometric techniques to analyze secondary data as well as data from the surveys, and used participatory techniques to elicit views from different groups of villagers as well as from local officials and key informants. The study teams used the qualitative information obtained through these discussions to complement and help interpret the quantitative findings of the econometric models and analyses of the survey results.

All the teams felt that it would not be possible to construct, from field surveys, reliable measures of income or consumption at the household level for the time before infrastructure interventions took place, up to or even more than 10 years ago. Consequently, in all the country studies, changes in poverty status are inferred from a comparison of households "with" and "without" interventions, rather than from "before" and "after" data at the household level. The PRC team, however, was able, using the provincial database, to construct measures of change in per capita income and per capita consumption over 3 years. The team used these data to evaluate the short-term impacts of transport interventions. This analysis was not appropriate for energy, since almost all households in the PRC provincial sample had benefited from rural electrification even before the beginning of the study period.

Since all three countries/regions have had extensive programs of rural road construction and rural electrification, reaching almost all the villages in the study areas, it was difficult to find places that had not been "treated" with transport and energy interventions, and impossible to "match" such places to the sample sites. Thus, it was not possible to implement a "double difference" design at the village level.

Findings

The following section examines the evidence from each of the country studies concerning the hypotheses formulated in Chapter 4. It should be kept in mind that these statements are simply hypotheses drawn from the literature review, which have been examined in the country studies, and not conclusions from this research. The main relevant hypotheses are those concerning rural transport improvements (roads) and rural energy improvements (electrification). Brief mention will also be made of the study findings on urban transport and energy improvements in Thailand, on rail impacts in the PRC and Thailand, and on port impacts in India.

Rural Transport Improvements

- *Rural transport improvements decrease costs to the poor for personal travel and goods transport.*

Only the PRC study actually assessed the (aggregate) expenditures of poor and nonpoor households on travel and transport. The data show that poor households spend about half as much on transport as nonpoor households. Transport expenditures for the poor and the nonpoor increased in the PRC, mainly because of a shift from walking and other slow modes of travel (bullock or donkey cart) to motorized travel following road improvements. The benefits of this shift are largely reflected in time savings. The clear willingness to pay for time savings associated with this shift may be a measure of the value of time (as well as comfort, convenience, and safety considerations) to the poor. More frequent traveling following road improvements was also a cause of higher transport expenditures. This induced

personal travel suggests that such travel has utility for both the poor and the nonpoor, both as a consumption good and as an investment in employment, education, health care, or social participation.

Participatory discussions in all three countries recorded a common perception that transport expenditures had increased, for the nonpoor as well as the poor, but that transport cost savings were reflected in better prices for farm products and consumer goods. In Thailand, especially, the greater availability and variety of goods in the local markets was valued because of the reduced risk of shortages.

When motorized transport replaces animal-drawn carts, farmers tend to shift from food crops to commercial crops.

- *Rural transport improvements generate farm income that disproportionately accrues to the poor.*

In Thailand, only about half of all surveyed households thought that their incomes had increased as a result of road improvements. Nonpoor households were slightly more likely than poor households to think so. Reasons cited for this improvement reflect both farm and nonfarm income sources. In India, less than half of the respondents thought that their incomes had increased due to transport improvements. The variation between poor and nonpoor households was not significant.

Other evidence from the India case study suggests that rural road improvements did indeed contribute to increased farm income, for a sample that was predominantly poor. Farmers tended to shift away from food crops and toward commercial crops, responding to price differentials that had begun to favor the production of perishable crops and livestock products. In turn, better road connectivity allowing for faster and smoother transport favored the marketing of such products. Input prices also decreased, contributing to the growth of farm incomes. Farmers attribute these changes to increased competition among dealers in response to road improvements.

In the PRC, the share of farm income in total household income declined due to the rapid growth of off-farm employment opportunities. Farm income was also depressed during the study period due to drought. Though the sample average declined, poor households with village road access were likely to have achieved some growth in farm productivity over the study period, while those in villages without road access suffered major losses. The study team interpreted these findings in terms of the response to drought: poor farmers in villages without road access could only sell more of their grain production, while those in villages with road access were able to make a partial shift into fruits, vegetables, and livestock.

- *Rural transport improvements promote the development of nonfarm activities in rural areas that generate income disproportionately accruing to the poor.*

Relatively little evidence emerged from the three country studies on the development of nonfarm enterprises in rural areas, although such enterprises were observed in each study location. The development of nonfarm enterprises in rural areas seems to be more closely related to the provision of electricity than to transport improvements. One nonfarm activity related to transport, however, is the employment generated by road, rail, and port construction activities.The PRC country study addressed the impacts of employment in rural road construction. The impacts of employment in rail and port construction are discussed in the sections below on railways and ports.

In the PRC, respondents worked for an average of more than 150 days on road construction between 1991 and 2001. Nonpoor households had more opportunities for wage employment than the poor. About half the labor days used for road construction were free (unpaid) days contributed

by the community to build village and county roads. Poor and nonpoor households were about equal in the number of free labor days contributed. Thus, from an income standpoint, the poor have not benefited proportionately from the employment created by road construction.

- *Rural transport improvements increase the range of opportunities for wage employment and thereby raise the price of labor in rural areas, generating income that disproportionately accrues to the poor.*

In the Thailand survey, increased wage work opportunities both inside and outside the village were cited as the principal reason for increased incomes following road improvements. This came about through a geographic and economic expansion of the labor market: the geographic expansion was mainly due to decreased transport costs and/or time, while the economic expansion reflected the multiplier effect of transport investments on the local economy. Village road improvements had the dual effect of drawing in even cheaper (farm) labor from poorer parts of the country, and facilitating the out-migration of villagers to better-paying jobs in the towns and cities.

In India, wages increased for both farm workers and nonfarm workers after road improvements. Not only is it now possible for workers to travel farther to find jobs, but labor contractors also now come to the villages with trucks and pick up workers, who might not otherwise be able to afford transport, and deliver them to work sites. In the PRC, a major strategy for coping with drought by poor (and other) households was to migrate over long distances looking for work. This strategy was adopted about equally by households with and without village road access.

- *Rural transport improvements increase the availability and accessibility of education and health care services in rural areas, resulting in greater participation in these programs by the poor.*

Although primary schools were generally available in the sample villages of all three countries, it was necessary for students to travel outside the village for postprimary education. Health care centers were generally not available in the villages. The studies showed that road improvements made little difference in the number of facilities located in the villages, but had a significant impact on the frequency and quality of services provided there. They also made it easier for people to go outside the community to seek services. These benefits were recognized by both poor and nonpoor households. Improvements in community-based services may be particularly important for the poor (and for women), who may find it more difficult to go outside the community.

In the PRC, the quality of primary education improved because more qualified teachers were attracted to schools in communities with road access. Better access also enabled families to send their children to school at a younger age. There is some evidence from the PRC that health conditions are worse in villages without road access, where a higher proportion of households suffer from disability or chronic diseases. Respondents in Thailand felt strongly that road improvements increased their access to health care and education services. These benefits were clearly related to the increased ease and convenience of travel outside the village. In India, road improvements brought about relatively little change in the availability of health care and education facilities in the sample villages. However, they have increased the number of teachers and primary school enrollments, and the number of visits from district nurses. Participatory discussions in India showed that transport conditions are closely related to the willingness of families to send their children, especially girls, to secondary schools.

In general, the health care access benefits of rural transport improvements were among those most highly valued by respondents, both poor and nonpoor. However, the poor may be less likely to take advantage of these benefits, except in an emergency.

- *Rural transport improvements increase (decrease) the access of the poor to natural capital, especially common property resources (land, water, vegetation, wildlife).*

This hypothesis was explicitly tested only in the Thailand and India studies. The results are very interesting. Respondents felt that both their own access and that of others to common property resources were increased by transport improvements. They were happy with the improved opportunity to appropriate such resources for themselves, but less happy about the opportunity given to others. In Thailand, poor and ultra-poor households were more likely than others to perceive a positive impact, while negative impacts were perceived mainly (and rarely) by nonpoor respondents. In India, the responses of poor and nonpoor households differed little. Greater concern over access to common resources was expressed in districts where these resources are relatively less abundant.

- *Rural transport improvements increase (decrease) the personal security of poor people in rural areas.*

Responses on this point were generally positive. Slightly over half of the survey respondents in Thailand felt that, on balance, roads increased their safety and security. However, a significant minority felt that the net impact of roads on safety was negative. The poorest in Thailand were more likely to perceive positive impacts and less likely to perceive negative impacts than either the nonpoor or the poor close to the poverty line. The main advantage, cited in particular by the poorest, was greater accessibility to the police. Less danger from thieves and wild animals, and fewer accidents due to improved road conditions, were also important factors for the poor. Nonpoor respondents were more likely to think that road improvements induce traffic accidents. They were also concerned about easier access to the community by outsiders. These responses suggest that isolation contributes to the vulnerability of the poor in remote communities, and conversely, that transport improvements promoting social interaction and the rule of law may significantly reduce the vulnerability of the rural poor.

Improved access to the police, and less danger from wild animals, were also important positive benefits for both the poor and nonpoor in India, especially in the more remote Panchmahal and Kuchchh districts. The PRC study did not test this hypothesis.

- *Rural transport improvements facilitate the delivery of emergency relief to the poor in case of natural disasters.*

None of the studies explicitly tested this hypothesis. The findings in Kuchchh district of Gujarat state in India, where a major earthquake occurred in 2001, suggest that this may be the case. More important for emergency relief may be the continued functioning of the national transport network (road, rail, and ports). At the time of the earthquake, the private port in India had only recently been constructed and was not designed to handle such traffic, though perhaps it could do so in an emergency.

- *Rural transport improvements have a positive (negative) effect on participation of the poor (a) in local organizations (bonding social capital), (b) in activities outside the rural community (bridging social capital), and (c) in local political processes and management structures.*

This hypothesis was of great interest to all the study teams. In fact, they found that transport improvements had a positive impact on both bonding and bridging social capital. Because of the scattered settlements within administrative villages, transport is often a constraint on social participation even at the local level. It may be that the responses regarding bonding social capital reflect mode changes at the household level (e.g., the general availability of bicycles, carts, and motorcycles) rather than village-level access improvements. In Thailand, transport improvements were seen as facilitating group meetings and mutual support. Time savings associated with transport improvements also increased the possibility of social participation both inside and outside the village. The responses of the poor and the nonpoor did not differ on this point.

In India, the great majority of respondents also reported an increase in social participation, including participation in local associations, community councils, communal work activities, and campaigning for elections. They attributed this increase mainly to transport changes. Again, the responses of the poor and nonpoor varied little. Transport improvements were felt to have had an important impact in improving relations within the village, especially for poor households. They also had a significant positive effect on relations outside the village, except in Panchmahal District, where the household sample contains a high proportion of socially excluded groups.

In the PRC, impacts on social capital were explored through participatory village discussions. More than half the participants felt that social contacts within the community had increased, but less than half believed that community consensus had improved. Feelings were also mixed with respect to relations with neighboring villages. Greater opportunities were arising for meeting and marrying outside the village, but also greater difficulties (for men) in doing so. It seems that although the socioeconomic situation in these remote villages has objectively improved, exposure to the outside world has also weakened internal social bonds and promoted a more critical view of village life in comparison with life elsewhere.

Rural Electrification

A similar set of hypotheses was tested in connection with the rural electrification programs that have been carried out in the three study areas. Only in India did the sample include a significant number of households not connected to electricity, and these households were not asked about electricity impacts. Thus, the responses in all three cases were based on respondents' recall of changes that took place following electrification, rather than on a comparison of households with and without electricity. The econometric analyses did compare households with

and without electricity, even though the nonelectrified samples in the PRC and Thailand was very small.

- *Rural electrification reduces energy costs for the rural poor.*

The Thai team ran a regression of household electricity bills against household income and expenditure and found a significant correlation between expenditures on electricity and household income, for the whole sample but not for poor households.[32] This could mean either that greater use of electricity enhanced income, or that households with higher income were more likely to spend money on electricity. A large share of interviewed households, both poor and nonpoor, felt that electricity had increased their expenditures. This was mainly due to electricity bills, but also to the purchase of appliances, especially television sets. The India team did not explicitly ask about household energy expenditures. However, through focus group discussions in the villages, people indicated that they felt electricity costs were high, bills bore little relation to the actual service provided, and the poor, in particular, were reluctant to connect to the system.

The PRC team divided household energy expenditures into those on electricity and those on other fuels, showing that poor and nonpoor households paid roughly similar amounts for electricity, while the nonpoor spent considerably more than the poor on other fuels. Participants in village discussions felt that they were paying high prices for electricity in return for low-quality services. Taken together, these findings suggest that while rural electrification may reduce energy costs relative to the costs of providing comparable levels of service using other fuels, rural residents do not perceive the costs that way: they are more concerned about the cash outlay required. With other fuels, they can calibrate the cost more closely to consumption, and the cost is often incurred in terms of time rather than cash expenditure.

- *Rural electrification increases farm productivity, generating income increases that disproportionately accrue to the poor.*

Less than half of all respondents in Thailand felt that rural electricity had helped to increase their incomes. In most cases, the mechanisms had to do with nonfarm activities rather than with increasing farm productivity. The poor and the nonpoor did not differ significantly in this response. In India, similarly, only a small minority of (electrified) households reported income improvements due to electricity. Poor households were slightly more likely to report such benefits than nonpoor households. The PRC team, using the provincial database, found higher income growth rates among households with electricity than among those without electricity, with an even sharper difference for poor households. Households with electricity, both poor and nonpoor, had more irrigated land and experienced less of a loss in farm income due to the drought than households without electricity. Farmers who could not afford to buy electric pumps were able to rent them when needed in a drought situation. These findings support the hypothesis that electricity (when used for irrigation) can be an important factor in mitigating risk for farmers who are poor or near-poor, even if it does not otherwise make a major contribution to farm income.

In India, rural electrification improved the quality of service in health care facilities.

- *Rural electrification promotes the development of nonfarm activities, which generate income disproportionately accruing to the poor.*

In Thailand, the primary mechanism for income improvement in response to electricity came through the greater availability of wage employment, in the village and outside it. The poor and nonpoor shared these views, but the nonpoor were more likely to mention jobs inside the village and the poor more likely to cite jobs outside. This suggests that the nonpoor were more likely to invest

[32] In fact, the percentage of electrified households in a village was negatively correlated with income for poor households, suggesting that electricity penetration may exacerbate inequality.

and capture the benefits of electricity by starting local businesses, while the poor depended on investments made by others to generate job opportunities. Similar patterns were observed in the India case, though electricity made a difference in incomes for relatively few households.

In the PRC, the small number of households without electricity had less income growth on the average but performed better in poverty reduction than households with electricity. This effect was attributed to the tendency of these households to adopt a coping strategy involving long-distance migration for employment. Households with electricity, both poor and nonpoor, greatly increased the share of their income coming from wages and salaried employment, in comparison with the share coming from the family farm. This shift was slightly more marked for poor than for nonpoor households.

- *Rural electrification improves the quality of education and health care services in rural areas, resulting in greater benefits of these programs for the poor.*

Respondents in all three study areas endorsed the benefits of electricity for improved education and health care, with little significant difference between poor and nonpoor respondents. In Thailand, respondents attributed the effects on education mainly to the benefits of lighting in facilitating homework. They were also aware of the role of electricity in training for modern sector employment, including computer skills. Lighting also provided the principal benefit cited in terms of health (reduced eye strain). Village lighting reduced dangers from wild animals and thieves and facilitated caring for the ill or dependents at night. Other health benefits mentioned included better food preservation through refrigeration, reduced indoor air pollution, and reduced heat stress due to the use of electric fans or air conditioning.

In India, more than half of all (electrified) households reported that rural electrification had improved family health and education status. The reported mechanisms for health care are similar to those in Thailand, but in addition, the quality of service in health care facilities improved. Impacts on education mainly came from improved lighting, as in Thailand, and in better access to news and information on TV and radio. Sample subgroups differed little in their responses to these questions. The PRC team found that households with electricity had slightly higher average levels of educational attainment, but did not differ from nonelectrified households in terms of the highest level attained. Electrification did not make a significant contribution to changes in school dropout rates or in access to drinking water.

- *Rural electrification increases the flow of information to the poor.*

Gaining access to information from radio and television, as well as reading more books and newspapers due to better lighting, are certainly among the benefits of rural electrification cited by poor and nonpoor alike. The field research showed that it is not necessary for households to have electricity in their own homes to participate in this benefit. People gather at the homes of family members or friends to watch television or to listen to the radio. While this aspect was not specifically assessed by all the study teams, responses on education in participatory discussions show that villagers see improved access to information as one of the more important benefits attributable to rural electrification (and also to road improvements).

- *Rural electrification, by decreasing pressure on woodlands, protects the access of the poor to natural capital.*

The field research yielded little evidence to support this hypothesis. In many cases, the supply of electricity to rural households was only sufficient to operate lights and small appliances like radios or television. Very few surveyed households used electricity for cooking or heating. Fuelwood, charcoal, and agricultural residues are still the dominant fuels for these purposes, although some households have switched to liquefied petroleum gas for cooking. On the other hand, field research showed that electricity is widely used to appropriate water for household and farm use by pumping from wells or community water sources. This does not seem to be a problem in Thailand, and in the PRC it has helped both poor and nonpoor households cope with drought. However, in India, electricity is seen as more of a private good, enabling some households to capture common resources (water) for their own use at the expense of others.

- *Rural electrification increases the personal security of poor people in rural areas.*

Respondents in Thailand felt that village street lighting and household lighting made an important contribution to their safety. Lighting is believed to discourage thieves and wild animals, and to increase the safety of walking within the village at night. The danger of house fires from other fuel sources was also lowered. In India, elec-

tricity was seen to have a significant impact on safety and security only in the more remote districts. The poor and nonpoor did not differ significantly in estimating this impact, either in India or Thailand. The PRC team did not assess this impact.

- *Rural electrification has a positive (negative) effect on participation of the poor in (a) local organizations (bonding social capital), (b) activities outside the rural community (bridging social capital), and (c) local political processes and management of community resources.*

Respondents in Thailand generally perceived a positive impact of electricity on social capital, although not as strong a relationship as for road improvements. Lighting promotes night meetings and visits and facilitates group activities. Watching television together and talking to distant friends and relatives on the telephone are important for social bonding and bridging. The poor and nonpoor felt pretty much the same about this perception. In India, the effects of electricity on social participation were less clearcut. While a majority of respondents in Bharuch and Kuchchh districts saw a positive impact on participation, only about 25% of those in Panchmahal and Jamnagar districts did so. However, about half of all *electrified* households surveyed in Panchmahal district reported positive effects of electricity on bonding and bridging social capital, while virtually no such effect was reported in the other districts. This suggests that electricity may help to confer social status on households that would otherwise be subject to social discrimination. In the PRC, no significant effects of electricity on social capital were noted.

Aggregate Impacts

This research postulated three hypotheses regarding the aggregate effects of transport and energy improvements on poverty reduction at the community or district level, and the potential synergies among them. Because of the difficulty in finding "without-project" cases, the field research did not focus on changes in the incidence of poverty at the community level. It has, rather, focused on changes in household income and poverty status, as well as on nonincome dimensions of poverty. Only the PRC team attempted to measure changes in household poverty status directly, using data from the provincial database. The Thailand team classified households according to their subjective perceptions of change in poverty status; the India team calculated aggregate measures of the incidence, depth, and severity of poverty, as well as of inequality, for the different "treatment" subsamples and for the study districts, but did not attempt to assess changes in these measures over time.

Effects on poverty may also be measured by changes in income. In theory, any income improvement for poor households corresponds to a reduction in poverty, even though it does not necessarily raise that household above the poverty threshold. Using this approach, the three country studies yield considerable evidence that transport and energy improvements do help to improve the incomes of the poor (as well as the nonpoor). Not all poor households benefit, however, and a few even suffer negative income impacts.

Following the review of the draft final report for this RETA, the three country teams were asked to further explore the characteristics of sample households that had not reported income benefits as a result of transport or energy improvements. The evidence suggests that such households are more likely to have characteristics associated with chronic poverty, such as disability or chronic disease, low educational levels, and high dependency ratios. The age and gender of the household head were not related to the ability of a household to obtain income benefits. These findings suggest that improved access to health care and education services may be the most significant short-term benefit of transport and energy investments for chronically poor households, paving the way for improved incomes in the more distant future. Further research will be needed to evaluate the factors that affect the ability of the poor to take advantage of the opportunities offered by transport and energy improvements. The present study cannot demonstrate the impact of such factors conclusively, but it can suggest some potentially rewarding avenues for future research.

- *Transport improvements, all other things being equal, have a significant effect on poverty reduction.*

The Thailand team ran regressions of different variables representing transport and electricity endowments at the village and household level against measures of household income, household expenditures, and average years of schooling (as a measure of human capital). Village dummy variables were also included in this analysis to account for other factors that might explain change in the dependent variables. Of all the transport variables used, only the current length of paved roads from the village to the district office was significantly related to household income, both for poor households and for all households. In contrast, household expenditures for all households

were significantly related to the current length of paved roads, the increase in length of paved roads over the study period, and the length of laterite roads at the beginning of the study period, as well as changes in average travel time to the district office. For poor households, only the increase in length of paved roads and the change in travel time were significant. Village dummy variables were also significant for both income and expenditure effects.

As to the nonincome dimensions of poverty, the Thailand team found that the increased length of paved roads and shorter travel times to the district center in 1992 were predictive of higher average years of education in 2001. However, these relationships were not statistically significant for poor households. In addition, road density (defined as the number of roads to the district office) was linked to educational attainment for all households and for poor households. Measures of transport change were generally not significantly related to subjective satisfaction scores. However, travel times to the district center in 1992 and current road density were associated with perceived improvements in family happiness. Greater length of laterite roads in 1992 was associated with improvement in family well-being, and greater length of paved roads in 1992 with improvement in family convenience. The current length of paved roads is correlated with perceptions of positive changes in the village economy and society.

The India team also conducted an econometric analysis of its survey data, dividing households into the four "treatment" subsamples. Since all households received the "treatment" of village access to road improvements and village electrification, the subsamples were based on household access (less or more than 0.5 km from a *pucca* road and connection or no connection to electricity). The study indicates that household road access had a positive effect on poverty reduction only for nonelectrified households. Poverty levels were actually higher (49%) in households that had both road access and electricity than in households that had electricity alone (46%). In fact, poverty levels were higher in households closer to roads, even for nonelectrified households, in three of the four districts. Only in Panchmahal were poverty levels lower among nonelectrified households close to roads than among nonelectrified households far from roads, and there the difference is small, although sufficient to dominate the findings for the entire sample. These findings suggest that in India, road access itself is not sufficient to overcome poverty. However, they may also reflect a tendency of poorer families to locate closer to improved roads in search of wider (wage work) opportunities.

The India team also analyzed its survey data using a probit model to predict the probability of a household's being poor, based on its access to transport and energy services. Potentially significant situational variables were also included in the analysis, which was carried out within each district in order to control for the effects of contextual factors that might vary across districts. The analysis was not conducted for the survey sample as a whole. The model showed that road access was significantly (negatively) related to poverty status only in Panchmahal district. Distance from home to an improved road also bore no significant relationship to poverty status. However, per capita expenditures on transport were significantly *(positively)* related to poverty status in all districts except Jamnagar. This finding suggests that the poor are spending more on transport than the nonpoor, probably because they have to travel to look for work. Thus, transport services alone do not lead to (income) poverty reduction, but rather are affected by the use people make of these services, as measured by expenditures.

The team also used this model to study the effect of transport and energy interventions on household incomes, measured in terms of per capita consumption expenditures. A highly significant ($p < .01$) relationship was found between road access and consumption expenditure for electrified households in all districts except Jamnagar. For nonelectrified households, however, the relationship was less significant ($p < .10$) and was observed only in Bharuch District.

The PRC team used a probit model to estimate the chances of a household's being poor or nonpoor in relation to transport variables. They found a statistically significant relationship for only two variables: distance to train stations, and per capita transport expenditures. Village road access did not make any difference in poverty levels for the extreme poor (poor by national standards), although it had the expected effect for the near-poor (poor defined in terms of international standards). This finding suggests that the poverty reduction benefits of village road access are mainly captured by the "less poor" households just above the national poverty line.

The common threads in these findings are that poverty levels (except in India) are inversely related to per capita transport expenditures, and that improved road access is positively related to household consumption expenditures. These findings suggest that rural transport improvements, all other things being equal, can have a significant effect on (income) poverty reduction.

- *Energy improvements, all other things being equal, have a significant effect on poverty reduction.*

Because of the small number of sample households without electricity, the Thailand team did not undertake a direct comparison of households with and without electricity. The team did run regressions of five variables representing electricity endowments at the village and household level against measures of household income, household expenditure, and human capital. Only the electricity bill was significantly related to household income, for all households. For poor households, income was negatively related to the percentage of electrified households in the village. An increase in the share of electrified households over time was correlated with higher household expenditures, both for poor households and for all households. The length of time that households have been electrified is also significantly related to expenditures, for all households, but not for poor households. Statistically significant relationships link three electrification variables with educational attainment. This result holds true for the poor, however, only in the case of direct expenditures on electricity. As to the nonincome dimensions of poverty, the Thailand team found that households with more assets were more likely to report satisfaction with changes over the last 10 years. Ownership of television sets, radios, and telephones had a particularly positive effect on all facets of family life.

The India country study showed that household access to electricity had a positive effect on income poverty reduction. Poverty levels were markedly lower (49%) in households that had both electricity and road access than in households that had road access alone (67%). The relationship between electricity and poverty status was strongly affected by other situational variables, especially for households with good road access. The India probit model showed that access to electricity had a significant effect on poverty status in Bharuch and Kuchchh districts for all households, whether near to or far from road improvements. It had a significant effect in Jamnagar for households living near improved roads, and a significant effect in Panchmahal for households living far from improved roads. Per capita expenditures on energy were significantly positively related to poverty status in all districts.

In the PRC, only 31 households in the provincial database were without electricity, and none in the field survey. Within the provincial sample, only 3 households, or 10% of those without electricity in 1998, were poor by national standards. Thus, access to electricity was not a significant determinant of poverty status. Using these data, the team used a probit model to estimate the chances of a household's being poor or nonpoor in relation to its access to electricity. The results were significant only for asset-based poverty. This result suggests that poor farmers with access to electricity were likely to increase their household assets by spending more on electrical appliances (especially television sets), but were less likely to use electricity for productive purposes.

In urban areas like the Thepleela slum in Bangkok shown here, transport and energy improvements bring important benefits for the upwardly mobile near-poor, but make less difference for the poorest households.

- *Transport and energy improvements, taken together, have a significant effect on poverty, which is greater than the sum of their individual effects.*

The data set from India is the only one that permits a meaningful comparison of households that had neither roads nor electricity with households that had one or the

other investment and with households that benefited from both. It suggests synergies between transport and electricity investments in promoting poverty reduction, because the poverty level of households with both road access and electricity (48%) is lower than the levels of households that have benefited from either investment alone (62% for electricity and 68% for roads) or have neither investment (76%). Moreover, the joint achievement in poverty reduction (28 percentage points) is greater than the added effects of the two interventions (8 percentage points for transport and 14 for electricity) taken separately.

Using consumption expenditure as a measure of income, the India team found a highly significant ($p < .01$) interactive effect between transport and energy investments in Bharuch District. Less significant ($p < .10$) synergies were identified in Jamnagar and Panchmahal districts; no significant synergy could be shown in Kuchchh District.

The depth and severity of poverty were twice as great among households that had not received either service than among households that had benefited from both. However, inequality, as measured by the Gini index, was somewhat higher among electrified households and slightly higher among households far from the roads. This suggests that transport improvements tended to reduce inequality, but that rural electrification had the overriding effect of increasing it.

Urban Transport

On the basis of the literature review in Part I, the study formulated a more limited set of hypotheses about the impacts of urban transport and energy investments on the urban poor. These hypotheses were investigated only in the Thailand study, based on a relatively small sample of about 200 slum households located in a provincial capital city and in Bangkok.

- *Urban transport improvements reduce transport costs for the poor.*

Unfortunately, the Thailand study does not provide any direct evidence about changes in transport costs. About half the urban sample households reported that road improvements had increased their expenditures. The effect was more marked for the "below average" households, but less marked for the "poor" households, suggesting that upwardly mobile near-poor families are more likely to increase expenditures on transport in response to road improvements than the very poor. The principal reason cited was more personal travel, but increased transport cost, increased cost of consumer goods, and overspending were also factors in increased household expenditure. Only a very few households (and those mainly well-to-do) reported decreased transport expenditures. These were about equally due to lower passenger transport cost and lower goods prices.

Increases in travel and transport expenditures do not necessarily mean higher transport costs. Economic theory would predict that as transport costs are reduced, the propensity of households to consume travel and transport will increase. In fact, a more careful quantitative analysis of travel and transport expenditures would probably show a high elasticity of such expenditures with respect to incomes, especially for urban households in the process of overcoming poverty. The poorest households in urban areas, however, are less likely to have the flexibility to increase their transport expenditures in response to transport improvements.

- *Urban transport improvements facilitate the delivery of health care and education services to the urban poor.*

About three fourths of urban survey respondents from all income groups felt that road transport improvements had a positive impact on household educational levels. More convenient travel to school was the main reason cited. Other reasons included access to more information sources and increased income that made it possible to spend more on education. A few respondents also mentioned that teachers (NGOs) could visit the slum communities more often. Over 80% of the respondents felt that road transport improvements helped make information more accessible to them. This positive impact was more strongly marked among the poor. The main reason was greater personal mobility and communication with the outside world. However, a number of respondents also cited the greater availability of newspapers, and a few also mentioned easier access to postal services.

An even more positive response was provided with respect to health care impacts, where the strongest positive effect was reported by the poorest group in the sample. Again, more convenient travel to health centers was the main reason, followed by shorter travel times. Other reasons mentioned included increased income allowing for more health expenditures, reduced road dust, more frequent visits from doctors, more convenience in visiting health clubs, and a generally better psychological environment.

- *Urban transport improvements reduce (increase) health and safety risks for the poor.*

Relatively few urban respondents perceived a net negative effect of transport improvements on health. The main negative effect identified was an increase in vehicular air pollution. As to safety, well over half of the sample felt that road transport improvements had a net positive effect, while less than 20% felt that they had a net negative effect. Both the well-to-do and the very poor had a more positive perception of the impacts of road improvements on safety, while those in the middle categories were somewhat less likely to take a positive view. By far the most important reason for improved safety was better access to urban communities by the police. Road improvements were also thought to discourage burglary and theft, contribute to reducing road accidents, and make urban communities more accessible to firefighting services. Respondents who felt that road improvements decreased safety mostly cited the likelihood of increased road accidents.

- *Urban transport improvements increase (reduce) opportunities for employment for the poor in (a) transport services, (b) commerce and industry, and (c) the informal sector.*

Over 20% of the urban sample reported an occupational change in response to road improvements. This impact was fairly evenly distributed across all income groups. Reasons given for occupational change were increased mobility providing access to jobs over a wider area, more business opportunities developing in the community, and jobs becoming easier to find. Over half the urban respondents felt that road improvements had helped to increase their incomes. This effect was more marked for the relatively well-to-do households in the sample, and considerably less marked for the poorest. The main reasons given for increased income included ability to work further from home, more jobs becoming available, higher product sales, and overall economic improvement. The study in Thailand did not identify any change with respect to the employment of the poor (or others) in transport services.

- *Urban transport projects positively (negatively) affect the participation of the poor in (a) community organizations (bonding social capital), (b) activities outside their neighborhoods (bridging social capital), and (c) local political processes and management structures.*

Urban slum residents endorsed the view that road transport improvements have a positive impact on social relations both within the community and between the community and the outside world. Greater convenience in traveling inside and outside the community was the major reason given to explain this effect. In the case of within-community relations (bonding social capital), a few respondents also mentioned that transport improvements facilitate getting together in groups, whereas in the case of outside-community relations (bridging social capital), a secondary reason was the ability to have more business connections with outsiders.

Urban Energy

The study hypotheses concerning urban energy were originally framed in terms of the impacts of energy sector reforms. However, the data collected by the Thailand team enable only a comparison of households with and without electricity.

- *Access to electricity reduces (increases) energy costs for the urban poor.*

Over half of the urban sample households felt that electricity had increased their household expenditures. This effect was less noticeable for the well-to-do and for the poor, and more important for the households in the middle income categories. The few respondents, all from the poorest group, who felt that electricity had lowered household expenditure, cited the lower cost of lighting.

- *Energy reforms increase the access of the urban poor to modern energy services.*

The Thailand study did not explicitly test this hypothesis. Slightly more than half the urban respondents felt that the benefits of electricity were equally distributed between the poor and the nonpoor. However, over 35% of the urban respondents felt that the benefits of electricity accrue more to the nonpoor. Study findings suggest that rural electrification has been more successful in reaching the poor than urban electrification, and that greater attention might now be paid to ensuring that the urban poor also have access to these systems.

- *Access to electricity improves the quality of health care and education services, resulting in greater benefits of these services to the urban poor.*

About half the urban respondents felt that having electricity had helped to improve their educational status. This was especially true for the well-to-do and for the "below average" households, but considerably less so for the poor. Over 75% of the sample felt that electricity increased their access to information. This view was more strongly held among the three upper-income groups, and markedly less so among the poor. With respect to impacts on health, the positive response was slightly stronger. This response showed no significant differences across income groups.

To make transport affordable for the poor, a wide range of service types is required.

It is noteworthy that perceived impacts on household education and health care do not seem to be related to any improvements in the quality of education and health care services available to slum dwellers. Rather, they appear to reflect the direct use of electricity by respondents themselves to improve their educational and health status.

- *Access to electricity reduces (increases) health and safety risks for the urban poor.*

A majority of urban survey respondents felt that electricity had a net positive impact on safety. This view was significantly less likely to be shared by poor households (many of whom did not have access to electricity). Only 6% of the sample felt that electricity had a net negative impact on safety. Positive effects on safety were largely attributed to street lighting. In-home lighting was also believed to be a deterrent to thieves. Those who saw a negative safety impact mainly referred to the danger of short circuits and house fires.

- *Access to electricity increases (reduces) opportunities for employment of the urban poor in (a) energy services, (b) commerce and industry, and (c) the informal sector.*

Access to electricity, in itself, is unlikely to make any difference in the likelihood of poor people's employment in energy services. This part of the hypothesis is more pertinent to the process of energy sector reform, which is said to result in the loss of jobs for poor people. The Thailand study did not test this hypothesis.

Survey data were not available on occupational change in response to electricity access by urban households. Less than 30% of the respondents believed that access to electricity had increased their income. Incomes were slightly more likely to increase for the well-to-do and for the near-poor, while the poorest were least likely to feel they had benefited. Respondents who saw a positive impact attributed it largely to overall economic improvement, more jobs, and higher sales. A few also mentioned longer working hours and higher product prices.

- *Access to electricity positively (negatively) affects the participation of the urban poor in (a) in community organizations (bonding social capital), (b) activities outside their own neighborhoods (bridging social capital), and (c) political processes.*

Less than half of the urban sample felt that electricity had had a positive effect on building social capital within the community. "Below average" households were more likely to have a positive view, but poor households were distinctly less likely to share it. Among those who saw positive effects, the role of electricity in facilitating group meetings was seen as the most important mechanism for building social capital. Enabling mutual help to improve economic status, and enabling night meetings, were also important, while one respondent mentioned being able to talk on the telephone.

The picture that emerges from the Thailand urban case study is that transport and energy improvements bring

important benefits to the upwardly mobile near-poor, but make less of a difference for the poorest urban households, who may be chronically poor.

Railway Impacts

Two country studies addressed the impacts of railways on poverty. The Thailand study looked at the use of roads and railways for long-distance travel. Public buses were by far the most common mode of transport for long-distance travel. The second most important mode was cars or motorcycles. Trains were used by only 7.7% of all rural households, but by a slightly larger share of "ultra-poor" households. Few rural households have considered changing from one transport mode to another; the ultra-poor are even less likely to do so. Those who had thought about making a change were primarily motivated by considerations of convenience and speed (time saving). Cost savings were not an important motivation for change.

Ultrapoor households in rural areas were slightly more likely than other rural households to plan on using trains, while poor households in urban areas were less likely than other urban households to express this intention. Near-poor urban households, however, had the highest expressed intention of using trains in the future. The main reasons that respondents, both urban and rural, thought they might use the train were low cost, convenient stops, comfortable riding, and safety, as well as a few who said they "just want to try it." The Thailand study team concluded that because of the location of stations, travelers whose destinations are in the middle of towns and cities, such as people traveling to work or to look for work in Bangkok, were more likely to prefer train travel. For those traveling to periurban, suburban, or rural destinations, however, train travel will not be the best choice. This conclusion suggests that the ultra-poor, who travel the longest distances looking for work and are most likely to go to Bangkok for this purpose, still benefit from the provision of subsidized train travel.

In the PRC, the construction of a railway brought sharp change to two counties covered by the study. In 1993 the per capita incomes of farmers in Zhen'an and Zhashui counties were lower than in any of the other counties in Shangluo Prefecture, and poverty incidence was very high (80–90%). After railway construction, the annual growth rates of per capita gross domestic product in Zhen'an and Zhashui were higher than in any of the other counties in the province. Annual growth in household per capita income underwent similarly sharp increases, especially in Zhen'an County.

Although the construction and operation of the railway contributed to the growth of the local economy and farmers' incomes, poor households did not benefit proportionally from this growth. In 2000, the incidence of poverty in Zhen'an and Zhashui was still higher than in most other counties in the prefecture. The reason for this disproportionate distribution of benefits may be that the railway affects only the areas along the rail lines, and has very limited effects on farmers who live at any distance from the lines. However, in villages close to the railway, significant changes could be observed.

After construction, railways' main contribution to poverty reduction is by supporting national or regional economic growth. The areas near railway stations also become a focus for growth and poverty reduction, but the areas between stations receive little direct impact.

Railway construction also generates employment opportunities and demand for local products in the areas where the rail lines are located. Three of the four sample counties for the field survey have had railways under construction since 1996. The poor did not experience any discrimination in obtaining access to employment opportunities, since jobs for local people in railway construc-

tion mainly require unskilled labor. On the average, poor households earned about 300 yuan per year from railway construction, about 10% of the household income corresponding to the poverty line.

In addition to employment, railway construction created other opportunities for local residents to increase their incomes. During the construction period, local output of meat, vegetables, and fruits greatly increased. In addition, the railway construction created employment in services such as restaurants, hotels, and commerce during the construction period. Some of these enterprises proved sustainable, as the operation of the railway encouraged more industrial activity and tourism in the area.

The impact of railway construction on employment generation is not only expressed in the form of directly increased job opportunities, but also in its demonstration effect. Before the railway was built, local residents depended on farming for a living. Employment in railway construction gave them the confidence, the skills, and the knowledge of alternatives to seek other employment outside their villages. Railway construction employment was therefore important in building local capacity to participate in larger labor markets.

The PRC study team also found that households within 5 km of a railway station made larger gains in poverty reduction and income growth in 1998–2001 than did households living farther away. Beyond this radius, no correlation was observed between the distance from railway stations and income growth or poverty reduction. Thus, the influence zone of railway stations with respect to poverty reduction would appear to be a radius of about 5 km. Two principal mechanisms may be responsible for the greater progress in poverty reduction made by households living closer to railway stations. One is that households living within 5 km of a railway station had higher growth in income from off-farm employment. Another possible reason is that households living closer to railway stations were more likely to have received technical training. However, these mechanisms tended to benefit households in the near-poor category rather than the very poor, who were not likely to be living in the vicinity of a railway station.

Port Impacts

The India country study assessed impacts of port development on poverty. Mundra Port, in Kuchchh district, is a privately developed port. Since it began operations, two factories have been constructed in the vicinity of one village. However, none of the villagers has obtained a permanent job in these factories. The port has developed a "township" for its staff in the village; a school and a dispensary have been opened for staff families. The villagers do not send their children to this school, as they cannot afford the fees. The dispensary provides health services to families of port employees and to villagers.

The indirect benefits of the port to local residents have accrued mainly to landowners and homeowners, as well as to those in a position to invest in commerce and trade. The negative impacts of the port are felt mainly by the poorer households who depend on wage labor for their income. Since many landowners have sold their agricultural land to the port or the factories, fewer job opportunities are available for agricultural laborers. Also, while developing the port, the Adani Group acquired the salt farms where villagers were previously employed. As a result, they have also lost this source of employment. The growth in commerce and trade has increased the prices of some essential commodities, putting further pressure on the limited resources of the poor.

In general, the villagers feel that they have not benefited from the construction of the port in their area. The port operators and associated industries rely on labor contractors who bring workers from outside the district, and even from outside the state. The origins of these workers (Panchmahal district in Gujarat, and the states of Bihar and Uttar Pradesh) indicate that they may be even poorer than the people of Kuchchh district. Thus, although the port employment has had little impact on poverty in its immediate vicinity, it may be having a positive impact on poverty on a state and national scale.

Conclusions

General

The main finding of this study is that transport and energy infrastructure investments have benefited the poor as well as the nonpoor, in contexts similar to those of this study. It is relevant here to emphasize the importance of the contextual factors: rural areas located in the hinterland of cities that have been historically important crossroads for trade and travel, relatively limited population pressure on productive lands, pro-poor governments and sector policies that are open to private sector participation, characteristically entrepreneurial cultures, and high literacy rates and a strong emphasis on education as the means to a better life. Differences in some of these contextual factors may well explain why similar poverty reduc-

tion results have not always been obtained in other Asian countries or in other parts of the world.

In general, the evidence is not sufficient to reject the null hypothesis that the poor and the nonpoor benefit proportionately. Transport and energy infrastructure is, and is seen to be, a public good, the benefits of which are available to all. Poor people welcome such investments, even if they are not immediately able to take advantage of them. They see the benefits of reduced transport costs reflected in the prices of their products and of the goods they purchase, as well as in the increased presence of traders and service providers in their communities. Poor people share equally in the qualitative benefits of improved access to health care and education services, increased safety and security, and access to information. The benefits of these public goods may be even more valuable to the poor than to the nonpoor, who are more likely to have private alternatives. Furthermore, poor people are as likely as nonpoor people to take advantage of opportunities for increased social contact and participation in civic life.

A second general conclusion is that transport and energy improvements are more likely to bring immediate economic benefits to poor households that are near the poverty line and have the possibility to escape poverty through their own initiative. Such investments are also important to mitigate risks for households that have moved out of extreme poverty but are still vulnerable to economic shocks. In the short run, transport and energy improvements are less likely to benefit the poorest of the poor, whose efforts are often handicapped by other factors associated with chronic poverty.

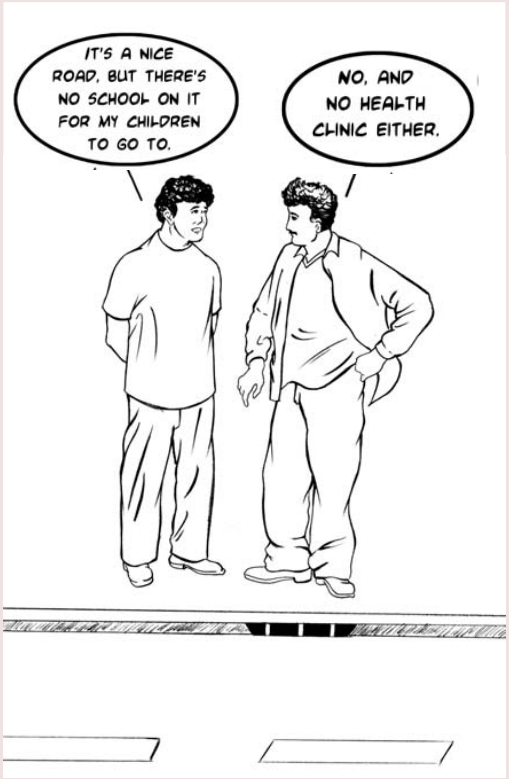
This study also shows that although some villages have more advantages than others, poverty is not so much a village characteristic as a household characteristic. Within well-off communities some poor households can still be found, and even in disadvantaged communities not all households are poor. Bringing transport and electricity to a community creates opportunities that both benefit relatively richer households and enable some of the poorer households to move out of poverty. Even for those households that remain poor, welfare may be improved by some of the secondary impacts of transport and electricity investments at the community level. However, although the level of objective welfare may rise even for the poor, the greater benefits accruing to the nonpoor may increase perceptions of relative poverty. Particularly with respect to electricity, it seems that richer households are better placed than the poor to make the complementary investments needed to turn an infrastructure investment into an opportunity to increase household incomes. Consequently, though everyone in a village may in fact be better off as a result of such investments, the perception may still be one of growing social inequality.

Transport and energy infrastructure creates opportunities to increase productivity. For some households, these opportunities became powerful drivers for an escape from poverty. Transport improvements were seen as having the most significant impacts on the incomes of the poor, mainly through increasing opportunities for employment in nonfarm enterprises. Electricity could also have an impact on incomes and diversification of income sources, but this impact appeared less likely to benefit the poor in the short term. The evidence supports the hypothesis that poor and nonpoor households do not differ significantly in the impacts that transport and energy investments may have on education, health care, safety, the use of time, access to information, and social interaction. In addition, the evidence suggests that time savings for the poor translate into increased productivity and improved welfare.

Whether transport and energy investments bring economic benefits depends to some extent on the assets (natural, physical, human, social, and financial) that people can mobilize in order to take advantage of these opportunities. Natural capital includes such things as climate, soil, rainfall, and terrain characteristics. For example, drought in some places and mountainous terrain in others limited the observed effects of transport and energy investments on poverty reduction. Physical capital includes, mainly, access to land that can be made more productive with improved technology and market conditions. However, transport and energy investments are also important in making nonfarm income-generating opportunities available to landless poor households.

Improvements in human capital, including health care, education, and the acquisition of knowledge and skills, are important elements of human welfare in their own right, in addition to contributing to the ability of people to raise productivity in response to transport and energy investments. Health care and education levels are likely to rise as a result of transport and energy improvements, with a long-term feedback effect on productivity. Social capital may affect the strength of the response in terms of culturally defined limits on the activities of vulnerable groups. However, it can also be a positive asset, especially when expanding economic or employment opportunities to a wider market. Financial capital, especially credit, can be another important constraint on the poor, when investments are needed to shift from traditional to modern farm products or to shift from farm to nonfarm income sources, including migrating to find work elsewhere.

Whether transport and energy infrastructure brings benefits to the poor (and the nonpoor) also depends to a considerable extent on the quality of services provided. The responsiveness of these services to the needs of the poor is partly a function of public policy and partly one of political culture and institutional governance. In Thailand, rural energy services are cross-subsidized by the profits from electricity services provided in the country's major cities. In India, subsidized energy services often do not reach the poor, and the resulting drain on state resources may "crowd out" other poverty-related expenditures. Energy service provision is uncertain and unreliable, and the poor do not see sufficient benefit to invest in connections. In the PRC, until recently, the tariff structure for grid electricity reflected local costs, and consequently the unit price charged in rural areas was higher than that in urban areas. In an effort to serve as many communities as possible, the rural grid had low capacity and did not provide enough power to support productive activities. These problems are now being corrected.



The wider policy framework has a vital role to play in ensuring that transport and energy investments are pro-poor.

In transport, all three countries have relatively open transport service sectors offering a wide variety of options tailored to the needs of different users. Competition is keen, resulting in prices close to marginal costs, so that the benefits of road improvements are likely to be passed on to the transport service consumer. However, in all three countries, the governments still provide subsidized rail transport for long-distance passenger travel. In India, subsidized state bus services are also maintained to serve areas that would otherwise be without public transport. Low fares on these subsidized public transport services make them financially dysfunctional; with increasing access to other options that offer greater convenience, comfort, and safety, even at higher cost, both poor and nonpoor households are increasingly shifting to modes of transport operated by the private sector.

The findings of this study endorse the notion that time savings are of great importance to the poor, implicitly valued at much more than their opportunity cost of labor. Other studies have shown that the poor, especially women, are significantly time-deprived. The requirement of walking long distances, often with heavy loads, to meet household and farm needs in rural areas or to engage in urban employment limits the time available for more productive activities, or for engaging in "reproductive" activities such as child and elder care and participation in social and religious events. Transport improvements generate time savings for the poor (and others) that are reflected in more time spent on farm or household work or on participation in health care, education, or community activities. Time savings are particularly important in expanding the radius within which off-farm employment opportunities are accessible to the poor, in both urban and rural areas. Energy improvements can also contribute to productivity if they are used together with time-saving appliances (for example, the use of gas or electricity for cooking, or the use of electricity to pump water for irrigation). Improved lighting can also extend the productive working hours of both men and women.

The results of the study also stress the importance for the poor of infrastructure and service improvements that decrease risk and increase security, at both personal and community levels. Though emergency health services are needed only on rare occasions, the poor as well as the nonpoor greatly value access to such services. The poor also highly value the ability to deliver emergency relief in cases of natural disaster such as floods or earthquakes, and establish and enforce the rule of law in remote communities, as they are likely to be the most vulnerable victims. Access to transport or electrical equipment, even on a rental

basis, helps to mitigate poor farmers' production and marketing risks and increases the reliability of their incomes.

One finding from all three studies, however, is that for some of the poorest of the poor in remote rural areas, village improvements in transport and energy infrastructure may produce net negative effects on welfare. These are the people whose livelihoods depend on activities, such as headloading or charcoal production, which may be directly or indirectly displaced by transport or energy improvements. This category also includes producers of local goods and services that cannot stand up to market competition. It is incumbent on project designers, therefore, to identify the presence of such potentially "economically displaced" poor people and to include project components designed to help them develop alternative, or more competitive, means of earning a living.

Private Sector Development

The research conducted so far does not point to significant differences between the public and the private sector in delivering infrastructure services to poor households. Greater market competition seems to result in more choices and better prices that maximize the pass-through of benefits to the poor. However, meeting the needs of the poor may mean delivering services at less than their true costs. If meeting these needs is a public priority, some form of subsidy may be required. The study has shown that the poor do not value low-cost, publicly provided services that fail to meet minimum standards of convenience, safety, and reliability; they will shift to higher-cost, higher-quality, privately provided services as soon as they have the option. However, this study has not addressed the broader question of whether the privatization of public enterprises in transport and energy results in cost savings that are subsequently redirected toward improving the welfare of the poor.

Gender Concerns

The study has provided little hard evidence regarding intrahousehold inequities in access to transport and energy services, particularly gender concerns. Some indications emerge that men have preferential access to employment in construction in the PRC. The reallocation of household and farm work that results may increase workloads for women (as well as for men). Women in India, especially poor women, face discrimination and unsafe conditions in trying to use public transport. No gender distinctions are indicated in transport and energy use in Thailand.

The study has, however, shown that women, particularly poor women, are often put at risk by the lack of, or poor quality of, transport and energy services. Reliable transport seems particularly important in encouraging parents to allow girls to continue their education, and in enabling the participation of women in social and economic activities, outside the village. Community lighting, including street lights as well as illumination in communal facilities like schools, health care centers, and community centers, has a positive impact on women's (as well as men's) safety, security, and social participation. The availability of lighting and television/radio in the home is particularly useful in enabling women and girls to study and access information that might otherwise be unavailable to them, as well as lengthening the time during which they can engage in productive work.

Environmental Impacts

This research has shown that the poor are relatively unconcerned about the potential negative environmental impacts of transport or energy infrastructure. The main environmental concerns expressed by both poor and nonpoor respondents have to do with air quality. In transport, dust from laterite roads is seen as a negative impact, so paved roads are seen as environmentally beneficial because they reduce dust. The respondents did not mention negative impacts due to poor road design. Traffic accidents are a concern, but views are divided as to whether road improvements reduce such accidents or, by inducing traffic growth and higher speeds, increase them. Degradation of natural resources due to increased access might be regarded as a negative impact, but most of the survey respondents, especially the poor, did not see it that way. Rather, they were happy with the fact that improved access gave them greater opportunity to appropriate a portion of those resources for themselves. The majority view seems to be that, on balance, rural road improvements are environmentally beneficial. In urban areas, both poor and nonpoor residents are more conscious of the negative impacts of transport improvements on air pollution. However, they are relatively insensitive to safety issues.

The research did not identify any significant environmental issues associated with the use of electricity. Such issues clearly exist: for example, the negative effects of excessive irrigation on soil quality, or the positive effects on indoor air pollution brought about by substituting electricity for biomass-based fuels. However, these issues were not very important for the study respondents. This may be partly due to the fact that the respondents, particularly the

poor among them, have only limited access to electricity. Even if they have household connections, load levels are likely to be low and irregular. Consequently, they are not using electricity very much. In particular, few households have substituted electricity for other fuels in cooking and heating.

Governance

This research only hints at a wide-open field for future work in the area of sector policy, sector institutions, and governance. Ongoing reforms are increasing the involvement of the private sector in providing transport and energy infrastructure and services. Yet these are public goods, and making sure that they serve all members of the public equitably is a vital public interest. Sector institutions are faced with the challenge of transforming themselves into regulatory bodies that are more responsive to the public, and particularly to the poor. Mechanisms for promoting greater participation by the poor in sector policymaking, planning, and performance monitoring are of great interest to governments and to the development partner community. The present RETA has not been able to explore this topic in any detail. However, it is hoped that the picture presented here of the needs and concerns of the poor in three Asian countries will encourage both governments and development partners to adapt their policies and programs in the transport and energy sectors so as to better serve the international development goal of poverty reduction.

This family in Northeast Thailand has followed up its acquisition of electricity and the near-ubiquitous television with appliances and electronic entertainment.

Chapter 9

POLICY AND OPERATIONAL IMPLICATIONS

Policy Recommendations

This regional technical assistance (RETA) makes a number of policy recommendations at several levels. First, each country team developed policy recommendations for discussion in a national seminar with key policymakers and stakeholders. At a workshop held in Vadodara, India, in July 2003, with ADB and JBIC Institute staff and the Study Coordinator in attendance, the three study teams shared the findings and conclusions from their field work. Workshop participants explored the following potential policy implications:

- eliminate electricity connection fees for the poor;
- improve village roads together with major and secondary roads;
- employ more poor people in labor-intensive road construction, ensuring that such employment is sustainable;
- reduce regulatory barriers to a minimum consistent with safety;
- eliminate all monopolies, even public ones;
- give priority to service improvements rather than new infrastructure investments, especially in urban areas; and
- improve both the quantity and quality of services provided to the poor.

These recommendations apply to projects and programs designed by development partners as well as to the work of national policymakers. The workshop participants felt that subsidized service delivery could serve as a disincentive for individual initiative and community responsibility. It is difficult to ensure that even targeted subsidies actually benefit the poor. To promote sustainability, it is essential to get local "ownership" for projects. Workshop participants felt that project designers should pay more attention to women's issues, in particular to their safety concerns. They also recommended that projects should seek to maximize the use of local labor in poor areas.

Members of all three country teams felt strongly that investment in transport and energy infrastructure should continue until national networks ensure that all people have access to quality services. If investment stops before the national networks are complete, it is the poorest who will be left unserved. At the same time, the emphasis on service quality underlines the need for continuing maintenance of existing infrastructure networks, and capacity expansion as needed to serve the demands of a growing economy. The desire to provide quality services to all requires efficient planning and operation of centralized systems, decentralized responsibility together with decentralized resources, and effective collaboration with the private sector. Although the country teams did not explicitly address cost recovery policies, the literature and this study support the view that marginal cost pricing should be applied to all consumers, with well-targeted subsidies for upfront costs and microcredit programs to encourage related investment by the poor, administered in a transparent manner.

The literature and country studies all support the concept of area targeting to reach remaining pockets of poverty and area-wide, cross-sector investment planning to capture synergies among transport, energy, and other forms of support for poverty reduction. In particular, infrastructure investments should be coordinated with social sector investments focused on enabling the poor to take advantage of the opportunities these investments provide. Improved agricultural services, incentives for industrial development, and microcredit programs for the poor should be considered to help the poor diversify their income sources, mitigate risk, and increase productivity. Barriers related to land tenure, home ownership, and legal and social status should be identified and addressed in program design.

While these geographical pockets of poverty that suffer from a lack of transport and energy infrastructure need targeting, this study shows that access to services varies significantly within villages and even, to some extent, within households. Thus, the area targeting approach alone

will not suffice to eliminate poverty. Policies must be designed that will ensure equitable access within communities; address gender, age-specific, and other barriers to the use of services; and encourage decentralized, demand-responsive management by local authorities. Regulation of the private sector should be limited to what is needed to ensure public safety and fair treatment for all, while private and community initiatives should be encouraged.

Of the three studies, only one, in the People's Republic of China (PRC), explicitly addressed the choice of technology in road construction and energy generation as a policy issue. This is rather surprising in the light of the widespread use of labor-intensive methods of road construction, and increasing interest in alternative energy sources for rural communities, especially in India. In Thailand, it is perhaps less surprising, as economic growth in that country has reached a point where even the poorest have higher-productivity uses for their time than building roads with labor-intensive techniques, and grid electricity is available in every village. One can conclude that technology choices should be part of the decision-making process through which projects are designed and approved, rather than being imposed by government fiat. In countries where human labor is still relatively cheap compared with mechanical energy, labor-intensive methods may still be appropriate for road construction; and alternative energy sources such as coal, charcoal, solar cells, or minihydro may still provide more satisfactory service than grid electricity. However, when national networks are well developed and well managed, they are almost certain to provide more cost-effective support to rural communities than solutions based on local labor and local resources.

Policy Impact

One of the objectives of this RETA was to strengthen the participating domestic research institutions by giving them a voice in policy discussions at the national level. The three country teams created steering committees involving key stakeholders, and with their help, planned and carried out national seminars. The steering committee mechanism was useful in securing input and support for the study design from key stakeholders and preparing the way for the national seminars.

The seminars were limited, however, by the relatively short time allowed and the relatively small number of participants, mainly providing an opportunity for the same stakeholders and other key players to review the country studies' findings and recommendations, and critique the results of the research, rather than disseminating and debating the findings and policy implications with a wider audience. They should be seen as initiating, rather than concluding, national debates on the poverty reduction effects of transport and energy investments.

So far, apart from the seminars, little has been done to inform the subjects of each country study about its findings and recommendations. Other channels of communication may be used in the future. However, the degree to which this RETA will influence transport and energy sector investment decisions in the countries involved remains to be seen.

A good road, and a hillside, give this Chinese boy a chance to try out some private transport of his own.

Operational Implications

Support from the International Development Finance Community

The RETA findings support the view that transport and energy infrastructure and related services have a role to play in poverty reduction programs, and the interna-

tional development finance community should continue to support them. While not all the poor will necessarily benefit from such interventions, a significant share will do so. Those who benefit economically are likely to be those for whom other barriers are less significant: those who are relatively better-off (though still extremely poor in international terms), better educated, or in better health; those whose poverty is temporary or seasonal rather than chronic; those who experience fewer social and cultural barriers to participation in economic and social activities. However, many noneconomic benefits associated with transport and energy investments at the community level are equally available to the poor and nonpoor and may be of special significance to the poor. Chief among these are the risk-minimizing and security-enhancing aspects of infrastructure. The study also shows that the quality and reliability of transport and energy services is just as important as the availability of infrastructure, for the poor as well as the nonpoor, and that the ability to achieve time savings is of special significance for the poor, particularly for women.

Some conclusions are implicit in these findings:

- Infrastructure networks should be extended to all communities, since it is the poorest communities that are most likely to be left out if programs stop short of that objective.
- Special measures may be needed to ensure that poorer households within communities gain equitable access to transport and energy infrastructure and services.
- Parallel investments need to be made to maintain and expand existing networks and to ensure continuing quality of service consistent with the needs of a growing economy.
- Programs aimed at reaching the poor may be geographically targeted and should include, or at least coordinate with, complementary investments in other sectors such as education, health care, water supply, agricultural extension, irrigation, and credit for small businesses.
- The study has shown that the use of labor-based construction methods has helped some poor families, particularly in the PRC, to supplement their incomes on a temporary basis. More important, perhaps, they have introduced remote rural residents to the labor market and given them some of the skills needed to seek more productive employment elsewhere.
- The study also shows, however, that significant and sustained poverty reduction from an income perspective depends on enhancing the productivity of individuals and households through complementary investments, either public or private.
- Finally, development partners may be concerned about the fact that not all households will respond in the same way to the economic stimulus introduced by infrastructure investments in an undifferentiated poor community. Thus, some households will move ahead faster than others, potentially increasing social inequality and social tensions within the community.

Conceptual Framework

Transport and energy were found to play an important role in poverty reduction, but the types and extent of impacts varied from case to case. Impacts were highly context- and situation-specific. An intervention in one setting will have different poverty impacts than in another. This heterogeneity makes it unlikely that simple benchmarks can be developed for measuring the poverty reduction impacts of transport and energy projects. On the other hand, the overall approach of examining the poverty impacts of transport and energy interventions within a wider conceptual framework of contextual and situational influences is readily transferable from case to case. This framework should be considered when selecting sectors and projects for inclusion in country lending programs, and examined in detail at the time of project formulation. Interventions should explore the scope for incorporating measures to address key situational factors that may affect poverty reduction impacts. For example, it may be necessary to change policies or programs in the sector, or to change policies, reform institutions, or make complementary investments in other sectors.

Contributions to poverty reduction are likely to be highest where existing infrastructure coverage is limited, poverty rates are still high, policies promote competitive services, and the wider framework of government policies and programs supports the poverty-reducing activities that transport or energy investments will facilitate. The wider policy framework has a vital role to play in ensuring that transport and energy investments are, in practice, pro-poor. First, it must ensure that the poor can actually benefit from such investments. Next, it must provide safeguards to protect against adverse impacts and to reduce risks that the nonpoor will capture most of the benefits. Last, a pro-poor policy framework must ensure that savings from efficiency gains in infrastructure management are redirected to support other programs designed to enhance the productivity and welfare of the poor.

Types of Impacts

Transport and energy are commonly considered primarily as agents of economic growth that contribute to poverty reduction by raising incomes. The case studies strongly confirmed this dimension of the poverty reduction impact: increasing agricultural productivity, raising agricultural wages, reducing transaction costs, increasing labor mobility, and generating opportunities for nonfarm employment facilitated improvements in poor people's incomes and assets. Access to nonfarm employment opportunities, in both rural areas and urban centers, becomes increasingly important as the poverty reduction process gathers momentum and economies diversify.

The case studies also found that transport and energy investments influence important nonincome dimensions of poverty, including health care, education, empowerment, opportunity, security, and freedom. Alleviation of the nonincome dimensions of poverty is also an important underlying factor in raising poor people's incomes over the longer term. This has implications for the role of transport and energy investments in country lending programs. Provision of basic transport and energy infrastructure and services may not only be important for promoting growth, but may also be effective interventions to support education, health care, and other aspects of social development. Such interventions may therefore also be important for achieving the Millenium Development Goals.

Time Frame

The study also helped to clarify that transport and energy interventions contribute to poverty reduction over an extended time frame, perhaps as much as 15–20 years. Attempts to measure impacts over a shorter period are likely to confuse short-term effects with longer-term impacts, and therefore produce misleading findings. Once operational, transport and energy interventions do begin to have effects on the poor, but the effects in the early years are often not a good indication of the full nature or extent of the eventual impacts. This is especially so for income dimensions. Interventions may lead to a transformation of the types of economic activities in areas served, but this usually takes place only gradually and in a cumulative manner. The effects of impacts on nonincome dimensions of poverty are similar. For example, a transport intervention may have immediate effects on school enrollment and access to health services, but this may not result in improved educational attainment and health status until years later.

Project Characteristics

The studies found that reducing the distance to the highway network and improving road quality contributed to income poverty reduction for about half of all poor households. In the poor communities studied, road connectivity was a necessary condition for poverty reduction. Since the countries studied provided a generally supportive framework of policies and programs, many other poverty-reducing improvements followed once roads were improved. Identification of poor areas that suffer from low road density and poor road quality, and examination of the supporting framework of policies and programs, are therefore important starting points in the formulation of pro-poor road projects.

The case study of new railways development found that the main contribution to poverty reduction was through supporting general economic growth. It also found that small areas of high growth developed around towns served by railway stations. A case may be made for future railway interventions' trying to extend these growth areas The case studies of electricity supply identified connection fees, tariffs, and quality of service as critical issues affecting the willingness and ability of poor people to take advantage of existing infrastructure. A strong case can be made for subsidizing connection fees or recovering these over an extended period. Including provision in the tariff structure to provide for low charges for very small consumers may also be feasible. Analysis of how to maximize connections and tariff affordability for the poor should be a critical project formulation issue for energy projects.

The studies found that in very poor and disadvantaged rural areas, poverty reduction impacts were generally greater if both transport and energy were improved, or if transport and/or energy investments were accompanied by other pro-poor interventions, such as provision of small-scale credit and technical training. In the future, when rural transport and energy interventions are formulated, the adequacy of complementary programs should be assessed. Where these are found to be inadequate, it may be useful to make provision for such programs within the scope of the project, or to develop the project on a multisector basis.

Targeting

The country case studies provide evidence that geographical targeting of poor areas that lack basic transport

and energy provision can have an important impact on poverty reduction, helping to facilitate a virtuous spiral of activities that address both income and nonincome dimensions of poverty. Participatory surveys also found that the benefits of improved transport were seen to be shared quite widely among the target population. Despite efforts at universal service provision, the benefits of energy investments were more likely to be seen as inequitably distributed, due to high costs and the need for individuals to make complementary investments in order to capitalize on energy services. Once the basic networks are in place, less scope will exist for geographical targeting, and it will have diminishing returns for poverty reduction.

The studies also found that some poor households had difficulty taking advantage of the transport and energy improvements in their area. These households tended to have characteristics indicating chronic poverty, including old age, illness and disability, minority status, and a high proportion of dependents. More effort is necessary to tailor interventions to enable the chronically poor to benefit. As basic infrastructure is put in place and absolute poverty decreases, providing household or individual targeting of support for the chronically poor gains priority, for example through subsidized transport services, and possibly through subsidies for electrical connection and cost of basic electrical appliances.

Safeguards

The study has shown that a small minority of poor households may suffer net negative impacts from transport and energy interventions if their livelihoods are displaced as a result. It is incumbent on project planners to consider this possibility, identify the groups concerned, consult with them, and include specific, targeted remedial measures in the project to ensure that the project does not leave them worse off. These measures are likely to involve assistance aimed at enabling them to move into more productive occupations.

Remarkably, the study has shown relatively little concern on the part of poor households about the environmental impacts of transport and energy infrastructure. Even road safety, where the poor are often those most likely to be victims, seems not to be a high priority concern for the poor surveyed in the studies. Perhaps the unknown risks of moving into the modern world appear minor in comparison with the known risks of remaining mired in poverty and isolation. With respect to common property resources, the poor appreciate the role that transport and energy can play in facilitating their ability to appropriate such resources to their own use. It is the relatively better-off, who enjoy privileged access under conditions of isolation, who fear the impact of improved access on common property resources.

Monitoring and Evaluation

Generally, ex ante analysis of the poverty reduction impact of projects is likely to be highly speculative, since it is difficult to anticipate the complex chain of long-term changes leading to impacts. While such analysis may sometimes be useful for illustrative purposes, or to ensure that thought is given to situational factors during project formulation, in many cases the results hardly justify the investment resources required. Similar concerns arise in the case of monitoring and ex post analysis. Since projects are typically tracked for only 2–3 years after becoming operational—and generally not for more than 5 years—monitoring data and ex post analysis are likely to record only short-term effects. These are likely to be misleading, and may understate the eventual impacts. For these reasons, it may be better for ex ante poverty analysis to address the sector rather than the project level, focusing on the identification and functioning of the broad impact channels and critical situational factors.

Similarly, the recent trend toward establishing more elaborate poverty impact monitoring of projects, and including poverty impact assessments in audit studies conducted immediately after project completion, may need refinement. Three options may be worth considering to improve the relevance of these studies. First, it should be clear that project-specific monitoring and evaluation studies examine intermediate socioeconomic effects, not final poverty impacts. Second, in view of these limitations, the monitoring instruments and analysis might be simplified to cover a smaller number of indicators. Third, it would be useful to initiate long-term monitoring studies to track the effects and impacts of a small sample of transport and energy projects over a period of as much as 15–20 years.

These concerns about the time frame for monitoring need to be taken into account in current efforts to develop a framework for results-based project monitoring in ADB.

Understanding the links between transport and energy infrastructure and poverty reduction still has a long way to go.

Chapter 10

PRIORITIES FOR FUTURE RESEARCH

It was not possible for this regional technical assistance (RETA) to address the full range of issues on the subject of transport and energy infrastructure investments and their impacts on poverty reduction. It focused on the end user of transport and energy services, and on distinguishing impacts on the poor from impacts on the nonpoor. It looked at impacts primarily in a rural context, although it has paid some attention to the urban poor, and to the ways in which the poor use transport and energy services to link urban and rural contexts together. The time frame for the RETA, and the extent to which communities in the study areas were already served by transport and energy services, made it difficult to use a "double-difference" design for the field research. Instead, the country teams chose to look at differences in household-level access, and to focus on subjective perceptions of impacts as well as on objective indicators of change, to the extent that the data were available.

Within the transport sector, the RETA gave greater attention to the impact of recent rural road improvements. However, two of the studies looked at the impacts of railway construction and operation and one studied the impact of a private port project. While a considerable literature already exists on the subject of rural roads, relatively less is known about railway and port (and airport) projects, or the impacts of capacity expansion projects on major highways.

With respect to these larger projects, it appears that impacts should be separately studied for the construction period and for the period of transport operation. Construction of large projects can provide a short-term stimulus to the local economy through employment and the purchase of local goods and services. To the extent that labor-based techniques are used, part of these benefits can be directed to the poor. However, labor-based techniques are often inappropriate for large projects. The opportunities for local employment may be limited, and the opportunities to provide local goods and services may also require a level of investment that the poor cannot afford. The main purpose of large transportation projects (highways, railways, ports, and airports) is to create a favorable environment for economic growth. The poor will benefit from growth opportunities to the extent that they have the necessary skills and assets to participate.

Within the energy sector, the RETA looked primarily at the impact of rural electrification programs based on extending grid electricity to rural communities. In principle, rural electrification programs based on other sources of electricity, such as community-based renewable energy projects, should not differ significantly in their effects on the poor. However, community-based projects might well have a significantly different effect, even though the electricity provided is the same. For one thing, community-based projects often have a limited capacity and a variable output. This limits the extent to which poor households can use such energy sources to increase their productivity. For another, the unit costs of delivering energy through community-based projects are generally higher than those of grid-based electricity services.

On the other hand, the relative advantage of grid-based electricity depends entirely on the quality of service provided and the relationship of the tariff structure to marginal costs. If state-supplied electricity is weak or unreliable, and if the tariff structure imposes excess costs on domestic consumers, then community-based projects may well be preferable. In addition, such projects can help to build community management capacity and increase local accountability for both the cost and quality of services. Decentralized activities, many believe, will increase the scope for participation by the poor, raising the probability that the poor will receive positive benefits and avoid negative side effects. This is a hypothesis worthy of further investigation.

Infrastructure and Pro-Poor Growth

The literature on the linkage between infrastructure investment, both public and private, and economic growth,

is growing. Some interesting work in this area has been done recently, especially in Asian countries, and continuing this general line of research would be worthwhile. Until now, the debate on pro-poor growth has focused on the link between economic growth and increases in poor people's incomes that can lead to a reduction in income poverty. However, it is also necessary to examine the link between economic growth and improvement in nonincome dimensions of poverty. It is necessary to broaden the notions of poverty reduction and pro-poor growth to cover both income and nonincome dimensions, and to conduct additional research to improve understanding of the latter. For cross-national comparisons, it will be necessary to develop a shared understanding of this broader concept of poverty and a common set of indicators for use in future research.

Sector Policy Issues

Transport

This RETA has mainly focused on the effects of improving road access to rural communities. It has not directly addressed the poverty reduction impact of system-wide improvements designed to alleviate congestion, increase average speeds, and provide more efficient transportation services on a larger scale. Yet, to the extent that the poor are using these systems, directly or indirectly, they may share in the benefits of such improvements. More work needs to be done to tease out the mechanisms by which transport cost savings that accrue in the first instance to vehicle owners or operators are passed on to intermediate users (shippers, merchants, service providers) and end users (travelers, producers, consumers). It seems that the degree of regulation and competition in service provision is likely to affect the pass-through of savings to end users. Subsidies to public transport providers, aimed at improving service to the poor, often appear to have perverse effects. Future research could explore these mechanisms and their effects on the poor in greater detail.

This study has indicated a relatively low level of concern among the poor about the potential risks of road travel. Yet the poor are commonly alleged to be the most likely victims of road accidents and inadequate emergency services. Research on road safety and the real incidence of accident costs may help to clarify views on this subject. Similarly, the poor, especially the urban poor, are more likely to suffer the effects of vehicular air pollution. Again, this has not been an expressed concern in this study. Additional research might serve to raise awareness and stimulate policy change where needed.

Large infrastructure investments such as limited-access highways, railways, ports, and airports are expected to stimulate economic growth in the areas they serve. Although the opportunities for the poor to participate directly in the construction and maintenance of such infrastructure are limited, they may benefit from the employment opportunities created by general economic growth. The extent to which the poor participate depends on their ability to access the infrastructure and related services (for example, secondary roads linking communities to major highways), and on their ability to take advantage of resulting employment opportunities (skills, credit, etc.). A favorable environment for this type of indirect impact seems especially likely when transport and energy investments go together and are combined with strong investments in education and telecommunications. Future research might usefully focus on more specific cases, identifying the factors favoring the participation of the poor in infrastructure-induced economic growth, as well as the barriers to such participation by the poor.

Energy

This study strongly suggests that participation by the poor in the benefits of energy projects could and should be increased. The barriers are mostly regulatory (especially in the case of the urban poor), and high upfront costs. Research could help to identify regulatory barriers and examine the potential for well-designed, targeted subsidies or credit programs to cover upfront costs. Poor quality of service on existing energy networks is also a disincentive to participation by the poor. Future research might focus on better defining consumer needs at different levels of consumption, and making services more responsive to those needs.

This RETA has not specifically addressed the effects on the poor of current policy changes that involve "unbundling" energy sector services and encouraging greater private sector participation. Research elsewhere in the world, particularly Latin America, has suggested that such policy change will be beneficial to the poor, even if short-term costs increase. Private operators, it is believed, will be more responsive to the needs of their customers and will seek to operate services more efficiently. The poor who are currently shut out of services by regulatory barriers or poor quality will gain access and will see their total energy costs reduced, in comparison with the costs of meeting their energy needs in other ways. Others fear, however,

that the private sector will raise prices beyond reach of the poor, and insist on the need for continuing subsidies. Here is a fertile area for future research in the context of ongoing sector policy change in the developing member countries.

Service Provision

Although the RETA initially aimed to cover changes in service provision as well as infrastructure investments in the narrow sense, the field research mainly focused on infrastructure projects, treating service provision as an intervening variable. Although some changes in service provision are clearly related to infrastructure changes (for example, the proliferation of motorized vehicles on recently paved roads), others may be quite independent of such change. An interesting aspect of this question is the extent to which the poor invest in assets, such as vehicles, equipment, and appliances, so that they may become direct users of the infrastructure provided. Even if the poor are unable to make such investments, they may share in the benefits by using equipment acquired by others (e.g., taking crops to market in a neighbor's truck, watching television in a neighbor's home). Renting equipment is another mechanism by which the poor can make occasional use of services they cannot afford on a regular basis. Further research could focus more closely on such changes in the asset base of the poor and the extent to which the poor can "own" new services in this way.

The RETA also suggests that the improved quantity and quality of services at the community level can have an indirect effect on the poor, even if they are not direct users of these services. For example, reduced transport costs can lower the cost of goods in local markets and increase the reliability of supply. Street lighting and electricity in community facilities such as schools and health care centers bring benefits in which the poor can participate. More work could be done, perhaps through participatory methods involving the poor themselves, to identify and quantify such indirect benefits and their effects on the lives of the poor.

Infrastructure and Urban Poverty

This RETA has touched only lightly on infrastructure impacts on the urban poor. Yet the character of poverty in Asia is changing, and poverty is growing in many urban areas, even as it is being reduced in rural areas. The nature of poverty in urban areas is different: many goods that are "free" in rural areas, such as clean air, water, fuels, and building materials, must be paid for in an urban setting. Wage employment and cash income are more critically related to quality of life in urban areas than in rural areas. Many of the urban poor depend on the informal economy to make a precarious living. In addition, urban areas heighten the perception of poverty by offering a ready comparison with the lifestyles of the really rich.

Future research could examine more closely the ways in which the effects of transportation and energy investments in urban areas "trickle down" to the poor. The incidence of both costs and benefits needs to be taken into consideration. Large urban infrastructure investments consume land and create barriers to physical movement, potentially causing physical, social, or economic displacement of people who are likely to be poor. They also raise the value of surrounding land and buildings and encourage the growth of enterprises that consume additional land and constrain the space for housing and small businesses. Socially conscious urban planning would take such impacts into account and aim to ensure that the urban poor

Research is needed on how to make regulatory institutions and service providers more responsive to the needs of the poor.

do not suffer in consequence. At the same time, urban infrastructure improvements that are appropriate in size and scale facilitate the delivery of services in poor neighborhoods and the access of the poor to employment and income-earning opportunities over a wider area. Policy research might focus on the meaning of "pro-poor growth" in urban areas and the types of controls that would be needed to ensure equitable participation by the poor.

Although the RETA did not specifically address rural-urban linkages, at least two of the country case studies (the People's Republic of China [PRC] and Thailand) demonstrate their importance. In the case of Thailand, long-distance travel patterns reveal the role played by transportation in linking the rural poor to opportunities in the city and strengthening social bonds between family members living in urban and rural areas. The PRC study also shows the role of long-distance transport in promoting labor mobility and mitigating environmental risks such as drought. Both transport and energy projects played a part in improving communication and information flow between rural and urban areas. The full extent of these rural-urban linkages and their effects on the poor, both rural and urban, remain to be further explored.

Large Projects

Considerable methodological difficulties arise when one examines the impacts of large projects, such as expressways or electricity generation, where attribution of impacts is especially difficult. At the same time, large projects continue to account for a large share of development partner support to the transport and energy sectors, and satisfactory existing studies of their impact on poverty are lacking. A case can be made for conducting studies to improve understanding of the nature and extent of poverty reduction impacts of larger projects. Such studies should be preceded by an initial phase to develop the conceptual framework and appropriate analytic methods.

Gender Issues

The field research done for this RETA did not permit an in-depth investigation of the differences between infrastructure impacts on men and women. Quantitative data were obtained at the household level, and the field teams did not find it useful to disaggregate their data in terms of male- and female-headed households. However, women actively provided answers at the community and household level, as well as in focus group discussions. In a few cases, focus group discussions were held separately with women, but these did not reveal many significant differences from the findings for men.

The main conclusion from this aspect of the research is that transport and energy improvements create new opportunities for women as well as for men. However, the extent to which women can take advantage of these opportunities is influenced by economic, social, and cultural factors. Safety and security are especially important factors for women, who are vulnerable in public settings. Access to electricity makes it possible for women to do more and to learn more within the home, while improved transport facilitates their involvement in activities outside the home. However, greater income-generating opportunities for men, especially those that involve daily travel or migration, do not necessarily help to improve women's productivity or status.

Most research on gender aspects of transport and energy infrastructure impacts has not distinguished between poor and nonpoor women, although it has generally been carried out in communities that could be characterized as poor. Future research could investigate this question more closely. Some research has suggested that, in the Asian context, poor women are actually more likely to benefit from infrastructure improvements than relatively better-off women, as the poor women are less socially constrained. If true, this hypothesis suggests that transport and energy projects may have a very profound effect on the social structure of rural communities.

Institutional Issues

By focusing on the end user, this RETA has paid little attention to the institutional and governance issues that have much to do with the effects of transport and energy investments on the poor. This is an area that really cries out for additional research. In addition to the general concerns of maximizing efficiency and quality in service delivery, research is needed on how to make regulatory institutions and service providers (public or private) more responsive to the needs of the poor. Decentralization of regulatory responsibility to local authorities has been proposed as one answer. Does this work, or will the decision-making process be captured by local elites? What safeguards are needed to ensure the equitable participation of the poor in, for example, stakeholder oversight groups? What role, if any, can be played by nongovernment organizations? How can the poor hold accountable those representing their interests? Do examples exist of effective community-based or-

ganizations that have successfully managed infrastructure assets and/or operations? What additional benefits can they bring to poor communities?

Another area that might usefully be studied is the behavior and incentives facing service providers at all levels. Anecdotal evidence from the RETA focus groups suggests that public transport operators, especially those serving the poor, often overload their vehicles, drive recklessly, and discriminate against women. Electricity agencies are notorious for their cumbersome, bureaucratic paperwork and procedures, which tend to discourage the poor. Lack of transparency and good governance at all levels creates opportunities for petty bribery that further penalize the poor in their attempts to secure services. At a higher level, decisions are taken on political grounds to which the poor have access only if a genuinely democratic political process is in effect.

Monitoring and Evaluation

Most of the ADB project reports reviewed for this RETA included project monitoring and evaluation (M&E) activities. However, the indicators were mainly measures of project outputs rather than poverty outcomes. For some projects, indicators include the number of jobs to be created. More recent projects identify poverty indicators, although some of these do not specify the extent of expected outcomes. Among the World Bank projects, some, though not many, have explicitly addressed poverty impacts in their proposed M&E activities. The World Bank has also developed detailed guidance on the design of M&E programs for transport projects.

Through the implementation of these ongoing projects, a substantial database on poverty impacts will be created. If the projects are implemented as planned, this database will be of high quality, containing baseline data and periodic follow-up survey data on key indicators for both "treatment" and "control" groups. These ongoing projects should be inventoried to determine the definitions of poverty that they have used and the key impact indicators that they have in common. The findings can then be fitted into an analytic framework that would permit comparison across projects to examine the effects of contextual and situational factors on project outcomes.

Indicators of poverty and poverty reduction in such studies are usually limited to income levels, assets, occupational status, and some indicators of health and education status. Additional indicators relevant to the noneconomic dimensions of poverty, such as safety, security, and social participation, should be developed. Time budget studies may be particularly valuable in examining the effects of transport and energy interventions, and resulting time savings, on the lives of the poor. In all of these studies, data collection and analysis should be disaggregated by gender as well as by income levels, in order to facilitate the study of gender-specific impacts. Greater use could be made of qualitative and participatory research methods to gain insights into the direct and indirect effects of such projects on particularly vulnerable groups.

Methodological Aspects

The literature review and case studies of this RETA showed that attempts to study the poverty reduction impact of individual transport interventions face considerable difficulties at conceptual, methodological, and practical levels. To reduce the risk of conducting studies that produce inconclusive findings, future study proposals should generally be preceded by work to develop a reliable concept, methodology, and practical approach.

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Appendix

LITERATURE REVIEW

Introduction

The literature review conducted for this regional technical assistance (RETA) aimed to assess the state of current knowledge on transport and energy linkages to poverty reduction. It did not question the validity of the demonstrated relationships between infrastructure investments and economic growth (Kessides 1993, World Bank 1994, Canning 1999, Yoshino and Nakahigashi 2000; see Mody [1997] for an analysis of the Asian experience), or between economic growth and poverty reduction (e.g., Dollar and Kraay 2000; see World Bank [1993] for an analysis of the Asian experience). Consequently, the review *excluded* studies that are limited to the linkage between transport and economic growth or between energy and economic growth, without an explicit poverty focus. This review focused, instead, on studies that provide empirical evidence, or at least plausible hypotheses, linking specific types of transport and energy investments to specific impacts on poverty. While this review covered qualitative as well as quantitative studies, particular attention was given to the quantitative ones, which could provide useful guidance (e.g., construction of indicators and indices) for the field research.

Although a fairly substantial literature on transport-poverty and energy-poverty linkages exists, relatively little direct, empirical evidence concerns the impact of transport and energy investments on poverty in developing countries, particularly in Asia. This is because transport and energy, like other infrastructure investments, are intermediate goods. They make possible other activities that increase the productivity and enhance the welfare of poor people, and they contribute to economic growth that may provide resources to reduce poverty. However, the linkage is not a necessary one. Other political, socioeconomic, and cultural factors are likely to be important determinants of the poverty impact of transport and energy investments.

On the basis of the literature prior to 2000 reviewed in the Stage 1 report, it was concluded that relatively little published research had addressed the relationship of infrastructure investments to poverty reduction, although much research had focused on their relationship to growth, particularly growth in the rural economy. It was noted, however, that several ongoing studies were designed to address poverty issues more directly. Since the RETA Stage 1 report was completed in 2001, much additional work has been completed and some of it has been published. The recent literature gives more explicit attention to poverty reduction as a dependent variable.

Since the literature review was completed in 2001, ADB, as part of an overall review of its 5-year-old Poverty Reduction Strategy (PRS) (ADB 2004a), has reviewed and analyzed large amounts of data and published literature on poverty in Asia and the Pacific, the roles of growth and social development and of infrastructure in poverty reduction, the impact of the poverty reduction strategy on country-level operations and project designs, and the monitoring and evaluation of the strategy, poverty assessment reports, and country strategies and programs. The PRS Review incorporates and updates the literature review presented in this Appendix.

Poverty

The Asian Development Bank (ADB) has adopted poverty reduction as the primary goal of its development activity (ADB 1999a). It is pursuing poverty reduction in Asia and the Pacific in the context of its four other strategic objectives: promoting economic growth, human development, and sound environmental management, and improving the status of women. ADB subscribes to the Millennium Development Goals (MDGs) established in 2000 by the international development community, including a 50% reduction by the year 2015 in the proportion of the world's population living in extreme poverty.[1] Much progress has already been made, and despite occasional

[1] Extreme poverty has been defined as per capita consumption valued at less than US$1 a day in 1993 purchasing power parity prices.

setbacks as the region's economy becomes more closely linked to the global economy, it is expected that these ambitious goals can be achieved (ADB 1999b).

Recent events have shown that progress in poverty reduction is vulnerable to external economic shocks, such as the East Asian financial crisis or the sudden liberalization of transitional economies in the Central Asian republics. Such shocks can, at least temporarily, push nonpoor households back below the poverty line. Progress in poverty reduction is also closely linked to progress in controlling population growth, in preventing and responding to natural disasters, and in controlling interpersonal, civil, and international conflict. ADB's strategy for assisting its member countries in poverty reduction rests on three pillars: promoting pro-poor, sustainable economic growth; promoting social development; and promoting good governance. All three objectives may be pursued through transport and energy projects.

The PRS Review arrived at several findings that will affect the PRS and how it is carried out. Among these findings that affect the conclusions of this study:

- Implementation of the PRS has led to a sharper focus on poverty in ADB's policy dialogue with its developing member countries (DMCs);
- Significant changes have occurred in project design in terms of pro-poor targeting and monitoring;
- In the period 2000–2003, ADB increased the share of transport and energy operations within total ADB lending and technical assistance; and
- It is recommended that ADB focus on sectors and subsectors that particularly help the poor—e.g., in infrastructure sectors, the suggested areas of focus included rural roads, rural electrification, small and medium-sized enterprises, water supply, and sanitation.

Definition of Poverty

ADB defines poverty as "a deprivation of essential assets and opportunities to which every human is entitled" (ADB 1999b). "Essential assets and opportunities" are further defined as "access to basic education and primary health services… the right to sustain themselves by their labor [i.e., access to employment opportunities], and… having some protection from external shocks [i.e., access to social protection]," and, importantly, "[a right to] participate in making the decisions that shape their lives." This leads to a definition of poverty indicators that includes basic education, health care, nutritional levels, water and sanitation, income, employment, and wages. These are "tangible" indicators that lend themselves to measurement, and the ADB strategy proposes that they serve also as proxy measures for the "intangible" elements of empowerment and participation. In practice, ADB country assistance strategies are based on the definitions of poverty that are used by its DMCs. Thus, the income levels corresponding to the "poverty line" differ from one country to another.

The concept of measurable, income-based or asset-based poverty can be further specified in terms of *extent* (percentage of the population below the poverty line), *depth* (mean distance of poverty incomes from the poverty line), and *severity* (square of the mean distance below the poverty line). In addition, measures of absolute deprivation (for example, incomes insufficient for adequate caloric intake) can be complemented with measures of relative deprivation or social inequity (e.g., the Gini index). In the Asian context, where significant progress has been made in absolute poverty reduction, social inequity has become an increasingly important dimension of the poverty problem as perceived both by developing countries and by development finance institutions.

The ADB definition fits well with the work on poverty and human development carried out by the United Nations Development Programme (UNDP) over the past decade (UNDP 1990 *et seq.*). UNDP defined a "human development index" combining measures of longevity, literacy, and infant mortality, complementing the income-oriented measures used by the World Bank. More recently, UNDP has added a stronger emphasis on improved governance and participation by the poor as key factors in overcoming poverty (UNDP 2000).

Amartya Sen has been a seminal thinker in shifting the development discourse to poverty alleviation in the broader sense. He defines development as freedom, and freedom as a set of capabilities that enable individuals to lead lives that are valuable in their own terms. Thus, in his view, poverty may be defined as capability deprivation (Sen 2000). Low income levels are thus seen as an indicator and an instrument of poverty rather than as a defining characteristic. Sen points out that the relationship between income and levels of capability varies between communities and even between households and individuals, depending on demographic, social, environmental, and cultural factors. The experience of poverty depends as much on one's perception of oneself in relation to others as it does on conditions of absolute material deprivation. This insight explains why income inequality may be an even more important determinant of perceived poverty than income levels that are insufficient to meet basic human needs.

The World Bank has also recognized the changing thinking about poverty. Its current view of poverty, based partly on the results of extensive consultations with poor people around the world, is given in the 2000/2001 *World Development Report* (World Bank 2001). This report defines the three pillars of poverty reduction as *promoting opportunity* (access to resources, services, and productive employment), *enhancing security* (reducing vulnerability to shocks), and *facilitating empowerment* (increasing the participation of poor people in decision making). The report defines the key indicators of poverty as income or consumption levels in relation to a pre-defined poverty line (national or international), measures of inequality, absolute and relative deprivation with respect to health care and education, exposure to risk, and perceptions of voicelessness and powerlessness.

Recently, development analysts have started to distinguish between transient poverty, structural poverty, and chronic poverty (see, e.g., Hulme and Shepherd 2003). Transient poverty is often the result of sudden shocks such as wars, financial crises, or natural disasters. It affects people who have the basic elements of human and social capital to rebuild their lives, given emergency assistance. Transient poverty is also experienced from time to time by people living close to the poverty line, who may be periodically pushed into poverty by seasonal changes or life cycle events. Structural poverty, by contrast, is basically due to lack of opportunity. It affects people who are disconnected from the wider economy and society and is often geographically focused (Datt and Ravallion 2002, Jalan and Ravallion 2002). The provision of infrastructure and services is critical to overcoming structural poverty. In the absence of intervention, however, structural poverty may be perpetuated for generations.

Chronic poverty may be due to a number of disabling factors at the individual or household level, including dependency (children and the aged); gender, caste or indigenous minority status; and physical or mental disability. The determinants of transient poverty have been shown to be different from those of chronic poverty (Jalan and Ravallion 2002). Chronic poverty thus requires a different treatment in terms of government expenditure (e.g., targeted services, social safety nets, direct income transfers). More attention is now being given to distinguishing between different types of poverty and designing appropriate development interventions for each one.

Poverty in Asia and the Pacific[2]

Global goals for poverty reduction cannot be achieved without significant progress in Asia, which still accounts for about two thirds of the world's population living in extreme poverty. Generally, the countries of Asia and the Pacific have made significant progress in poverty reduction over the past 20–30 years. Their development strategies have focused on promoting broadly-based economic growth, including major infrastructure investments, and creating an attractive environment for private, employment-generating investment. The "green revolution" in agriculture played an important part in achieving significant and sustained growth in Asia. Growth provided fiscal resources that were redirected toward social programs, including major investments in education and health care services, and in social safety nets. These programs have accomplished a great deal in terms of bringing down poverty levels.

However, recent events have shown that progress in poverty reduction can be masked by the effects of crises or shocks, temporarily increasing poverty and placing a significant strain on government resources. Such events are often geographically specific (natural disasters, local conflicts). In these cases, programs to help the newly poor can be geographically targeted, and infrastructure services can play an important role in delivering relief. In other situations, such as the Asian financial crisis, the effects are felt throughout society in the form of reduced resources for poverty reduction. In these cases, priority needs to be given to ensuring that the benefits of past infrastructure investments are not lost through neglected maintenance, and that services continue to be provided to as many people as possible under fiscal constraints.

While the poverty of the past has been largely rural, and while rural areas remain poorer than urban areas, an important part of the solution to structural poverty has involved rural-urban migration. The effects of this migration are not well understood. On the one hand, it may contribute to growing disparities between rural and urban areas, as the better-off rural people become more closely linked to the urban world, while poorer people become relatively more isolated in rural areas. Alternatively, it may help reduce rural poverty if poor rural people are successful in finding urban employment, and especially if they recycle their earnings into rural savings or investments. Rural-urban migration promotes both the growth of markets for both rural and urban products and the redistribution of re-

[2] This section is largely based on Cook (2001).

sources through intrahousehold transfers and extended community support groups. The effects of rural-urban migration on the formation and maintenance of social capital are also not well understood. It has been observed that infrastructure investments, which facilitate personal mobility and migration, may have negative effects on "bonding" social capital within a community, but positive effects on "bridging" social capital linking poor communities to each other and to the rest of society.[3]

Urban poverty has not figured largely in the assessment of poverty in Asia and the Pacific. However, pockets of severe poverty certainly exist in Asia's urban centers. While rural-urban migration may continue to reduce rural poverty, urban poverty is likely to grow in the future. In contrast to the rural poor, the urban poor suffer the negative side-effects of uncontrolled urban growth: air and water pollution; high costs of food, housing, water and energy; poor sanitation; and problems in delivering adequate health and education services to poor urban areas. In pure welfare terms, households with comparable incomes may be worse off in urban areas than in rural areas, where many resources (water, fuel) may still be obtained "free" from common property resources. In thinking about strategies for poverty reduction in the future, it will be necessary to anticipate a shift in relative importance from rural to urban poverty and develop ways of addressing the problems that are likely to arise.

Poverty assessments in Asia and the Pacific generally find no significant difference in poverty levels between male-headed and female-headed households. This may be partly due to cultural factors, partly to the effects of migration and resource transfers, and partly to the tendency for poor households to consolidate into larger units. This apparent lack of gender bias may also reflect the fact that most poverty assessments have not looked into the intrahousehold distribution of income and social responsibilities. Children, the elderly, and disabled persons in poor households are clearly at greater risk, and strategies to reduce poverty in the future should take their special needs more explicitly into account.

Continuing progress in poverty reduction in Asia and the Pacific depends upon sustaining high levels of economic growth while controlling growth in population. The capacity of Asian countries to continue reducing poverty will depend partly on their success in maintaining a competitive advantage in the global marketplace and mobilizing private investment. In addition, more equitable societies, all other things being equal, seem to be more successful in widely distributing the benefits of growth and thereby reducing poverty. Patterns of governance, and the relative importance of the public and the private sector, also appear to influence the rate of poverty reduction. Excessive public investment, indebtedness, and inflation seriously constrain the ability of governments to direct public resources toward poverty-reducing programs.

Poverty in Development Projects

Since poverty reduction was established as the overarching development goal by the international community, international finance institutions have sought ways to integrate poverty concerns more explicitly into the design of development projects and the monitoring of development outcomes. Few projects explicitly designed to address poverty reduction were approved before 1995, and most of these are being implemented. International institutions and other development partners have developed guidance for staff and clients on how to take poverty reduction into account in project and program analysis (ADB 2001, World Bank 1999). However, empirical research measuring the poverty impact of development projects is still rather limited, with relatively few research results yet available.

Early efforts to incorporate concern over the distributional effects of development projects in project appraisal (Little and Mirrlees 1974, Squire and van der Tak 1975) were generally unsuccessful (see Powers [1989] for a review of experience with this approach in the Interamerican Development Bank [IDB]).[4] ADB's *Guidelines for the Economic Analysis of Projects* (ADB 1997) requires that an analysis be made of the distribution of project effects (costs and benefits) among different groups, and that the proportion of the poor in each group be calculated so as to assess the proportion of net benefits going to the poor (the poverty impact ratio). Some issues with this approach have been identified: how to assess societal benefits derived from meeting the basic needs of the poor, whether to consider that different social groups may have different discount rates and different degrees of

[3] Pouliquen, Louis, comments offered at the World Bank's Rural Week, 2001. For a fuller description of these concepts and their relationship to poverty, see Narayan (1998).

[4] Incidentally, Powers (1989) reports that in IDB lending, where a (differently defined) poverty impact ratio was systematically calculated for some years, transport and energy projects consistently showed the lowest values for this ratio. Fujimura and Weiss (2001) suggest that this may be due to the difficulties of tracing indirect income effects, since transport and energy are intermediate rather than final consumer goods.

risk exposure, how to specify indirect income effects, how to evaluate the share of the poor in benefits accruing to government, and how to establish the project counterfactual (Fujimura and Weiss 2001).

As part of preparing its poverty reduction strategy, ADB undertook a series of stakeholder consultations in 1998–99 in several member countries (ADB 1999a). These consultations identified the lack of basic infrastructure as one of the aspects of exclusion of the poor, but pointed out the need to balance the social gains from infrastructure investment in remote areas against diminishing economic returns. Other changes needed to overcome poverty (intensifying agricultural production, improving human capital through health care and education programs, creating nonfarm employment opportunities) were not, in these consultations, explicitly linked to infrastructure needs.

A review of 20 ADB projects approved from 1992 to 1998 in five DMCs showed that although they contained a large amount of poverty data, they usually failed to analyze the causes of poverty and often lacked a coherent strategy to overcome it (ADB 2000c). Most did not have a well-defined poverty reduction objective accompanied by baseline data, specific targets, and relevant indicators. The projects provided little information on the breakdown between poor and nonpoor beneficiaries. An ex ante review of recent (since 1995) projects in the transport sector concluded, however, that staff and clients have been moderately successful in mainstreaming poverty concerns in project formulation (Hansen 2000). This review notes the absence of agreed indicators for capturing the non-economic dimensions of poverty, and the necessity of ensuring good follow-up on project monitoring and evaluation activities to find out if their poverty reduction objectives are actually achieved.

The World Bank, too, has established poverty reduction as its overarching objective. Poverty assessments have been carried out in almost all borrowing countries, and assistance is provided to clients for the development of institutional capacity to monitor poverty as well as economic growth. The World Bank has prepared a *Poverty Reduction Strategy Paper (PRSP) Sourcebook* (World Bank n.d.), with chapters on each of the sectors. The *PRSP Sourcebook* chapters on transport and energy are reviewed in the corresponding sections of this chapter.

Infrastructure projects carry a particular risk of impoverishing, or further impoverishing, people affected by relocation associated with the construction of major facilities such as highways, bus terminals, ports, airports, railways, dams, power plants, and transmission lines. Both ADB and the World Bank, as well as other development partners, have strong policies determining the requirements for resettling people affected by such projects and internalizing the consequent costs in project cost-benefit analysis. Current thinking in the area of resettlement policy and planning focuses on early identification of risks such as loss of land, loss of employment, loss of shelter, loss of food security and other health risks, loss of access to common property resources, and loss of social capital, including family and community ties, formal and informal social organizations, and traditional mechanisms of social control and political participation (Cernea and McDowell 2000). ADB has also prepared guidance for staff on identifying these risks and planning appropriate mitigation measures to include in projects (ADB 1998).

Poverty and the Private Sector[5]

Sustainable poverty reduction requires sustained, pro-poor growth as well as targeted transfers and safety nets for the poor. The resources needed to fuel sustained growth far exceed the resource mobilization capacity of governments and international institutions. Private capital flows are already far more significant, and the private sector is often a more efficient and effective manager of investments, particularly profit-making ventures, than government. Thus, the active involvement of the private sector is essential for successful poverty reduction. This conclusion is particularly relevant for the infrastructure sectors. (See Box A.1.)

A study of current private sector involvement in infrastructure provision for the poor shows that over 80% of low-income countries have some type of private participation in infrastructure. In the lowest-income countries, the public sector is still responsible for most infrastructure investment, although even here, private sector involvement is growing rapidly (Houskamp and Tynan 2000). About two thirds of all private sector investment in low-income countries in1990–1999 went to two countries, India and the People's Republic of China (PRC), while significant shares were also allotted to Indonesia and Pakistan. These four countries resemble middle-income countries in the levels and types of private infrastructure, which cover all or nearly all of the sectors reviewed (energy, telecommunications, transport, and water supply). The majority of

[5] A useful symposium on this subject is *Infrastructure for Development: Private Solutions and the Poor*, Proceedings of an international conference held in London and sponsored by the Public-Private Infrastructure Advisory Facility (PPIAF), DFID, and the World Bank, 31 May–2 June 2000. Several of the studies cited in this review are reprinted in Brook and Irwin, eds., *Infrastructure for Poor People: Public Policy for Private Provision*, World Bank and PPIAF, 2003.

Box A.1. Role of the Private Sector in Poverty Reduction

The private sector, the engine of growth, can also play a direct role in poverty reduction. It can participate in physical and social infrastructure, including provision of basic services that will benefit the poor… As the role of the private sector expands, that of the government should shift from owner and producer to facilitator and regulator… Governments must also monitor the social impacts of privatization to see that retrenchment, redeployment, or compensation programs are appropriate... For poorer areas, public investment is generally necessary (p. 9).

The contribution of the private sector to poverty reduction will be enhanced through enterprise development, expansion of infrastructure and other public services, and improvement of corporate governance and responsibility…. Private operators could be enabled to increase their participation in providing infrastructure and public services and in projects targeting the poor. Regulatory reform will, however, need to precede sector-specific approaches such as privatization, contracting out, and public-private partnerships (pp. 23–24).

Source: ADB 1999.

projects in low-income countries are "green field" projects, where a private entity or a public-private joint venture builds and operates a new facility from the ground up. This category also includes build-operate-transfer (BOT) and build-operate-own (BOO) projects, as opposed to divestitures and operations and management contracts with major capital expenditure.

Komives, Whittington, and Wu (2000) made an attempt to measure the extent to which the poor benefit from infrastructure services (defined to include water, sewer, electricity, and telephones) on a global basis. Access to roads and road transport services were not included in this survey. Given the limitations of current country-wide infrastructure statistics, the paper used data from the World Bank's Living Standards Measurement Survey to construct statistics for a pooled sample of 55,500 households from 15 countries around the world. Results suggested that the very poor rarely benefit from infrastructure services. Electricity coverage was more widespread than that of other infrastructure services at all income levels; water connections came second, then sewer connections, followed by telephones. Electricity was the only infrastructure service with significant penetration (32%) among the poorest 5% of the sample households.

A recent survey of professionals working in public utilities in developing countries (Houskamp 2000) shows strong agreement that (i) improved services are a top priority for low-income households, (ii) a majority of low-income households understand the positive health and safety consequences of improved services, and (iii) the techniques currently available for assessing the level of demand are still inadequate. Respondents agreed that the best outcome would be for everyone to receive services through formal delivery systems. Technological considerations make it advantageous to plan and build networks starting with trunk facilities and working down to distribution or feeder pipes and lines. The respondents also agreed that efficiencies from standardization and economies of scale are significant in utilities, limiting the possibilities for competition. However, they felt that if provision of services by providers other than public utilities were allowed, small entrepreneurs would offer sustainable low-cost alternatives to formal network supply. The survey reflected views that achieving some improvement in service for all low-income households is more important than meeting absolute service quality standards for a smaller number of households. Respondents also agreed that utilities in developing countries should be subsidized to ensure that the poor gain access to essential services. They felt that cross-subsidies (or social tariffs), though imperfect, are the best means of making infrastructure services accessible to low-income households.

Privatization of "natural monopolies," such as utilities, raises some important questions about the role of public policy in protecting the interests of consumers and ensuring access of the poor to services. Ehrhardt (2000) summarizes the key structural issues that governments should consider when planning to introduce private participation in network utility industries. He recommends regulatory reform to allow entry by new providers in some market segments to compete with the incumbent or to serve previously unserved market niches. Small operators may be able to provide a "basic needs" level of service more cheaply than formal network operators. Small operators and new entrants may also offer cost-quality combinations better suited to poor people's willingness and ability to pay; new entrants can offer innovative tariff and payment systems that make it easier for poor people to access service. To allow and support pro-poor structural changes, regulation should allow new entrants to access existing networks on fair terms, be light-handed so as not to burden small and informal providers, and be reduced as competition increases.

Smith (2000) identifies three principles for the design of pro-poor regulatory systems: (i) intervene sparingly, and with care; (ii) ensure that regulatory bodies have the right expertise, are independent of those regulated, and are placed at the appropriate level of government; and (iii) involve stakeholders in regulatory policy formulation and implementation through a transparent process. Regulatory bodies need access to reliable information in order to make sound decisions. This includes information about the needs and priorities of consumers, firms, and other stakeholders, as well as information about the performance of regulated firms. A pro-poor regulatory strategy would focus on deregulation, eliminating barriers to entry, reducing the scope and intensity of price controls, and being more pragmatic in attempts to control service quality. In addition, such a system would systematically take into account the perceptions and priorities of the poor in evaluating industry performance.

Legally established monopolies in infrastructure services such as transport and energy, with provisions for cross-subsidies between different categories of users, are often justified as a form of "protection" for the poor. However, recent research has shown that the intended benefits of such regulation rarely reach the poor. Restructuring and privatization of public enterprises to promote competition may be a more effective way to accomplish this objective. Regulators need to become effective advocates for the needs of the poor, and to help in ensuring that they are heard. This may involve building new partnerships with civil society and adopting new methods of obtaining information about the practical effects of different regulatory approaches.

Pro-Poor Growth

In recent years, considerable work has been done on the nature of "pro-poor growth" and the role that infrastructure investments may play, alone or in combination with other public expenditure priorities, in enhancing the distributive impacts of growth (Ahluwalia 2002, Ali and Pernia 2003, Jalan and Ravallion 2002, Kakwani and Pernia 2000, Kakwani 2000, Pernia 2001, 2003). These studies tend to show that the benefits of trade policy and institutional reforms are less likely to reach the poor, especially those who are geographically isolated, when public (or private) investment in infrastructure is constrained. Infrastructure has a key role to play in streamlining product and factor markets and extending opportunities to the poor, especially the rural poor (Yao 2003). Particularly in Asia, economic growth and poverty reduction have followed expanding access to global markets, which in turn depends on expanding transport and logistic infrastructure at the national level (Carruthers and Bajpai 2002). Other types of public investments (e.g., education) are also needed soe the poor can take full advantage of these opportunities.

The importance of linkages between farm and nonfarm growth in the rural economy for the welfare of the poor has been known for some time (e.g., Hazell and Haggblade 1993). Recent research has underlined the increasing marginalization of agriculture in the world economy and its consequences for the rural poor (Bryceson, Kay, and Mooij 2000). This theme suggests that the positive impacts of infrastructure investments on poverty reduction, even in rural areas, may be achieved more by expanding opportunities in the nonfarm sector than by increasing agricultural output. However, a recent analysis of data for Viet Nam shows that the processes determining poverty and those inhibiting diversification of income sources are not the same (van de Walle and Cratty 2003). Thus, development of the rural nonfarm economy offers a way out of poverty for some, but not all, of the poor.

The World Bank recently completed a wide-ranging review of the literature on the impact on poverty reduction of increased access to infrastructure services in four sectors: energy, water and sanitation, transportation, and information and communication (Brenneman and Kerf 2002). This review defines "increased access" in terms of greater quantity, improved quality, or reduced costs (greater affordability). It looks at eight categories of impacts, from general growth linkages to economic impacts on the poor (through cost savings or employment opportunities); impacts on health care, education, and governance; noneconomic welfare impacts; and fiscal impacts (releasing public resources for implementation of pro-poor social policies). The definition of poverty alleviation used in this review is equally broad, ranging from growth impacts in poor countries (assumed to benefit the poor) to targeted impacts on the poorest of the poor. The review found strong evidence of growth-enhancing impacts for transport and energy, as well as strong synergies with education. Some positive synergies were also found with public health. Linkages with improved governance and fiscal impacts were generally found to be weak, except for information and communications. The report concludes that infrastructure impacts on poverty are similar in all regions, but are better documented in regions where physical infrastructure is still largely lacking (e.g., Africa) than in regions where access problems are due more to affordability and quality issues (e.g., Asia).

The United Kingdom's Department for International Development (DFID) has been one of the main sponsors of research on transport and energy interventions targeted to the needs of the poor. Recently, its work has focused on directly linking infrastructure activities to the achievement of the MDGs (DFID 2002a, 2002b). A background paper prepared for this program stresses the need for efficient management and timely expansion of national networks in tandem with policies and investments designed to improve services to the poor (Willoughby 2002b). The paper argues that infrastructure should be seen as a leading sector in efforts to improve the productivity of the poor. Infrastructure contributes to pro-poor growth in four ways: by spreading the benefits of trade to low-income areas, reducing the risks associated with private investment in manufacturing and agriculture, facilitating the delivery of education and health care services, and reducing the risks associated with natural and man-made disasters. Making infrastructure more responsive to the needs of the poor requires institutional and regulatory reform to promote competition, with greater accountability to and participation by the public, including the poor, as well as the elimination of subsidies now largely captured by the nonpoor.

A recent International Labour Organization (ILO) publication provides an extensive analysis of requirements for the rapid assessment of poverty impacts, with special reference to employment-intensive infrastructure projects (Murphy 2000). The proposals reflect current thinking on the livelihoods approach to analysis of the effects on poverty of potential interventions. Basically, what makes the proposed approach "rapid" is the avoidance of direct measures of income and expenditure, relying instead on scaled (and somewhat subjective) measures of access to food, water, shelter, energy, and "nonfood essentials," as well as health status and asset ownership (household goods and tools, land and livestock). The methodology proposes categorizing respondents into four groups: the "ultra-poor" who are extremely deprived and highly vulnerable; the "poor" who are deprived and vulnerable; the "modest" who are not deprived, but still vulnerable; and the "prosperous," who are neither deprived nor vulnerable. The first three categories roughly reflect the concepts of chronic poverty, structural poverty, and transient poverty.

Transport

Most of the early empirical work linking transport investments with poverty reduction defined poverty in terms of a region or a rural economy, without disaggregating to the village or household level. A recent survey of the issues and evidence on the links between transportation and poverty reduction uses the "sustainable livelihood" framework developed by DFID. It is argued that a general equilibrium approach would be needed for a rigorous assessment of the complex consequences of transport interventions for the lives of poor people. Current studies are limited to the roads subsector, and suffer from many methodological problems. The report stresses the role of transport infrastructure and services in building the asset base (physical, human, and social) of the poor. However, the report also points out that the effects of transport improvements on the livelihoods of the poor depend on both the broader structural and institutional context and the other assets available to the poor. Therefore, projects should evaluate sector policies and possible needs for institutional strengthening, especially in building capacity for decision making at decentralized levels that may be more responsive to the needs of the poor.

The World Bank has developed informal staff guidance on addressing poverty issues in transport sector operations (Gannon and Liu 1999). The report suggests caution in evaluating project benefits based on measures of willingness to pay, which may place a premium on projects primarily benefiting higher-income groups. It also points out that privatization of public transit may lead to labor redundancy, increased fares, and reduced affordability, which would impact most severely on the poor. Conventional cost-benefit analysis is not suitable for evaluating improvements to very low-volume rural roads and the benefits to nonmotorized transport users (including pedestrians) of improving roads to all-weather standards. In these contexts, alternative appraisal methods such as cost-effectiveness analysis should be used to guide project selection.

Additional guidance is provided in the Transport chapter of the World Bank *PRSP Sourcebook* (Gannon, Gwilliam, Liu, and Malmberg Calvo, undated). This chapter aims to help decision makers integrate transport interventions into poverty reduction programs. It points out that transport affects poor people as consumers, producers, workers in transport operations, and groups exposed to adverse impacts. Demand for transport is largely derived from other sectors; hence, transport investments will have the greatest impact on poor people when other sector interventions (both policies and investments) are also in place. The *Sourcebook* stresses the need to address both infrastructure and services in transport policy, establish public accountability for poverty outcomes, and promote broad public participation in planning and action to meet trans-

port needs. The chapter also includes a set of diagnostic tools and key questions that can be used to assess the transport needs of poor people and the performance of the transport sector from a poverty reduction perspective. It describes key policy and strategy options in relation to rural transport, urban transport, and institutional reform. Finally, it discusses the role of monitoring and evaluation in the transport sector and includes proposed indicators.

The empirical literature on transport and poverty reduction is heavily biased toward (i) roads, (ii) rural dwellers, and (iii) Africa. Asia is very different from Africa. The difference may be most striking in terms of the role of women (see Box A.2), who provide the main mode of transport in the parts of Africa most studied in relation to poverty. In Africa, women spend much time head-loading goods on foot, in addition to undertaking other physical tasks, little shared by men. This is not typical of Asia.

Transport Needs of the Rural Poor

Staff members at Intermediate Technology Limited, in collaboration with the ILO, conducted early studies on rural transport services in Bangladesh, India, Kenya, Republic of Korea, Malaysia, Nigeria, Philippines, Tanzania, and Western Samoa (Barwell et al. 1985). These studies concluded that transport planning in developing countries did not take adequate account of the needs and requirements of the rural poor. The transport needs of the rural poor are largely for the movement of small loads over relatively short distances. Much of this is "on-farm" transport, between farmers' homes and their fields, pastures, woods, and water sources. The majority of the rural poor lacked direct access to a motorable road, and consequently they also made infrequent use of public transport services. Lack of credit facilities in rural areas was a major constraint on the ability of the poor to acquire appropriate means of transport.

Further work focused on the problems of supply and appropriateness of transport vehicles serving the poor, whether in urban or rural areas. Dawson and Barwell (1993) noted the existence in different parts of the developing world of low-cost vehicles and carrying devices appropriate to local-level transport tasks. These are collectively called intermediate means of transport (IMTs)—intermediate, that is, between walking (with loads carried on the head) and conventional, expensive, and high-capacity motor vehicles. IMTs include simple devices to facilitate the carrying of loads by people, such as the shoulder pole and the backpack frame; human-powered vehicles such as wheelbarrows, handcarts, and bicycles; animal-powered vehicles such as donkeys with panniers and animal-drawn carts and sledges; small, low-cost motor vehicles such as mopeds and motorcycles; and boats propelled by oars, sails, or small motors. (See Box A.3.)

Given that so much rural travel is on foot or by IMT remote from the road network, improving the condition of footpaths and tracks can also have a significant impact on the efficiency of rural travel and transport (Barwell 1996). Improvements can take the form of increasing the safety of footbridges or other water crossings so that people do not have to make long detours to avoid dangerous river crossings; straightening paths so that they are not unnecessarily long and indirect; reducing the length of steep or

Box A.2. Women's Transport Needs

Women's transport needs are different from men's, and the transport responsibilities of women and men are quite separate. The triple burden of women—reproductive, productive, and community-managing work—determines their transport activities and needs. Women are time- and energy-impoverished from meeting transport needs and are generally less mobile than men in the same socioeconomic group. Also, women are much less likely to have access to and use transport technology than men. Existing transport infrastructure, services, and technology may be inappropriate for women (e.g., bicycle design). Women have less money and face more cultural constraints.

Women's transport activities are much less visible in transport planning. Infrastructure and transport services oriented to the needs of women could drastically reduce women's workload and free up time and energy for other productive and reproductive tasks. Transport planners need to consult with men and women to address the intrahousehold division of labor, multiple transport needs, and cultural attitudes and norms. Furthermore, planners need to implement targeted schemes, such as providing credit for appropriate intermediate means of transport, and to develop and enforce regulations to ensure the safety of women, especially while walking or on public transport.

Source: Hanmer, L., E. Lovell, R. Chapman, and T. Slaymaker. 2000. *Poverty and Transport: Toolkit.* London: Overseas Development Institute.

Box A.3. Introduction of Intermediate Means of Transport in Ghana

The First Transport Rehabilitation Project in Ghana included a pilot program to introduce new forms of intermediate means of transport. In Ghana, as elsewhere in Africa, few transport options were available to bridge the gap between head-loading and motorized transport. The project aimed to bring benefits to the poor by constructing or rehabilitating farm-to-market roads, using labor-intensive construction methods, and promoting the manufacture and sale of low-cost transport vehicles (bicycles with trailers). Design models supplied by international consultants were modified and manufactured by local agencies, mostly in the informal sector. Rural women were the main beneficiaries, since they do most of the head-loading. They learned to ride bicycles and also used the trailers as pushcarts. One local producer modified the trailer for use as an "ambulance" to carry sick people.

Affordability for the poor was a problem, as was the capacity of local manufacturers to produce vehicles at significant scale. The Government set up revolving funds in some communities to start hire-purchase programs. Other group purchase schemes were initiated by nongovernment organizations (NGOs). Local NGOs were also used successfully as consultants for collecting socioeconomic data, providing feedback on vehicle design, and as subcontractors in some projects.

Source: Pankaj, Thampil. 1991. *Designing Low Cost Rural Transport Improvements to Reach the Poor.* Infrastructure Notes, Transport RD-3. Washington, D.C.: World Bank.

slippery sections; and making a footpath also passable by an IMT such as a bicycle or an animal-drawn cart. A World Bank publication provides further guidance on incorporating nonmotorized transport (NMT) into project design (Guitink, Holste and Lebo 1994). This requires addressing issues ranging from economic policy (analysis of import and tariff regulations, availability of credit) to traffic engineering and management (developing design standards for infrastructure accessible to NMTs and integrating them with design standards for motorized traffic), road safety regulation, and integrated land use planning. The World Bank has recently conducted a comprehensive review of its experience with introducing NMTs (Starkey et al. 2002).

To learn more about local transport needs in rural Africa, village-level travel and transport surveys and related case studies were carried out in the early 1990s. Barwell (1996) synthesizes the key findings and recommendations from research comprising five village-level surveys of household travel and transport demands, carried out in Burkina Faso, Uganda, and Zambia. The study found that women contribute at least 65% of the household time spent on travel and transport. The study also found that rural households in Sub-Saharan Africa (SSA) make significant use of IMTs. Finally, the village-level studies showed that proximity to an active urban center and to a main road, complemented by good road access, has a positive influence on the level of household income. Since few rural households in SSA own conventional, four-wheeled motor vehicles, it is through transport services provided by commercial motor vehicles (trucks, buses, taxis) that they benefit from improvements to the rural road network.

Transport Needs of the Urban Poor

Relatively less attention has been paid to the transport needs of the urban poor, a small but growing category in Asian towns and cities. Kranton (1991) reviewed the literature to date, which was mainly based on information obtained during the late 1970s. The research was also biased toward travel by public transport and toward longer trips, neglecting the frequent, short pedestrian trips made by the poor to reach markets, schools, and social services. The vast majority of trips made by the urban poor represent travel either to work or to school. While in urban areas the journey to school is generally short, the journey to work may be quite long and time-consuming. The problem is less significant for residents of inner-city slum areas than for poor households clustered on the urban periphery, far from the central business district. Crowded, infrequent, and unreliable public transport makes commuting especially difficult for the poor, who may have to transfer several times in order to reach their job sites. Costs in many cases remain prohibitive in relation to their incomes. Kranton also notes that the need to travel long distances to work affects the household economy and the intrafamilial division of labor, limiting the employment and educational opportunities of poor women and girls in urban areas.

Men in urban areas make more and longer trips than women (Allport 2000), whose trips are mainly for marketing and accompanying children to and from school and other services. If a poor household owns a bicycle or other means of transport, the male head of household is more likely to use it for the journey to work, so that women, children, and the elderly must walk or use public transit.

Local culture is also an important determinant of modal choice, even for poor people. In some cities, for example, walking and cycling are not seen as acceptable modes of transport, especially for women. This attitude has been associated with the development in urban areas of alternatives to public transportation, through the use of paratransit (small, owner-operated motor vehicles) or NMTs (carts, rickshaws).

A recent report, prepared as part of the World Bank's efforts to develop a new urban transport sector policy, provides some additional evidence from Africa (Howe and Bryceson 2000). This study found that walking is the only mode of transport used by at least half of the urban population, and among the poor it accounts for 80% to 90% of all trips. Yet the urban infrastructure in the four cities studied makes little accommodation for pedestrian movements. While some of the poor can be found in informal settlements on the urban periphery, the poor are more widely dispersed, both in informal "in-fill" settlements and in nominally wealthy areas. This makes it difficult to meet the transport needs of the poor with geographically targeted interventions. Finally, the study found that NMTs accounted for 50–80% of the trips made but less than 10% of the total direct transport costs, while private cars accounted for about 5% of trips but 60–70% of total direct transport costs. Including indirect costs such as pollution and accidents would only increase the costs attributable to motorized transport.

Rural Transport Improvements

The focus on rural development in the late 1970s as the key to poverty reduction produced a flurry of studies of the socioeconomic impacts of rural road investments. These early studies were reviewed in a United States Agency for International Development (USAID) program discussion paper (Devres 1980). The report paid particular attention to the evidence regarding distributional effects. It found that, in general, rural roads created opportunities, and that those in the best position to take advantage of these opportunities were likely to benefit most, in the absence of complementary programs to counteract this effect. The study also points out that participation of affected communities in rural road planning could help resolve many social and economic issues and maximize the desirable impacts of projects. (See Box A.4 for a more detailed summary of findings.)

Cook (1983) reviewed the findings of World Bank-funded research on travel behavior in rural areas of devel-

Box A.4. Early Evidence on Rural Road Impacts

- Roads lead to agricultural production increases. Larger, wealthier farmers are able to benefit most.
- Subsistence farming yields to commercial farming. Production of crops that are perishable and/or are transport-intensive generally increases the most.
- Rural roads expand the use of new tools, machines, inputs, and modes of transportation. Wealthier producers benefit most.
- Rural roads encourage the establishment of government services and private cooperatives. The major beneficiaries appear to be the larger farmers.
- Agroindustrial, industrial, and commercial enterprises increase along the road corridor. Such expansion can hurt local cottage industries.
- Rural roads stimulate short-term employment, especially if they are built using labor-based technologies. They also contribute to wider employment opportunities in the medium and long term. However, workers engaged in traditional modes of transportation may be displaced.
- Road improvements lead to higher land values and more intensive land use. These benefits may be captured by wealthy outsiders and/or a local elite.
- Transport cost savings are available to all, but the new modes of transportation may be out of the economic reach of the poor.
- Marketing activities increase and new marketing patterns arise with road improvements. The largest beneficiaries are large cash crop producers and those close to markets.
- Rural roads increase the availability and use of consumer goods, social travel, and recreational activities. The consequences for the poor are mixed.
- Rural roads increase access to health and education services, but the benefit of these services to the poor is not always evident. Other barriers remain. Also, roads may serve as the vectors of new diseases and/or new cultural values disrupting the community.
- Roads have mainly negative effects on ethnic minority groups but mainly positive effects on women.
- Farm-to-market roads have relatively little impact on rural-urban migration, but rural arterial roads may accelerate migration to urban areas.
- Rural roads accelerate deforestation through the expansion of agricultural land and the increased commercial exploitation of forest resources. Intensified production may lead to soil degradation and erosion as well as pollution from fertilizers and pesticides. Poor road design may lead to flooding and other types of environmental damage.

Source: Devres, Inc. 1980.

oping countries, including studies carried out in the Benin, India, Republic of Korea, Mexico, and Upper Volta. The results showed that personal travel on rural roads is an important activity in rural areas, consuming a substantial amount of time and energy.[6] A significant share, but probably less than half, of all such travel is work-related. Other reasons for traveling include seeking health care or education services, or participating in social, political, or religious activities. The study shows that changes in personal mobility resulting from rural road improvements may have far more profound effects on rural development than changes in commodity transport. It points out that the appropriate design of projects intended to serve mobility needs may be different from those designed to promote commodity transport.

Additional case studies were comprehensively reviewed in Howe (1984), who found little evidence for any effects of road investments on rural incomes and income distribution, although some evidence existed for effects on access to services. Howe points to some of the more negative outcomes documented by these early case studies, such as land consolidation by the wealthy and increasing landlessness among the rural poor, the decline of local industries in the face of competition, and damaging effects on natural resources. His review highlighted important policy implications: the difference between the poverty-reducing impacts of new roads and improvements in existing roads, the importance of the agriculture sector policy context in determining whether expected benefits could be realized, the failure of project evaluation methods based on agricultural value added to capture the benefits associated with improved personal mobility, the role of land tenure in determining income distribution outcomes, and the need for a coordinated set of public policies and programs to ensure the effective participation of small farmers in project benefits.

Four case studies published in Howe and Richards (1984), on Botswana, Egypt, India, and Thailand, also showed little evidence of transport planners being responsive to concerns about income distribution and poverty reduction. Labor-based methods of road construction and maintenance were not widely used, despite their well-documented benefits to the poor. In the absence of targeted interventions, the authors conclude that rural road investments are likely to reinforce existing socioeconomic structures in rural areas and to speed up any tendency toward social and economic stratification.

From the early 1980s into the 1990s, considerable interest was shown in using low-volume rural road construction and maintenance to generate employment opportunities for the rural poor. Employment in road construction provides direct, immediate benefits to poor people and also generates additional benefits through the multiplier effect of expenditures in the rural economy. Labor-intensive methods also often make use of locally available construction materials, adding to the transfer of investment benefits to the rural economy. Where labor-intensive methods have been used, the benefits that are likely to result are clearly evident (Edmonds and Howe 1980). Programs can be wage-targeted to reach the poorest of the poor, and ways found to ensure participation by women. The multiplier effects from wages spent in the rural economy have been estimated in the range of 1.5–2.8. Furthermore, labor-intensive works can be constructed at costs 25–30% less than those of comparable capital-intensive methods (Keddeman 1998). Labor-based techniques are most appropriate for roads in areas of relatively high population density but with low expected traffic levels, and where communities are expected to assume responsibility for future road maintenance. However, labor-based methods of road construction are only infrequently used in practice, and the immediate benefits of wage employment are not usually sustained over time.

A study of access effects in Bangladesh (Ahmed and Hossain 1990) compared outcomes in a matched sample of 16 villages having comparable soil and agronomic conditions, topography, and water regimes. The villages were ranked on an index based on village access (taking into account distance, main means of transport, and cost) to primary and secondary markets, secondary schools, banks, bus stops, and the *upazila* center. The study found somewhat higher (24%) agricultural incomes in the villages with better access, and a larger increment (78%) in incomes from livestock and fisheries. The study also found that agricultural wages rose (by 12%) and total wage income almost doubled (92%) in villages with better access. Significantly, this study concluded that landless laborers and poor farmers benefited proportionally more than the wealthy from these increases in agricultural income and wage earnings. However, the effect on business and industry was relatively small and had little poverty impact because of the ability of wealthy families to capture these gains through their better access to capital.

The study found no significant difference in educational levels between the more accessible and less acces-

[6] The study does not include off-road travel common in rural areas such as farm-to-field travel, herding, and water and wood gathering, nor does it include home-to-school travel for most children.

sible villages in the sample. However, their levels of health differed significantly and, although it found no difference in health status between men and women in villages with better access, the study observed a significant difference in health status between men and women in villages with poor access. For a variety of reasons, however, the Bangladesh experience may be unique in this respect, and investment outcomes there are unlikely to be replicable elsewhere.

A more recent effort at empirically evaluating the impact of rural road improvements on the rural economy and the life of rural people is found in Levy (1996). This study of a rural roads (paving) project in Morocco compares before- and after-project data for a sample of four project roads and four control roads.[7] The study did not disaggregate the beneficiary population in terms of poverty, except for stratifying the sample households by farm size. In addition to reducing vehicle operating costs, the project succeeded in eliminating frequent road closures during rainy days. Reduced vehicle operating costs were reflected in lower prices for goods and passenger transport, resulting in (considerable) induced (and deviated long distance truck) traffic growth on project roads. Ownership of motor vehicles and the supply of passenger transport services increased significantly. Access time to service centers was cut by at least 50%, due partly to better road transport and partly to the location of new facilities in the study areas. Agricultural production patterns changed dramatically as farmers shifted from low-value, less perishable foodgrains to high-value fruits and vegetables produced for export markets. Use of inputs and extension services by small farms increased more than for large farms, which had previously had sole access to such services. Off-farm employment increased dramatically in both sample and control zones, but growth was twice as great in the areas affected by project roads.

The sample zones showed much higher gains in primary school enrollment than the control zones. The quality of schools improved through better teacher recruitment and retention. Use of health care facilities also increased, as quality improved due to the ability to attract more qualified staff and to ensure a regular supply of medicines. Paved roads facilitated the implementation of immunization and other preventive health care programs. Significant impacts for women included a major increase in female primary school enrollment and the availability of maternal and child care programs. Women's lives were also affected by the presence in the market of butane gas at affordable prices, reducing the requirements for fuelwood collection. Travel between the study areas and urban centers increased markedly.

A second impact evaluation study addressed the impacts of feeder roads constructed in the state of Bahia, Brazil, some 10–15 years after completion (World Bank, 1997). The goal of the program was to promote coffee, cocoa, and dairy development in the state; poverty reduction was not an explicit objective. Roads were selected in consultation with the major producer organizations for each commodity. Not surprisingly, the roads initially benefited primarily the large farmers already living in the project areas. However, they also stimulated in-migration and brought improved living conditions for the population as a whole, including small farmers and landless farm workers. The share of landholdings under 50 hectares (ha) ("small farmers") increased substantially over the study period. The report is largely based on data collected under contract by a local nongovernment organization, which did not permit quantification of social impacts or analysis of the distribution of costs and benefits.

The DFID Infrastructure and Urban Development Department has sponsored much research on labor-intensive technologies for road construction; appropriate design for low-volume roads, tracks, and trails; and appropriate technologies for NMT. This research has shown that reductions in transport costs can have a significant impact in rural areas, as there is a high elasticity of demand (30% increase in demand with a 10% cost reduction).[8] Such cost reductions can be achieved through improved asset management and a better interface with the private sector. Private investment in the provision of transport services accounts for well over half of all transport costs. DFID research on the market for transport services has shown that significant cost reductions can be achieved by providing better information to operators. DFID has also paid particular attention to road safety and the distribution of safety-related costs imposed on road users.

In parallel with the present RETA, ADB's Operations Evaluation Department carried out a study of the impact of rural roads on poverty reduction (ADB 2002d). The analysis was based on in-depth case studies of six ADB-financed rural road projects in Indonesia, Philip-

[7] Note, however, that the preproject data was not actually collected before the project, but is based on the recollections of survey respondents. Control roads were selected after the project was completed, but no attempt was made to "match" the control villages to the sample villages.

[8] John Howe, personal communication.

pines, and Sri Lanka. In each country, one project was a stand-alone road project and another was part of a rural development project. The study concluded that the poor and the very poor benefited substantially from social impacts through improved access to state services. However, economic benefits were difficult to identify, especially since most projects lacked baseline data and failed to implement planned monitoring and evaluation activities. The study found that the poor were often unable to capture the benefits of transport cost savings, due to their indebtedness to traders and the lack of competition on transport routes. Lack of maintenance of improved roads was another constraint, leading to a rapid decline in the benefit stream and reduced incentives for the poor to take the risks involved in changing their livelihood strategies. Problems with access to land, poor land quality, and lack of other assets, particularly access to information, meant that the poor in the cases studied were largely unable to capitalize on rural road improvements.[9]

ADB also sponsored a study of the impact of roads on poverty reduction in Bangladesh (TA 3508-BAN). This study found that providing all-weather access for rural residents on small roads with improved earthworks, bridges and culverts, and assuring regular maintenance of such roads, has a strong impact on reducing poverty (ADB 2000e, The Louis Berger Group, Inc. 2002). In addition to improving the integration of the poor in the national economy, these interventions are important in mitigating risks to the poor during floods. Maintenance works can also provide a significant source of employment for the poor, both men and women. However, paving improved rural roads has little effect on the poor because the benefits largely accrue to larger farmers. Improving major roads promotes economic growth that can absorb low-skilled labor in nonfarm occupations, possibly helping to move some rural poor out of poverty. Regional road improvements may have similar effects if targeted to relatively poorer regions, although the majority of benefits were found to accrue to the nonpoor.

A carefully designed study of the welfare impacts of rural roads in Viet Nam is nearing completion. Preliminary conclusions from the first and second round of data collection indicate an expansion of access by the poor to freight transport services following road rehabilitation, and also a slight increase in bus and other forms of passenger transport services (boat, rail, animal-drawn carts) (van de Walle and Cratty 2002). However, the study notes a decline in two- and three-wheel motorcycle services, suggesting that passengers are substituting cheaper alternatives (including accompanied freight transport) which were not available before road rehabilitation. Significant time savings were noted in access to health facilities. However, time needed to reach local shops has increased.[10] Agricultural credit is now more widely available in the project communes. Impacts on migration to look for work were similar for the poor and nonpoor , but the poor were slightly more likely to reduce their agricultural and other unskilled labor days in favor of increased days of work in crafts or industry. Significantly, time savings were highest for the poor. This finding may reflect a poorer initial condition of roads in the poorer communes served by the project.

A cross-sectional analysis of data from the 2000 Living Standards Measurement Survey for Guatemala, which included a special module on transport, showed that poor and indigenous households had less access to motorable roads than others, both in urban and rural areas (Puri 2002). Perceptions about improvements in road quality did not differ among poor and nonpoor households, but they differed significantly by region. The frequency of road closures, taken as another indicator of road service quality, did not vary significantly across income groups or ethnic groups, or between urban and rural areas.[11] In rural areas, road closures (mainly due to flooding) had a greater impact on poor and indigenous households by restricting access to schools and employment and by raising the cost of consumer goods. Lack of access to public transport services was another key variable disproportionately affecting the poor and indigenous households in rural areas.

The study examined the links between the availability and quality of transport services and access to other goods and services related to poverty reduction, including water, wood, health care services, schools, and places of employment. With the exception of health services, the links were not very significant, since most of these needs are met by walking, by both poor and nonpoor households. The propensity to use motorized transport increased slightly with household income. Travel times were not significantly different between urban and rural areas, a fact accounted for by the high congestion and consequent slow traffic speeds

[9] When the results of this study are compared with those of the present RETA, it should be noted that the countries selected for the ADB/OED study were to complement those selected for the RETA; thus, while the RETA selected sites where economic growth had been accompanied by strong performance in poverty reduction, the ADB/OED study was carried out in sites where poverty reduction had been less successful.

[10] This surprising conclusion is interpreted to mean that local small businesses—food stalls and shops—may have been driven out of business by competition from newly accessible, bigger, and better stores.

[11] Road closures in urban areas were often due to unrelated causes such as political demonstrations and other social conflicts.

experienced in urban areas. Places served by motorable roads generally had shorter travel times than others, suggesting that service providers are more likely to deliver services in areas that can be reached by motorized means. Communities with motorable roads were also more likely to have markets, banks, post offices, police and fire stations, and telephone service. A follow-up study on the impacts of road improvements showed that road closures were reduced, public transport services increased, and the travel cost (though not the travel time) for accessing other services was reduced (Puri 2003).

An ex post study of the poverty impact of the ADB-financed Jamuna Bridge in Bangladesh showed that the bridge has substantially reduced poverty in the region that it serves (The Louis Berger Group 2003a). New economic activities developed in the vicinity of the bridge and along access roads. The growth of freight traffic was smaller than expected, but the growth rate for passenger traffic (buses and light vehicles) was significantly (four to five times) higher than expected. A computable general equilibrium (CGE) model of the national economy showed that the bridge dramatically reduced transport costs, releasing a key constraint on trade and development of the regional economy, as well as on the circulation of labor. The bridge also facilitates energy supply to the region and has improved the environment for private industrial investment. The CGE model was then combined with a social accounting matrix to estimate the impacts of these changes on different socioeconomic groups. While the results show that landowning nonpoor rural households and rich urban households captured a greater share of the benefits than the poor, the benefits to the poor were nevertheless large enough to reduce (by 20–40%) the number of rural households in poverty. An interesting sidelight of this analysis is that the abrupt decline in transport margins affected the incomes of (urban) vehicle owners and operators more strongly than the corresponding general price decrease, causing a net decline in their welfare.

The direct impacts of bridge (and ferry) user cost savings were also studied, based on small sample surveys and participatory discussions with users and other affected people. This approach found that the poor and very poor received a relatively small share of the direct benefits, as they do not own or operate the types of vehicles that are allowed to use the bridge, and they account for a relatively small share of bus passengers. Thus, the benefits to the poor are largely derived from the impetus to regional growth provided by the bridge, rather than from its direct effects on their own transport needs. In addition, bridge planners failed to consider the likely effects of the bridge on land values and the problems that this would pose for displaced people, who are likely to have been further impoverished by the project.

Urban Transport Improvements

The heavy transport cost burdens faced by the urban poor are symptoms of poverty, not causes of poverty. The urban poor reside in less accessible locations precisely because, given their meager income, these locations serve them best. Much can be done in terms of transport to help the *rural* poor. It is less clear how to use transport as an effective policy instrument to help the *urban* poor. Direct interventions targeting the transport needs of the urban poor are more difficult to implement, and may be less effective, than interventions targeting the rural poor.

Especially in urban areas, transport subsidies are widely used with the intention of helping the poor. The effective targeting of transport subsidies is crucially dependent on market structure. The more competitive the market for transport services, the greater the retention of subsidy by users. It is difficult, however, to limit transport subsidies to the poor: subsidies are vulnerable to misuse and to capture by the wealthier residents; they also weaken transit operators' incentives for cost control, create opportunities for rent-seeking, and eventually become financially unsustainable. In rail and metro (urban rail) investments, even subsidized fares are often beyond the means of the poor; indeed, these investments work against the poor by increasing land values and forcing the poor out of rental housing, to relocate on the urban fringe.

Urban transport corridors tend to be constructed through poor areas because property acquisition costs there are low. Furthermore, poor households often rent housing units from richer owners, who may capture the benefits of transport interventions targeting poor areas. The costs of involuntary relocation and community severance, however, fall upon the poor. And those who remain are, in the case of a road project, exposed to greater air and noise pollution as well as serious safety risks.

Rickshaws and other types of human- or animal-powered transport may be banned to reduce congestion. This is to the advantage of the well-off, at the expense of the poor who provide such transport services and who may use these services, if they can afford them. In many cities, more could be done to encourage the use of bicycles as an inexpensive form of transport that makes efficient use of scarce road space and provides employment through roadside services such as pumping tires and simple

repairs. However, cities are often hostile to bicycles, which must share road space with fast-moving traffic and face limited and insecure parking.

The ways in which transport tariffs are set have important implications for public transit utilization by the poor (Allport 2000): when fares are set below market levels, poor people living in the inner city may benefit, but those in peripheral areas lose because transit operators will reduce or withdraw services. Graduated fares benefit the poor who travel on short journeys, whereas market flat fares are advantageous to commuters over longer distances. For commuters with journeys requiring interchange, the need to pay more than once leads to much higher costs than for journeys not requiring interchange.

At present, DFID is sponsoring new work on the need for transport services in poor urban areas and the ways in which these needs can best be addressed. Case studies are being conducted in Faisalabad, Pakistan; Colombo, Sri Lanka; and in Dar es Salaam, Tanzania. These studies build on the results of an earlier study of "partnerships to improve access and quality of urban public transport for the urban poor," carried out in Karachi, Pakistan (Sohail 2000). Karachi is a port city that has developed a large industrial base. For historical reasons, low-income settlements have been forced to the outskirts of the city, so most poor workers must commute a long way to their jobs. The unpredictability of transport services and likely loss of time inhibit both work-related and social travel, significantly affecting the life chances of the urban poor. Public (bus) transit is the cheapest option, but it is highly disorganized and unreliable. Regulated fares provide low returns to private operators, who consequently neglect all maintenance and safety considerations. Graft and corruption abound, adding to the costs and delays of service. Route planning is nonexistent, route permits are not respected, and urban infrastructure takes little account of public transport needs (bus stops, parking, workshops, etc.). Vehicular pollution and high losses of life and property due to accidents add to the costs borne largely by the poor.

The situation in Colombo, Sri Lanka, is similar, though perhaps not as chaotic. Public transport services are provided by old public buses operated by eight partially privatized regional transport companies, and privately operated minibuses, motorcycles, and three-wheelers. These vehicles have low carrying capacity and contribute to congestion. Entry into the sector is virtually unregulated. Income-generating opportunities have been created for poor and unskilled operators as well as for vehicle owners, repair shops, spare parts dealers, etc. However, the poorly distributed and unreliable transport service fails to meet the needs of many people, especially the poor, elderly, disabled, women, and children. Buses as well as roads are poorly maintained. Pedestrian walkways are subject to encroachment by hawkers and vehicle operators. Regulatory agencies exist but are ineffective, due to the political influence of private bus operators. Virtually no opportunity exists for public participation in urban transport policy decisions.

DFID also sponsored research on urban transport services in Uganda (Benmaamar 2003). While not focused explicitly on the urban poor, the study showed that, contrary to conventional wisdom, the deregulated transport services market is far from being competitive. Entry is effectively controlled by the Uganda Taxi Operators and Drivers Association, which has the responsibility of collecting revenues from drivers for the City Council. Of the substantial profits generated, little is reinvested to improve services. The policy, planning, and regulatory functions of the Government have been marginalized. An alternative to the privately operated minibus and taxi services is the *boda boda* (bicycle/motorcycle taxi) service (Howe 2002). Entry into this sector is less difficult, though vehicle ownership is still constrained by high costs, limited credit availability, and the difficulty of obtaining repairs and spare parts in many parts of the country. Research indicates that the great majority of boda boda operators are poor (in the case of motorcycles, most operators do not own their vehicles). However, even boda boda fares are too high for the poor to use them more than occasionally. In addition, they constitute a safety hazard, and the motorcycles used contribute to urban air pollution.

The boda boda research is a spin-off of a major study sponsored by DFID of sustainable livelihoods, mobility, and access needs in Uganda and Zimbabwe (Box A.5). The study builds on earlier work undertaken in Zambia in a rural context (Davis 2000). The purpose of the Zambia research was to identify the mobility and access needs of the poor by using the "sustainable livelihoods" approach. This approach considers five categories of assets for the poor: natural capital, physical capital (including infrastructure), human capital, financial capital, and social capital. Davis's research showed that inadequate access to markets was the main livelihood constraint in Zambia, closely linked to food insecurity through the difficulty of obtaining agricultural advice, fertilizers and credit, as well as high transport costs resulting in high input prices and low profit margins. Access to health care and education services was also highly constrained.

The work undertaken in Uganda and Zimbabwe extended this analysis to urban and periurban areas, with a

Box A.5. Sustainable Livelihoods, Mobility and Access Needs

United Kingdom's Department for International Development has been sponsoring research on sustainable livelihoods, mobility, and access needs in Zimbabwe and Uganda to validate the usefulness of the sustainable livelihoods approach in assessing poverty reduction through interventions in the transport sector. The research was carried out in two transport corridors, one in each country, including the capital city, a secondary town, rural and periurban settlements. The research is unique for its focus on rural-urban linkages and on the role of personal mobility in the survival strategies of the poor. This approach led to a focus on transport services and the modes and means of transport rather than on transport "infrastructure."

Through a study of household activity and travel patterns, the study explored the access of the poor to formal and informal employment opportunities, natural resources, services, and markets. Starting with secondary data collection, key informant and focus group interviews, the research included a large household survey complemented by more in-depth studies of travel and transport behavior in a subset of sample households.

Source: Maunder et al. 2001.

particular focus on rural-urban linkages (Bryceson *et al.* 2003). In each country, a corridor was chosen linking a primary city to a secondary city. Research was conducted in both cities, in a periurban neighborhood and in a rural village in the corridor. The research methods included focus group discussions, household surveys, transport surveys, and travel diaries. The study found that agricultural activities were important even for urban households. It also showed a high degree of residential mobility between urban and rural areas. Not surprisingly, journeys to work and school were the main travel purposes, followed by social visits. Walking was the main modal choice for short journeys, although Uganda showed a higher rate of bicycle usage, partly due to the availability of boda boda transport. Long-distance travel in both countries was predominantly social in nature, including travel for funerals, weddings, and rituals. This type of travel can be considered an investment in building social capital.

Rail Transport

The role of railways has declined as investment has poured into roads. Rail passenger transport is rarely affordable by the poor. Where rail is used extensively by the poor, fares are heavily subsidized, either by public revenues or by other railway users. In these circumstances, the railway is often expected to make up a shortfall in passenger revenues by cross-subsidizing from freight traffic. Given that rail is already at a disadvantage in relation to road transport operators, this is a recipe for the demise of rail services. Even by direct employment of labor, the railways offer little potential for sustained poverty reduction. If the railways are obliged to employ more labor than needed, this cost burden will hasten the demise of rail services.

In urban areas, rail rights of way must be carefully monitored to avoid encroachment by poor residents and consequent safety hazards. New rail corridors are likely to be located in low-value areas occupied by the urban poor. (The same applies to intermodal transfer facilities such as ports, bus terminals, etc.) In such cases, special care must be taken to ensure that the resulting disruption, including displacement and resettlement, does not impose costs on the poor without adequate and appropriate compensation.

Ports and Waterways

In the past, ports have been an important source of employment for unskilled labor. With advances in transport technology and more effective port management, these opportunities are likely to diminish. However, water transport, including river transport and coastal shipping, remains important for poor people to meet travel and transport needs, as well as to earn income. Some places in the developing world, such as parts of Indonesia and the Pacific Islands, are still so remote that water transportation remains the major means of access. In other cases, such as Bangladesh, a dense waterway network complements the road system to ensure all-weather access for rural communities.

Bangladesh has provided an important contribution to the literature on water transport serving the poor, with studies on its extensive fleet of "country boats." However, the focus has been on policy and technology rather than on poverty impacts. The International Forum for Rural Transport and Development (IFRTD) has produced a useful guide to recent literature on water transport, including several Asian cases (Palmer 1998). It is currently planning further case studies with a stronger poverty focus, funded by DFID. ILO has also initiated studies on river transportation in Cambodia where asset distribution is a component of the analysis.

Aviation

Aviation is a high-technology mode and thus offers few employment opportunities for the poor, other than manual labor on civil works during airport construction. Nevertheless, the poor may share in the benefits that spring from airports and air services. Air access to remote areas, such as scattered island archipelagos, facilitates provision of services and can be a lifeline in emergencies. Access by air can also be a prerequisite for tourism, which may employ unskilled poor people and give them a chance to develop skills and improve their livelihoods.

Gender Impacts

As of 2001, little research focusing on the gender distribution of impacts of transportation and energy investments had been published, but considerable work on this topic has since been completed. The general theme of this research, in both transport and energy, has been the need to move away from a gender perspective that focuses on enhancing women's capacity for productive work to one that addresses the equity dimensions of gender relations, and pursues the economic, social, and political empowerment of women. These gender-based studies have typically not distinguished poor from nonpoor women. Rather, they are based on the assumption that women are by definition disadvantaged and vulnerable in their social contexts. Projects have often succeeded in empowering women and possibly helped some to move out of poverty. They have also helped to identify political, institutional, social, and cultural barriers preventing women from capturing the benefits of infrastructure interventions. Poorer women may benefit from this experience, as well as from the solidarity and social capital achieved through strengthening women's organizations.

With regard to transportation, early reviews based on African experience showed that typical rural road improvement programs had little impact on women, whose transport needs were largely limited to the off-road network (Bryceson and Howe 1993). A study carried out in Uganda examined access to bicycles in relation to rural women's transport needs (Malmberg Calvo 1994). This study found that women were denied access to bicycles for both economic and social reasons. High prices and lack of access to credit were major constraints for both men and women. Even when a household could obtain a bicycle, women were generally not permitted to use it, either to meet household transport needs or to generate additional income.

With the MDGs came an increasing interest in gender issues and the relationship of gender to poverty. Responding to this concern, the IFRTD undertook an extensive research program on gender and transport, with support from DFID. In the late 1990s, IFRTD sponsored a series of coordinated case studies carried out by local partners in both Africa and Asia. Nineteen reports were included in a book published with support from DFID and the World Bank (Fernando and Porter 2002). Ten of the case studies are from Africa and nine from Asia. One of the main findings was that there are important differences between Africa and Asia, making it difficult to generalize across the two regions. In particular, the public sector is much more active in providing transport services in Asia, and the use of intermediate modes of transport is much more widespread there.

The IFRTD research did find, in both Africa and Asia, a consistent pattern of cultural constraints on women's transport activities, reinforcing unequal relationships between men and women. These constraints tend to exclude women from the benefits of transport investments, either by limiting their participation or by limiting their ability to retain any benefits they may receive. However, the study also finds evidence of cultural change in the face of changing economic realities. In fact, poorer women may be more readily "liberated" from these constraints than more well-to-do women. The effects tend generally to increase rather than reduce women's workloads. Walking, both on and off roads, is still the main means of transport for poor women and their children, and they are particularly vulnerable to issues of safety as well as, in the case of women and girls, sexual harassment while traveling.

Changing expectations regarding transport options can be an important part of a program of female empowerment, as illustrated by the National Literacy Programme in Tamil Nadu, India (Rao 2002a). The program actively promoted cycling for women, as a way of increasing their productivity as well as their self-confidence and their exposure to a wider world of knowledge. Many women learned to ride, although few were able to purchase their own bicycles, even though credit programs were offered. Some bicycles were purchased by women's groups, and others could be obtained through rental when needed. The value of this skill in medical emergencies was particularly instrumental in raising women's self-esteem and promoting community acceptance. One lesson learned from this program is that while women may gain access to bicycles, they rarely control the use of this resource. When a household owns a bicycle, the needs of men (or boys, for transport to school) take precedence over the needs of women or girls. Women's workloads have

increased in many cases, as they have been expected to take over transport tasks formerly performed by men. However, women also recognize an increase in their productivity, as they can complete household tasks more quickly and are no longer dependent on unreliable and unfriendly bus transport to reach markets.

The same author studied transportation needs among women of the Santhal scheduled tribe who live in the hilly southeastern part of the state of Bihar, India (Rao 2002b). Such hill tribes are generally poor, lacking in social services, and limited to unskilled occupations. Women in Santhal culture are particularly disadvantaged, being considered the property of men and having no independent access to assets of any kind. On the other hand, Santhal women experience few cultural restrictions on their mobility. Their livelihood strategies depend on diminishing and ever more distant forest resources in remote hilly areas, where even intermediate transport modes cannot penetrate. Roads in the area link villages to markets and are poorly maintained. Women must walk, and climb, both to obtain household fuel and water and to collect firewood and other forest products for sale. Access to bicycles (by men) has partially shifted the burden of transporting forest products to market, but has also shifted control of the income from marketing to men. Women's domestic transport needs are likely to be met more cost-effectively by interventions in other sectors (water supply, fuelwood plantations). Improving footpaths would also help in meeting the transport needs of both men and women in this vulnerable group, as well as reducing the risks to which they are exposed.

Two of the case studies were conducted in the state of Gujarat, one in a rural setting and one in an urban setting. Both were based on material provided by the Self-Employed Women's Association (SEWA), a leading women's NGO in India. The rural case study was built around SEWA's Water Campaign in North Gujarat, a region where access to water is a major constraint (Bid, Nanavaty and Patel 2002). This means that agriculture alone is not a viable livelihood strategy. Both men and women must rely on wage labor, gum collecting, and salt farming, all occupations which require travel to the place of work. Formal, but infrequent and irregular, transport services are provided by the State Road Transport Corporation. Otherwise, villagers must rely on informal transport, including walking. Water supplies must be head-loaded over long distances, with detrimental effects on the health of women and girls, as well as on the access of girls to schooling. Women must also purchase household necessities at the nearest market. To do this, they must make tradeoffs between the low financial cost but higher time cost of bus transport, and the higher cost but greater speed and reliability of informal transport. Lack of access to transport services is also a significant constraint on women's participation in social and economic development activities and in events related to the creation and maintenance of social capital in rural areas.

The urban case study looked at the role of transport in the lives and livelihoods of six women employed in the informal sector in Ahmedabad, representing six categories identified through a survey of 76 self-employed women (Shresthova, Barve and Chokshi 2002). These categories include porters (head-loaders), hawkers and vendors, "recycling wallahs," farmers, home-based workers, and laborers (commuters). The role of transport in these different occupations is clear. Even the home-based workers have to obtain their materials from and deliver their products to contractors. More than half of the respondents estimated that they had to spend between 2 and 8 hours traveling every day in order to meet their work-related travel needs. Women walked whenever possible; when distances were too great, they depended on public transport services. On average, women spent nearly 30% of their cash income on travel and transport, including 13% on work-related travel expenses. Many were interested in the possibility of obtaining a vehicle (a rickshaw, bicycle or push-cart, a tractor or bullock cart in rural areas), but some felt socially and culturally constrained from operating such a vehicle. Urban women were more likely than rural women to envision operating the vehicle themselves. The last case study from India also addresses urban transport, this time in the city of Calcutta, with a focus on the problems of women commuting to the city (Mukherjee 2002). Women from periurban areas commute to jobs as maids, vendors, industrial workers, and office workers. They also travel to the city to visit a hospital or relatives; older girls commute to the city for continuing education. The survey showed that women commuters are usually extremely poor. They are away from home an average of 12 hours a day and 5–6 of those hours are spent traveling and waiting for transport. They must walk to and from bus stops or rail stations in the dark, and they are vulnerable to pickpockets and police harassment. However, they spend very little money on travel. (Most do not pay for train fares.) Often the fact that they are gone so long leads to problems at home. The study suggests that the best way to address these women's issues would be to provide income-generating opportunities located closer to their homes.

Two studies of gender, poverty, and transport in Nepal focused on the responsibilities of women in both the hill areas and the plains for transporting heavy goods, including fuel, fodder, and water, as well as providing porterage for farmers and construction crews. One study reports on the experience of constructing a "green road" in the hill region (Seddon and Shrestha 2002). Women participated in the construction of this road, but had no role in decision making. Because wages were related to tasks, and men and women were assigned to different tasks, women workers generally received lower wages than men. However, little gender-based discrimination seems to occur in access to transport services and related facilities. This study traces the distribution of benefits to landowners, traders, and vehicle owners. Women operators of shops providing roadside services were included in this group. Small farmers and service providers with no land were the last to benefit. The study points out that vehicle transport has now almost completely displaced porters, especially women, who find it difficult to obtain alternative employment as wage laborers in agriculture.

The road has changed agricultural patterns in the region it serves. Now, growing vegetables and fruits, livestock and dairy production are emphasized. However, the gender division of labor remains unchanged. Consequently, the workloads of women and children (as well as men) have increased. Positive changes in education and health care have occurred, but the share of women in access to these services has not changed markedly. The big change has been the increase in women's personal mobility and consequent exposure to the outside world.

The other case study in Nepal (Ghimire 2002) considers the gender division of transport tasks in areas that are still served by traditional trail systems, and how these have been affected by the construction of rural roads. In the mountain zone, increased access has generated an increased demand for dairy products, which has increased women's work in collecting fodder and mulch. In the plains, improved access has encouraged the spread of bicycles, motorcycles, and rickshaws. Women can use bicycles, but they are mostly owned and controlled by men. Women's access to bicycles has increased their mobility, and the availability of bicycles in a household has also encouraged men to participate in what were formerly women's tasks, such as firewood collection. This study illustrates the ways in which increased communication with a wider world can help to break down social and cultural constraints on women's participation in the benefits of transport investments.

The picture in Bangladesh (Matin et al. 2002) is somewhat more depressing. Traditional values emphasize the subordination and seclusion of women. Thus, women's mobility is negatively related to social status and family honor. Women from poor households, however, may travel to fields, to markets, or to road construction sites for work. Women are treated discourteously on buses, so they prefer to use the less "public," but more expensive, rickshaws or rickshaw vans. Road improvements do provide poor women with more income-generating opportunities, both in road construction and maintenance and in gaining access to other forms of employment. Women's travel, however, is limited by the need to get home several times during the day. Transport improvements indirectly benefit women by making it possible for services to be delivered in rural communities, where women can access them more easily. Bangladesh has opened a political space for the participation of women in local government. However, effective participation depends on women's increased physical mobility, exposure to new knowledge and ideas, and ability to form networks and political alliances.

In Sri Lanka, a case study assessed the impact of the introduction of a new cashew-processing technology on gender roles and transport requirements. Traditionally, men handled cashew marketing. Around 1989, women also began to become involved in the marketing of decorticated cashews. They walked, carrying small quantities, while men used bicycles and motorcycles and were able to handle larger quantities of nuts. In 1994, Intermediate Technology Sri Lanka introduced a tray drier that increased the quality of the processed nuts and set up a new cashew processing center in a nearby town. Both men and women are involved in the management of the center, which requires travel and participation in decision making. Women are moving from home-based work to part-time employment as laborers at the center, while continuing to work at home in their spare time. Women's workloads have therefore increased, as they now spend more than half an hour each day on travel. Some women have gained status and self-confidence through their participation in activities to extend the benefits of this technology to more communities. However, these new responsibilities have not reduced women's traditional workload or changed the gender distribution of labor in activities other than cashew processing and marketing.

Policy Change and Sector Reform

In a world collectively dedicated to the fight against poverty, it will be necessary to revisit transport sector policies and to build the capacity of transport sector institu-

tions in order to meet poverty reduction objectives. Care must be taken to ensure that transport investments and recurrent expenditures do not "crowd out" investments in other areas that are equally relevant for poverty reduction. At the same time, increasing the efficiency of the transport sector can release resources for other, more targeted poverty reduction programs.

Ensuring adequate funds for the maintenance of existing capital stock is of overriding importance. While investments in pro-poor growth must still meet economic efficiency criteria, targeted investments aimed directly at poverty reduction can be evaluated using cost-effectiveness criteria. Attention must be paid to the transport needs of women and other vulnerable groups. Ensuring that transport policies and institutions are responsive to the needs of the poor will be best accomplished by providing for participation by the poor (or their representatives) at all stages of transport planning, decision making, and implementation (World Bank n.d.). In many instances the obstacle to mobility is not lack of infrastructure, but rather the lack of affordable and appropriate vehicles. In some countries, bicycles are subject to very high tariffs or taxes, making this low-cost transport mode unaffordable for the poor. Lack of access to credit is another factor preventing the poor from taking advantage of opportunities to benefit from transport improvements.

Regulations and design standards may also inhibit the development of public transport services appropriate for the poor, by creating barriers to the supply of informal transport services, restricting market entry, and imposing service standards. Commercialization and privatization of state-owned transport enterprises may result in higher prices for services that previously were affordable to the poor, and may bring about labor redundancy. Public policy will need to anticipate these possible adverse consequences and provide "safety nets" in the form of explicit, targeted subsidies and relocation assistance for the poor.

With the exception of resettlement studies, little research has been done to date on the impacts of urban transport infrastructure, rail transport, ports and shipping, and aviation on the poor. In urban areas, transport subsidies are widely used with the intention of helping the poor, but such subsidies are vulnerable to misuse and to capture by the wealthier parts of the population. For rail and metro investments, even subsidized fares are often beyond the means of the poor. In fact, these investments may work against the poor by increasing land values in transport corridors and forcing the poor out of rental or squatter housing, to relocate on the urban fringe. When fares are set below market levels, poor people living in the inner city may benefit, but those in peripheral areas lose because transit operators will reduce or withdraw services.

Impact Assessment Methods

A summary of the methods used prior to 1990 to evaluate rural transportation impacts argues that conventional models, focused almost exclusively on agricultural production, fail to grasp the full workings of the rural economy. In particular, they fail to account for the values placed by rural people on such intangibles as time, energy, health care, security, social interaction, and spiritual intercession (Cook and Cook 1990). Such an incomplete specification of the impact model accounts for its relatively low explanatory power. In particular, it is strongly evident that failure to account for the value of time (on the assumption that the value ["shadow price"] of poor people's time is negligible) and for the intrinsic, as well as instrumental, values of personal mobility leads to an underestimation of the benefits of passenger travel (including pedestrians) and nonagricultural commodity traffic. A more complex model of rural transportation improvement impacts is proposed, including the measurement of multiplier effects.

Dissatisfaction with conventional cost-benefit analysis as a way of evaluating ex ante poverty impacts has led some to experiment with alternative methods of assessing the incidence of rural road project benefits. Jacoby (1998) uses data from the Nepal Living Standards Measurement Survey to estimate a nonparametric model that assumes the benefits of road improvements to be fully captured in land value changes. His analysis shows that as a hypothetical road extends farther from the existing network (up to 8 hours walking distance), benefits become progressively more targeted to the poor. However, he also shows that the magnitude of these benefits would not be large enough to significantly affect the relative distribution of income in the project area.

Another approach, known as Integrated Rural Accessibility Planning (IRAP), was developed by ILO in the Philippines in 1990 and has since been used in Cambodia, Indonesia, and the Lao People's Democratic Republic. The approach is based on quantifying village access to activities and services. The aim is to develop a planning tool based on rural transport needs rather than on effective demand for transport services. Using the elements of the "transport task" identified by Barwell (1996), it derives an access indicator, the value of which for a given village is calculated in relation to population served and the time and effort required to access a variety of goods

and services. Weights attached to the different aspects of the transport task are determined through consultation with local people. Such an indicator can only be used to allocate resources efficiently within a given envelope to meet an identified need; it is not the same as providing an economic justification for an investment. It is a bottom-up and participatory approach that implicitly targets the poorest communities. Proposals to initiate or further strengthen IRAP in Bangladesh, India, Indonesia, Nepal, and Viet Nam are currently being considered (ILO 2000). This approach has also been applied in South Africa (Sarkar and Ghosh 2000).

One result of the recent preoccupation with poverty reduction as the focus of development investments has been a proliferation of proposed methods to take poverty into account in ex-ante project evaluation. ADB conducted a review of transport sector projects approved since 1995 to assess current practices and determine how they could be improved (Hansen 2000). Building on this work, ADB has prepared technical guidance for its staff on the analytic and operational issues that need to be addressed in project preparation (ADB 2003a) and best practices for improving the poverty orientation of transport projects (ADB 2003b). It begins by insisting on the need for close consultation with the poor themselves in order to identify their needs and perceptions of poverty as the basis for future impact monitoring, as well as to promote project sustainability. Stakeholders should be disaggregated into poor and nonpoor groups, with attention also paid to gender distinctions and the allocation of government benefits between poor and nonpoor groups. Where equity and efficiency considerations are in conflict, ADB policy allows for cross-subsidy between different components of a project that, overall, would have an acceptable rate of return. The subsidized "social" components should then be justified on cost-effectiveness grounds. From a design standpoint, projects should include measures designed to meet the needs of the poor, and should take advantage of opportunities to employ the poor in labor-based construction and maintenance. On the policy front, attention should be paid to pricing public transport services and reducing regulatory barriers to informal private transport services. Finally, a rigorous system of poverty impact monitoring, including baseline data collection and periodic follow-up studies, is recommended.

A suggested method to estimate the poverty reduction impact of rehabilitating major roads combines the results of classical road feasibility studies with data obtained from small sample surveys of road users, potentially complemented by participatory rural appraisals or focus group discussions with users and beneficiary communities (Gajewski, Luppino, and Fujimura 2002). This approach is based on ADB's *Guidelines for the Economic Analysis of Projects*, which call for estimating the proportion of the net benefits to each beneficiary group that accrue to the nonpoor, the poor, and the very poor, in order to calculate a poverty impact ratio. The method basically estimates the share of road user cost savings that will be passed through to the poor. The participatory approach also helps to identify nonmonetary benefits and costs perceived by the poor, and the policy and institutional changes, as well as complementary investments, which could enhance poverty reduction impacts. ADB tested the approach in Tajikistan with technical assistance (ADB 1999c) for poverty analysis of a road rehabilitation project (ADB 1999c).

The World Bank has developed detailed guidance for staff on the socioeconomic impact assessment of rural roads projects (Grootaert 2002). This guidance is intended to support the design of evaluation studies to be carried out in connection with future rural road projects. The tools provided are to be applied on low-volume roads and in projects to improve paths, tracks, and trails, and to provide NMT. They include two modules, one to capture the direct effects of these investments on transport cost, time, and accessibility of services, and one to capture the indirect effects reflected in changes in household income and other household characteristics (education and health status, social interaction, political participation). Both modules also measure the distribution of these effects upon different socioeconomic groups in the project's influence area, enabling an assessment of project impacts on poverty reduction. A set of indicators is proposed to measure rural transport project outputs, project outcomes (direct effects), and welfare outcomes (indirect effects). Use of a quasi-experimental (double difference) design is recommended, with problems of endogeneity addressed through propensity score matching. Where baseline data are missing or comparable control groups cannot be found, instrumental variables may be used to introduce an observable source of exogenous variation.

Van de Walle (2000a) assesses current methods of evaluating rural road investments, including recent proposals to incorporate poverty reduction and equity concerns. She points out that rural road programs often operate under a fixed budget constraint and in an environment where economic efficiency is not the sole policy goal. Under these circumstances, a cost-effectiveness approach to project selection is appropriate. Based on data from Viet Nam, her study uses indices to capture the different aspects of poverty, accessibility, and economic potential in

small areas (communes). It shows that these three measures are not interrelated and therefore all three must be considered in project selection. A method for evaluating the social welfare benefits of individual road links is proposed, including a social equity measure based on income levels in the project area, and an efficiency measure based on expected economic benefits. The goal is to maximize social welfare in relation to project costs, under an overall program cost constraint. If no minimum rate of return is required, this can be accomplished by simply calculating the cost-benefit ratio for each project and ranking the results. If a minimum rate of return is required, this should be established, taking into account the expected proportion of nonmonetary and monetary benefits. This can be done simply by "discounting" appropriately the minimum rate of return.

A recent DFID-sponsored study on the valuation of transport-related time savings by the poor in Bangladesh produced very interesting results (I. T. Transport Ltd. 2002). Typically, the value of time saved by the poor is estimated at or close to zero, on the theory that their opportunity cost is low. Recent research, however, shows that the poor, especially poor women, are more time-constrained than the nonpoor. Under conditions of time poverty, travel time represents a real opportunity cost to the poor. Consequently, the value of travel time savings to them is high. This study, using stated preference methods, was able to show that poor people in Bangladesh attach a high value to travel time savings. The study points out the need to redefine the meaning of a "work-related trip" in a developing country rural context, since most poor people are self-employed. The research shows that the poor are willing to pay in excess of what conventional economics would suggest is their opportunity cost, in order to achieve travel time savings, even for predominantly "social" trips. Thus, including higher values for travel time savings to the poor in the economic evaluation of rural road projects can be justified. This argument is equally applicable to the time savings generated by energy projects.

Summary

This review of the literature on transport and poverty reduction has shown that most of the existing work has been done on roads, particularly rural roads, serving poor areas and presumably poor people. This bias is logical, since roads represent the transport mode most often used by the poor. Nevertheless, other transport modes can bring services to the poor (as an alternative to bringing the poor to the services). The bias toward rural areas is also logical, since rural areas are where the bulk of the poor population resides. Still, large numbers of urban dwellers are also poor, and their transport needs must also be considered.

Much of the past work has focused on impacts on agricultural production. However, more recent work has also taken account of the increasing importance of nonfarm activities in the rural economy. Studies have generally treated increased access to social and economic services as a benefit, without examining whether such increased access actually enhances the welfare of the rural poor. Recent themes have included the differentiation of gender roles in transport and the impacts of transport infrastructure development on the physical and social environment. Interesting speculations have been offered about the impact of transport improvements on security, social capital, and community values. Relatively little work has looked at rural-urban linkages and at the roles of migration and remittances in the livelihood strategies of the urban and rural poor.

The literature on urban transport and poverty reduction is limited. With the exception of resettlement studies, almost no empirical analyses of the impacts of rail, port, or aviation improvements on urban or rural poverty have been undertaken. Most existing studies are of uncertain value because they do not present systematic "before and after" data on poverty, and they do not evaluate the complementary actions that could have assisted a transport project to reduce poverty. However, many people in developing countries, and not just transport planners, believe firmly that transport improvements do alleviate poverty. The need is for properly designed case studies, with baseline data collected before the project, and continuing for as many years after the project as is needed, to track the effects on poverty and to distinguish project effects from underlying change.

Energy

As with transport, a considerable literature asserts that energy projects are good for the poor, but relatively few empirical studies measure these effects. Early studies of electrification schemes suggested that electrification would encourage new businesses and other economic activity. It is now widely recognized that it is unrealistic to expect that the provision of energy infrastructure alone will precipitate growth in economic activity and related poverty alleviation (ESMAP 2000). However, the availability of modern energy, together with other enabling factors, can accelerate changes in economic welfare.

ADB's energy sector strategy recognizes that poor people in its DMCs need energy at an affordable cost (ADB 2000b). Its goal is to increase the availability of energy in a least-cost and environmentally friendly manner, and to improve access to energy, particularly for the poor. It notes broad agreement on the links between energy and poverty reduction, but little hard data on the magnitude of the welfare impacts of different kinds of energy interventions. It is expected that greater use of energy services by the poor will result in better health care and education, higher labor productivity, and easier entry by the poor into labor markets. Other benefits may come from efficiency improvements resulting in lower costs, and from the elimination of poorly targeted and nontransparent subsidies. ADB will promote these outcomes by supporting sector restructuring, greater involvement by the private sector, improved environmental performance, and regional systems integration.

The World Bank *PRSP Sourcebook* (n.d) identifies five goals for energy development that could have positive effects on poverty: (i) expanding access to modern energy, (ii) improving the reliability of energy supply, (iii) ensuring fiscal sustainability, (iv) improving sector governance and regulation, and (v) reducing health and environmental costs. Access is a function of both availability and affordability. The poor place a high value on modern energy services, and to the extent that they are available and affordable, are willing to pay the full cost. Reliable energy supply is essential for making sustained improvements in household welfare and for efficient operation of businesses generating economic growth. Lack of a reliable energy supply tends to discourage households from making the necessary investments for an energy transition, and requires businesses to invest in costly back-up facilities or to obtain alternative supplies at higher prices. Fiscal instability and growing deficits contribute to higher inflation, reducing the purchasing power of the poor and increasing their vulnerability. Good governance and effective regulation are key determinants of whether the poor receive adequate service at an acceptable price.

Brook (2000) identifies ways in which improving access to better, cheaper energy services contributes directly to the welfare of the poor: freeing cash and human resources for more productive uses, improving access to health care and communications, broadening opportunities for the development of household businesses, and improving community and household environmental quality. The ways energy policies are set and energy services are delivered also provide indirect benefits to the poor: a more efficient, sustainable energy sector contributes to national productivity, employment, and earnings; a more competitive and transparent energy sector provides fewer opportunities and incentives for corruption; decreased reliance on government subsidies frees fiscal resources; and a sector that is net contributor to the tax base can boost fiscal resources.

DFID has also sponsored a substantial program of research on energy for the poor. This program has tended to focus on ways of improving the efficiency of traditional fuels and the development of small-scale, renewable technologies to meet local needs, rather than on the issues of large-scale energy provision through public utilities. However, DFID's position paper *Energy for the Poor* (DFID 2002b) argues for greater effectiveness in energy sector management, improved performance through privatization and regulatory reform, and expanding access, especially for the poor, through creating conditions attractive to private capital and appropriately targeting subsidies for the poor. The paper promotes a people-centered approach to energy planning that gives adequate weight to different technology options in relation to different development needs.

In preparing this paper, DFID undertook a series of literature reviews on the linkages between energy and poverty in relation to the MDGs on health care, environment, gender, and education. In health care, the main impact of reliance by the poor on traditional fuels appears to come through indoor air pollution, a major contributor to respiratory diseases, which in turn are a major cause of ill health among the poor (Bruce 2002). Risk of burns and other injuries, as well as fatigue from increasingly lengthy fuel-collecting activities, are other negative consequences. Women and children are particularly exposed to these risks. A reliable energy source is also important to the effective delivery of health care services, notably in storing vaccines and sterilizing equipment. Further research is needed to link health outcomes for the poor more explicitly to energy interventions.

The review of energy-poverty linkages with respect to the environment showed that while some empirical work has been done to assess the poverty and environmental impacts of energy interventions, studies have more often focused on the ways in which poverty determines energy use and corresponding impacts on the environment (Riley 2002). It is argued that the poor are more dependent on natural resources and are therefore at greater risk from environmental degradation, notably from the overuse of biomass resources as fuel. While this relationship is particularly evident in rural areas, the urban poor are also more vulnerable than the nonpoor to the risks created by urban environmental degradation and pollution. To the extent that energy development contributes to economic

growth and rising incomes, it appears also to contribute to increasing levels of deforestation and pollution. However, recent research suggests that this relationship may follow a "Kuznets curve" that inverts once a certain threshold of per capita income is reached. Hydropower development through large dams has received particular attention with respect to its impacts on the physical environment, as well as direct social impacts on displaced people.

Energy Needs of the Poor

The studies reviewed (Barnes and Floor 1996; Foster and Tré 2000) suggest that poor people, like others, are rational consumers who will naturally seek to maximize their economic welfare by using a mix of available traditional and modern, or commercial, energy resources. People rarely use one energy resource exclusively (Table A.1). Factors affecting their choice include availability, affordability, efficiency, and reliability. For example, rural electrification is unlikely to change the use of biomass by poorer people for cooking. Providing access to modern energy, as an activity aimed at poverty reduction, should recognize the full energy needs of poor communities. Intervention to improve access to more than one modern energy resource will have a greater impact on energy use, with attendant positive impacts on the well-being of the poor.

The minimum energy requirement for sustaining life is for cooking (Alam, Sathgaye, and Barnes 1998). The poorest generally satisfy this energy requirement by using one or more biomass alternatives such as wood, dung, or agricultural waste (straw, bagasse [sugar cane waste], etc.). As people's incomes increase, the energy resource used in cooking may change to charcoal, liquid (kerosene) or gas (liquefied petroleum gas [LPG], natural gas), depending on their availability and cost. Easy road access will be a key factor in the affordability of some of these alternatives. Electricity would normally be unlikely to be adopted for cooking until users' incomes have reached a relatively high level. An important factor, in addition to income level, is reliability of supply (Foster and Tré 2000).

The next priority is fuel for space heating. This priority represents a significant basic need for poor people in cold countries, such as the Central Asian republics. However, the majority of people in ADB member countries need little energy for space heating. Generally, the same fuel choices as for cooking will apply to space heating. In contrast, electricity is by far the best energy source to provide lighting. Battery-driven lights are very expensive. Oil- and gas-fired lighting is relatively much less efficient than electric lighting. Other uses of electricity include entertainment (radios, tape players, televisions, etc.), lighting and fans. Electricity is the primary energy used for these activities, whether there is a grid supply or not. Batteries

Table A.1. The Energy Ladder

Use	Lowest Incomes	Rural Poor	Rural Medium Income	Rural High Income	Developed Country
Cooking	Traditional	Traditional, Kerosene	Traditional, Kerosene, Biogas, LPG	Charcoal, Kerosene, Biogas, LPG Coal	Gas or Electricity
Space Heating	None or Traditional	Traditional	Traditional	Traditional, Coal	Oil, Gas, or Electricity
Lighting	None or Candles	Candles, Kerosene	Candles, Kerosene, Electricity	Electricity, Kerosene	Electricity
Other Appliances	None	Dry-cell Batteries	Dry-cell, Storage Cell Batteries Electricity	Electricity, Dry-cell, Storage Cell Batteries	Electricity

LPG = liquefied petroleum gas.
Note: Traditional energy includes wood, agricultural residues, and dung.
Source: Barnes and Floor 1996.

are used to the extent the people can afford them. However, studies have confirmed that batteries are an expensive way to meet these demands (Fitzgerald, Barnes, and McGranahan 1990).

In the absence of access to modern fuels, poor people in developing countries depend on biomass for their energy needs. Burning biomass such as wood, charcoal, dung, and straw exposes them to high levels of dust and soot, directly affecting their health, life expectancy, and quality of life. Breathing air containing suspended fine particles is a major cause of chronic and acute respiratory infections, which are among the greatest causes of death and ill health for the poor (Lamech and O'Sullivan n.d.).

Energy in the Rural Community

Although poor people living in rural areas may be unlikely to use electricity to meet many of their household energy needs, electricity can help meet other needs of the poor through community services. Services to the community, such as potable water pumping, education, medical services, and security are easier to provide once electricity is available. Quantifying the value of these services, however, is difficult (ESMAP 2002c). The economic impacts of other modern energy services, such as refrigeration to improve and extend food storage, water pumping for irrigation, agricultural processing, and small scale industries, are more readily measured.

Improved agricultural productivity is often the result of using modern energy in agriculture. However, much of the energy needed is petroleum-based, as the equipment needs to be moved around the farm. The availability of electricity for processing agricultural products generally increases the opportunities for such processing to occur in the farm community. This will increase employment opportunities that may provide income to poor members of the community, especially women. Pumped water supply can also release women and children (especially girls) from domestic drudgery, giving them more time for education and/or employment. The availability of electricity in rural areas also provides an incentive for industry to locate there, generating additional employment.

A review of rural electrification programs in Africa (Webb and Derbyshire 2000) highlights the need to consider rural electrification as part of a broad power sector reform program. The main difficulty in providing electricity services to rural areas is the high cost per consumer of extending existing electricity grids. Thus, an alternative approach is needed. Such approaches may be characterized by alternative market structures and institutional arrangements, including alternative forms of ownership, and/or the use of alternative technologies for energy production. Alternative forms of ownership could include private companies, cooperatives, local consumer associations, public-private joint ventures, or local government initiatives. Alternative technologies have focused on the use of nontraditional energy sources such as solar, micro/mini hydro, geothermal, wind, and hybrid types of projects (Box A.6).

Recent technological changes offer new possibilities for rural electrification. Advances in photovoltaics in the last decade are making it financially practical to provide some electric energy to regions outside the economic limits of traditional grid service. The impact of this option on poor consumers, however, is limited because the capital cost of the equipment remains high. In Kenya, more than 120,000 small solar photovoltaic systems have been sold to rural consumers by private companies, but most of the buyers have been among the top 25% of rural income earners. However, hire-purchase and finance agencies have entered the market, enabling lower-income (though not poor) families to buy systems on credit (Hankins 2000). Thus, strategies remain to be developed to make these technological alternatives affordable to the poor.

Some of the benefits of modern energy may be achieved through the application of alternative technologies in the use of traditional biomass (see World Energy Conference and FAO 1999). Where fuelwood is still used for cooking and heating, the atmosphere inside houses could be improved, with attendant health benefits, by using more efficient stoves and better smoke management (chimneys).

A World Bank review of rural electrification projects (Sanghvi and Barnes 2001) suggests that while such projects rarely support themselves financially, they can be justified in terms of the external benefits derived by rural populations through improved access to information and communication, education, economic opportunities, extended and more reliable health care services, and improved security. It also shows that grid extension is not always the most cost-effective solution, and that decentralized delivery options and alternative energy sources should be included in plans to meet the energy needs of the rural poor. Costs can be controlled through community contributions and local involvement in labor-intensive aspects of construction and operations. Complementary technical assistance and credit could be provided to increase the poverty-reducing impact of rural electricity by promoting its use in productive enterprises. With regard to policies favoring the poor, the review recommends financing initial connection charges rather than subsidizing operating costs.

Box A.6. Women and Wind Power in the People's Republic of China

An Asian Development Bank project is providing funds for a series of utility-scale, grid-connected wind power projects, as well as off-grid solar and diesel community projects, in three provinces of the People's Republic of China: Xinjiang, Heilonjiang, and Liaoning. Most villages in these provinces are already electrified, but some poor communities in remote areas remain unconnected to the grid. Though substantial success has been achieved in poverty reduction in these provinces over the last decade, recent natural disasters and low prices for agricultural products have caused many families to fall back into poverty.

Poverty in these areas is blamed on the lack of irrigation needed to increase yields on small farm plots. The small farms in these remote communities do not generate enough agricultural wastes to supply fuel for cooking and heating; thus, villagers must travel long distances to collect fuelwood. Although coal is available, poor households cannot afford to buy it.

A consultation with poor women who would benefit from the project showed that they expect electricity to reduce their workload significantly, enable them to participate in educational programs, and improve family health through "cleaner living." They plan to use electricity for lighting, pump irrigation, power for small businesses, and entertainment (radio and television). However, they are aware of potential affordability constraints; thus, grid-based options are preferred because of lower costs. The consultants also noted that the access to knowledge offered by radio and television programs will make a significant difference in the perception of realities and opportunities by poor women.

Source: Ma Zhong and Shen Mingming. 2000.

A recently completed study in the Philippines aims at developing methods to capture and quantify the benefits of rural electrification that escape classical cost-benefit analysis (ESMAP 2002c). The study found that willingness to pay for energy services is as high as the cost of providing grid electricity in rural areas. Indeed, many households without electricity are using more expensive and risky alternatives such as kerosene lamps and auto batteries. When providing grid electricity lowers costs, energy consumption increases dramatically. The study examined the contributions of improved lighting and television access to education, health care, security, and entertainment values, as well as the use of appliances to generate time savings and to enhance productivity of home-based businesses. Due possibly to drought and the lack of irrigation infrastructure, access to electricity had little effect on agricultural output or income. However, it proved significant in extending the time available for small businesses (mostly *sari-sari* stores), studying, and performance of household tasks. Appliances such as refrigerators, stoves, and power tools also contributed to income generation. The average incomes of households with electricity were twice those of households without electricity.

Respondents' views were mixed on the benefits of access to television, recognizing the importance of news and entertainment, but fearing that it could distract children from studying.[12] The study found little impact on health, but this was attributed to a poor choice of indicator (days lost from work). Impacts on safety and security were perceived to be important, but could not be quantified and valued. The study suggests that future research should explore the use of other methods taken from resource and environmental economics, including contingent valuation and land value increases.

A joint World Bank-Global Environment Facility (GEF) project in Bangladesh is promoting extension of electricity services to remote households and small businesses by expanding a successful partnership between the Bangladesh Rural Electrification Board and village electricity cooperatives (VECs) (DevNews Media Center 2002). The VECs are governed by councils, including elected consumer representatives. They establish tariff rates and oversee collections, providing cost-effective and client-responsive services to rural communities. The project supports the development of stand-alone generation and distribution systems, based on renewable energy, for communities too remote to be connected to the national grid. Because nonpolluting renewable energy sources will replace the current use of kerosene, the project is eligible for a grant from GEF to recognize its contribution to the reduction of greenhouse gases.

A study in Tajikistan financed by ADB aimed inter alia to identify policies that would alleviate the effects of higher electricity tariffs on the poor (The Louis Berger Group, Inc. 2003). Currently, poor households are paying about as much as the nonpoor for access to electricity, while the supply they receive, especially in rural areas, is much less reliable. Poor households rely heavily on wood, and to a lesser extent on diesel fuel and candles, to meet

[12] After electric lights, televisions are typically the first appliance purchased by households benefiting from grid electricity. Some nonelectrified households also run televisions on auto batteries.

their energy needs. The study showed that electricity services would have to be greatly improved before people could be expected to pay higher tariffs or comply with stronger collection efforts. Introduction of a complete and fully transparent metering system would be needed to accomplish this goal. Furthermore, surveys of customer willingness and ability to pay would be needed to determine the true levels of effective and potential demand. The study recommends maintaining the current lifeline tariff until a transparent system for metering and billing in accordance with actual consumption is in place. After such a system is established, significant subsidies for the poorest households will still be needed.

An ongoing DFID study (DFIC 2004a) is looking at the role of renewable energy in alleviating rural poverty and promoting sustainable livelihoods in rural communities. Through a partnership with local universities, it will conduct case studies in Cuba, Nicaragua, and Peru on the introduction of renewable energy schemes in remote areas, aiming to identify factors associated with their success or failure. On this basis, it aims to develop a multicriteria model for decision making on energy policy and technology options. In the Philippines and Viet Nam, another ongoing study (DFID 2004b) will explore the possibility of reducing the cost, improving the quality, and expanding the use of family-hydro systems to generate small amounts of electricity, by securing financing from the Prototype Carbon Fund. Such systems are currently being used by low-income households in the PRC and Viet Nam. The research will focus on quantifying the carbon emission reductions associated with the use of such systems, as well as on the potential demand for such systems in other countries, such as the Philippines.

Energy in Urban Areas

Most Asian cities are already served by grid electricity. The challenge is to help the urban poor gain access to these services at affordable rates (ESMAP 2001). The cost of extending electric service to the urban and periurban poor should be low because they live near where an electric distribution system has already been built and, as their demands are small, only small additions to the infrastructure should be needed to supply them. Further, small loads should allow these connections to be made using lower-cost technical specifications. The problems are low use rates, a high proportion of illegal connections, and poor payment performance, resulting in high overhead costs to manage these potential consumers. The poor payment performance recorded in many urban centers is less likely to be due to an inability to pay than to a number of other factors, including poor service and high tariffs caused by the utilities' efforts to compensate for low collection rates.

This report concludes that the low cost of extending urban electrification to the poor should make such programs economically justifiable. However, the authors do not address the issue of property ownership and the fact that many of the urban and periurban poor are squatters. In some countries, this represents a barrier that makes obtaining a legal connection very difficult or impossible. Where the utility does not seek proof of ownership, other institutions might. For example, in Sri Lanka, the utility does not demand proof of ownership of the property as a condition of service, but when poor consumers seek the financial support available to help pay for the connection charges, the banks demand such documentation.[13]

The study by Powell and Starke (2000) points out that unless electrical energy can be produced and delivered more cheaply, it will remain beyond the reach of many of the poor. New technologies *are* drastically reducing the costs of electricity generation, but transmission and distribution costs are still a barrier to expanding grid-based services in isolated or sparsely populated areas. This study concludes that the urban poor stand to benefit from efficiency improvements resulting from sector reforms, but that alternative solutions will be required in rural areas.

The DFID energy research program includes a number of completed and ongoing projects aimed at addressing poverty-energy linkages in urban areas.[14] One project (DFID 2000c) addresses the role of energy in relation to the sustainable livelihoods approach adopted by DFID. It explores the energy/poverty linkages in poor urban households in the PRC, Ghana, and Indonesia, focusing on the strategies they have adopted to cope with rising energy costs. The results show that the poor cope by shifting down the energy ladder (e.g., from kerosene to fuelwood), by reducing their energy consumption, and by reducing other expenditures. These strategies have a strong negative effect on the assets of the poor. Natural assets are affected by increasing pressure on fuelwood supplies. Physical assets, especially housing, deteriorate due to lack of maintenance. Health declines because of poor nutrition (often directly related to a reduction in the number of cooked meals) and because of more limited ability to pay for health services. Education also suffers because of poor

[13] Carol Litwin, personal communication.

[14] The following project descriptions are taken from materials available on the DFID Knowledge and Research Energy Website. Available: http://www.DFID-kar-energy.org.uk.

lighting and lack of access to television and radio, as well as reduced ability to pay for schooling. Finally, social capital is affected by constraints on participation in social events and recreational activities. All of these effects make the urban poor more vulnerable and demonstrate their need for more affordable and cleaner forms of energy.

Another study (DFID 2002d), carried out in East Africa, assesses the impacts on the urban suppliers of traditional fuels (wood and charcoal) of shifts from traditional to modern fuels. The study distinguishes between large-scale transporters and wholesalers, who tend to be male and nonpoor, and small-scale transporters and vendors, who tend to be female and poor. The shift from traditional to modern fuels also entails a shift from traditional (manual) transport to modern (mechanized) transport. Fuel substitution has positive effects on lower-income households in terms of conditions for cooking, although it increases their vulnerability to price increases and periodic shortages. The study recommends legitimizing the charcoal industry in order to protect the livelihoods of poor fuel suppliers and to promote efficient and sustainable production.

An ongoing study (DFID 2004c) attempts to identify barriers to access to modern energy by the urban poor. This study focuses on the demand characteristics of urban poor households and on the supply constraints faced by local utility companies, aiming to identify workable solutions through a participatory approach. Research is being carried out in India, the Philippines, and South Africa. Yet another study (DFID 2004d) is looking at the impact of the withdrawal of modern energy on the livelihoods of the urban poor in Albania, KyrgyzstanRepublic, and Moldova. Based on community focus groups, it will identify ways in which the urban poor have been made more vulnerable by the deterioration in energy services following the collapse of centrally managed economic systems, as well as the ways in which they are coping with these changes.

Energy for Commercial and Industrial Development

The availability of reliable modern energy is an important factor in the selection of a location for a new enterprise. Where access to modern energy is not available, the probability of new enterprises locating there is very low.[15] The only exception to this rule is the existence of a large, natural resource such as an exploitable deposit of some commercially valuable mineral. In this instance, if the value of the resource is great enough, the mining enterprise will develop its own energy for the mine. Because such enterprises are generally private, their investment in energy is not likely to benefit poor people in the surrounding community.

Lamech and O'Sullivan (n.d.) enumerate the social benefits of expanding commercial energy provision. They include economic benefits (growth in incomes resulting from increased employment opportunities, and increased time for employment), social welfare benefits (increase in quality of life resulting from better lighting, access to information, and health gains), and environmental benefits (reduction in deforestation and diversification of crops resulting from a switch to greater use of commercial energy). However, little evidence is available on the degree to which claimed benefits, from rural electrification in particular, are realized. World Bank studies in Asia suggest that investments in rural electrification are only economically justified where a dynamic agricultural or rural industrial sector already exists (World Bank 1994). Exceptions are found in parts of the PRC and India, where massive rural electrification programs led to a significant shift in agricultural production, although similar effects could have been achieved with alternatives such as increased used of diesel pumps. The conclusion is that rural electrification can support rural economic growth but not initiate it. The driving force behind expanding commercial energy services is, however, largely political, and therefore the pressure for expansion is unlikely to diminish.

Gender Impacts

A DFID-sponsored review showed that gender bias is evident in energy poverty, although little quantitative data is available (Annecke 2002). This bias derives from role expectations requiring women to provide and manage household energy, while also contributing their own energy to the accomplishment of household and agricultural tasks. Programs to promote energy development for economic growth have not addressed these needs of poor women. Alternative energy sources are particularly important in freeing up the time of girl children to attend school, as well as providing lighting that can facilitate schoolwork and safety at night. While small-scale energy

[15] As noted previously, the opposite relationship generally is not true, i.e., that making modern energy available will precipitate new industrial investment. The availability of modern energy in a region is only one factor in the decision to locate a new enterprise. Other factors, including availability of appropriately qualified workers, easy access to markets, and business-friendly regulations may be more important.

projects have often been gender sensitive, gender specialists have paid little explicit attention to the role of energy in the poverty cycle. A gendered approach to energy and poverty would not simply seek to make the execution of women's tasks more efficient, but would seek to alter the distribution of household responsibilities between men and women and achieve greater gender equity in the distribution of benefits from energy interventions.

In the context of the World Energy Assessment, UNDP, with support from the Swedish International Development Agency, carried out a set of case studies on energy and gender issues (Karlsson and Misana 2001). The eight case studies focus largely on Africa, and mostly concern alternatives to grid-based electricity for meeting the energy needs of rural women. Based on lessons learned from earlier projects, these case studies show a strong emphasis on linking energy services to the creation of income-generating opportunities for women and facilitating their participation in community decision-making. They also tend to show, however, that where grid-based electricity cannot be economically supplied to rural communities, alternative technologies also require some sort of financial subsidy to be affordable to poor people. The case studies show that gender-sensitive energy policies should include (i) making electricity for lighting widely available in homes and communities (to extend women's working day, support female literacy and educational attainment, and increase women's safety); (ii) providing electricity to run productive equipment; (iii) promoting cleaner fuels, improved fuel distribution systems, and improved stoves; (iv) involving women in technology development and dissemination; (v) developing energy credit programs accessible to women; (vi) improving market information to assist women in becoming energy entrepreneurs; (vii) supporting gender equity in sector policies more generally; and (viii) removing barriers to women's full participation in economic, social, and political life (Karlsson and McDade 2001).

Two of the eight case studies were carried out in Asian countries. In Bangladesh, the case study concerns a microenterprise project involving women in improving lighting in rural households by producing and marketing battery-operated lamps to replace traditional kerosene lamps (Khan 2001). The lamps are used in homes, shops, religious and social centers, and on fishing boats in an area not likely to be reached by grid electricity. Traditionally, women and girls are barred from the marketplaces where evening lighting is provided by privately operated diesel generators. The battery-operated lamps are markedly safer and better for health than traditional alternatives. Their batteries can be recharged using diesel generators or solar panels. The high cost of batteries and long distances to battery-charging stations initially proved to be barriers for poorer women. However, the project has designed a credit program (including a subsidy) that will enable poorer women to participate in the future. The study showed that increased income generation was a main motivation for women to buy the lamps, along with providing children with light for studying at night. The project has also been beneficial to the women who received training, learned to assemble the lamps, and have taken over marketing and sales activities. Their increased income has gained them status and voice in their homes and in the community.

The Nepal case study concerns a community development program that offers remote communities the option (among others) of developing microhydropower systems to provide electricity. The program aims to ensure gender equality by forming separate community groups for men and women to discuss development priorities, and then forming functional groups to implement projects on which men and women are equally represented. All projects must be agreed upon at the village, district, and national level, and each level of government participates in the investment. Microhydro projects are accompanied by skills training for every participating household to ensure that additional income is generated to cover the operating costs of the system. The program also supports solar photovoltaic systems, biogas systems, and improved stoves, as well as a range of nonenergy interventions. Energy improvements reduce the time taken for women's traditional tasks and enable them to participate in other activities, both for income generation and for building social capital through community participation. The study concludes that energy projects should not be promoted in isolation, but should be introduced as a component of integrated development planning.

Policy Change and Sector Reform

It is very difficult to devise a program of subsidies that will achieve the three desirable results of helping poor people, being affordable to implement, and not distorting the market system. It is well accepted that economically efficient use of a commodity will be achieved if that commodity is priced at its cost of supply. Subsidizing, or overtaxing, a commodity will tend to increase, or decrease, the amount used and thereby reduce the overall economic welfare of the community. For example, in many countries some forms of energy, typically imported petroleum fuels, are taxed more heavily than other fuels. The result is both to reduce the use of the taxed fuel and to raise the price of the alternative indigenous fuel to levels

that keep it just competitive. The effect is particularly harsh on the poor (Barnes 1995).

Electricity is often subsidized to agricultural and domestic consumers. This type of subsidy benefits the better-off consumers more than the poor because the better-off consume more energy. A better approach, one that is used in many countries, is to provide a subsidized lifeline rate for a limited amount of electricity to domestic customers each month. Although all consumers will benefit, the amount of the benefit is limited and can be recouped by setting the rates for higher levels of consumption at levels that are just high enough to recover the subsidy in the initial consumption.

Barnes and Halpern (2000) note that subsidies are likely to remain a key part of pro-poor energy policies in developing countries for some time. Traditional ways of delivering subsidies, particularly cross-subsidization of consumption, often fail to help the poor. Thus, energy subsidies should be directed at encouraging access to service, rather than covering the operating costs of providing services. Subsidies should (i) reach the poor; (ii) be structured in such a way that they encourage provision of services at least cost; and (iii) achieve social goals at the lowest program cost while providing incentives to business to serve the poor and rural population.

Electricity is known to have the highest connection costs of all forms of modern energy, and these costs can be an insurmountable obstacle to the poor. To a lesser extent, the initial cost of using kerosene and LPG may also be high, as new stoves and storage containers are needed. One approach to the issue has been to provide new customers with the option of paying for the connection and other equipment costs over time as an additional charge on their electricity or liquid fuel bill. Such an approach may still not be sufficient for the poorest consumers. In the past, ADB has generally followed the principle that subsidies should be eliminated. However, the most recent Energy Policy (ADB 2000c) recognizes that subsidies that are well focused on poverty reduction may be acceptable and necessary for a period of time.

Recent studies have indicated that most poor consumers can afford the recurrent monthly costs of electricity, but not the capital costs of the initial connection, wiring in their homes, and electric appliances. Where this can be shown to be the case, a well-focused subsidy of these costs may be more effective than the more widely used lifeline tariff on energy. As noted above, other forms of modern energy also require new appliances, so it will be important to establish a consistent policy for all forms of modern energy (Barnes and Halpern 2000). Efforts should also be made to ensure that all alternatives are priced consistently, so that economically rational use and consumption rates may be expected (Barnes and Floor 1996).

Villagran (2000) states that power sector reform programs should aim at improving access to electricity for potential consumers regardless of their location with respect to the grid. Recognizing that in the long run, grid electricity is the least-cost, highest-quality solution, he points out that the government should allow customers and service companies to make the technology decisions. Governments should also avoid blocking the development of markets for alternative fuels through price subsidies and quantity controls. Off-grid systems can be successfully managed by village committees, local vendor representatives, rural electric cooperatives, or rural energy corporations. Mechanisms for bidding on the right to serve a rural market can be used to minimize the subsidy required. Finance for the high initial costs of off-grid systems is often a problem, and innovative financing methods may be required.

Private Sector Involvement

Various models have been examined as ways to involve the private sector in the supply and maintenance of equipment, and different financing mechanisms, involving either utilities or the private banking system, have been tried. The same institutional arrangements have been examined as vehicles for well-targeted subsidy of the systems. The studies have also considered the various ways the private sector can become involved in providing and maintaining these systems (Jechoutek 2000; Ehrhardt 2000).

As most countries seek to restructure their energy supply systems, in particular their electric supply systems, debate has been renewed over whether the involvement of the private sector in the provision of services is likely to improve access by the poor (see Albouy and Nadifi [1999] for a review of the evidence on this issue). The immediate reaction is to suggest that, as the private sector must focus on the profitability of the enterprise, poor consumers who use little energy and are expensive to interconnect will receive far less service from a restructured energy supply system (Houskamp 2000). However, it can be argued that the long-run effects will be positive, on the basis that efficiency improvements will stimulate general economic growth and that this will have a positive impact on poverty alleviation. In addition, the removal of a major cost to the national budget may bring direct benefits to the poor, as

the funds released (assuming that they represent real revenues) can be directed to well-focused social programs.

A preliminary assessment of the impacts of the utility privatization and sector regulation in Argentina (Chisari, Estache, and Romero 1999) shows that economic gains are significant and that all income groups will benefit. However, it predicts that higher income groups will benefit more, in relation to their pre-restructuring utility expenditure, than the lowest income groups. At the same time, the analysis shows that effective sector regulation would produce significantly greater benefits for lower-income groups, reaffirming the belief that the poor consumer suffers the most from poor governance (See Box A.7 for a more detailed description of this study.).

Covarrubias and Reiche (2000) describe the approach being taken in Argentina to reform and privatize the production and delivery of energy services, while also actively promoting the expansion of rural electrification. The government awards concessions to private companies to provide electricity to small rural markets (between 3,000 and 25,000 potential customers). Companies are invited to bid on the basis of the subsidy they would require to provide minimum levels of service, encouraging them to identify cost-effective technologies and marketing methods to supply low-income consumers. Current spending on kerosene, candles, bottled gas, and dry batteries is used to determine what consumers should be able to pay, with the subsidy making up the difference between these payments and the cost of providing service. The benefits of rural electrification are seen as (i) dramatic improvement in the quality of lighting, allowing children to study and adults to extend income-generating activities into the evening; (ii) elimination of the health and safety hazards of using kerosene or candles for illumination; (iii) improved access to national and worldwide information through the use of radio and television; and (iv) better learning conditions in schools through the use of computers, the Internet, and satellite television.

Several more examples of methods being used to involve the private sector in the provision of modern energy to rural areas have been described, particularly in Latin America (Jadresic 2000; Estache, Gomez-Lobo, and Leipziger [2000] for a review of this experience). The examples describe several alternative models that are being tested. Estache, Gomez-Lobo, and Leipziger conclude that the relation between "privatization" and the poor is complex and in general ambiguous, and that more research on this matter is badly needed. However, greater involvement of the private sector is expected to lead to innovation in the provision of energy services and, with appropriate government regulation, seems likely to increase the access of the poor to modern energy.

Community Participation

It has been widely suggested that, if alternatives are adequately explained to the community, and the community is given the right to make the ultimate decision, an infrastructure intervention is more likely to be successful (ESMAP 2002b). Energy infrastructure must be paid for, and different energy options will have different costs and benefits, so the community must fully understand the implications of each option. The community may determine that a better source of energy for cooking would have a greater impact on community welfare than a rural electrification scheme. This might be provided through

Box A.7. Impacts of Power Sector Reform and Privatization in Argentina

Using a computer generalized equilibrium model built around a social accounting matrix constructed for Argentina, a World Bank research study explored the effects of changes in utility performance on revenue and expenditure for 21 productive sectors, external trade, government, and domestic consumers in five income classes. The pluses of privatization included efficiency and productivity gains, quality improvements, and cost savings.

The study showed that privatization generated significant benefits to the economy. The impact of these benefits on the poor, however, depended upon the effectiveness of sector regulation. Direct gains were significantly higher for the higher-income classes, because when regulation was not effective, the gains from privatization were turned into a quasi-rent captured by the richest, who were the largest domestic owners of capital in infrastructure services. Part of these gains was also captured by foreign consumers and the government, because they owned part of the "privatized" areas.

The study found that through its indirect effects on the economy, privatization improved the overall distribution of income, as measured by the Gini index (a measure of inequality). When sector regulation is effective, however, the income distribution effect was six times as great, because under effective regulation, more of the gains translated into labor income, the principal source of income for the poor. When sector regulation was ineffective, a larger share of the indirect benefits went to the owners of capital.

Source: Chisari, Omar, Antonio Estache, and Carlos Romero. 1999.

locally generated biogas, better supplies of kerosene, or LPG. A fuel service station for users of a new or upgraded road could also be the base for providing alternative modern fuels for domestic and small commercial use.

If a rural electrification scheme is selected, the community may need to become involved in its management. As a minimum, such management will be responsible for collecting charges for electricity consumed and making payments for communal energy uses. For local management to be successful, training will be needed in bookkeeping and general management. In addition, training can provide local people with the ability to safely install and maintain basic house connections. Nevertheless, the community will need access to qualified maintenance services to do necessary work on the high-voltage systems and to perform checks on work done in households, in order to reduce the risk of injury and property damage caused by improper installations.

Impact Assessment Methods

In a recent paper, Foster and Tré (2000) discuss the feasibility of measuring the impact of energy sector interventions on the poor. Indicators measuring the impact of energy sector projects on the poor should consider a household's full portfolio of energy sources. The approach would require the specification of quantitative welfare indicators, including basic needs, economic benefits, and social benefits. Values would then be determined for each indicator for both poor and nonpoor groups. Data would be collected for the same households before and some time after the intervention, as well as for a control group (the "double difference" design). The authors show that much of the information needed can be obtained from living standards measurement surveys or other income and expenditure surveys commonly carried out in developing countries. Based on the results of the 1998–99 National Survey of Household Income and Expenditure in Guatemala, they calculate the values of the proposed indicators for 1 year, suggesting that these could be used as a baseline for a potential future assessment of the impact of electricity reform on poverty in Guatemala.

Another study proposes the use of shadow prices, based on semi-input-output analysis, to estimate indirect income effects on the basis of directly measured income effects (Potts 1999). The approach is illustrated with the example of a district heating rehabilitation project in the Republic of Latvia. The benefits of electrification projects are valued based on a combination of consumer willingness to pay, the benefits generated from additional income-earning activity, and savings compared to the use of alternative energy sources. The cost-benefit analysis for this project identified savings in energy costs due to increased efficiency as the main benefit, with additional savings in maintenance and labor costs. It was assumed that the efficiency savings would be passed on to consumers, while the maintenance and labor cost savings would accrue to the utility. Labor cost savings would be achieved at the expense of semi-skilled and unskilled workers, who would be the main losers from the project. Consumers could be disaggregated into residents, public institutions, and public and private industry. To evaluate the incidence of poverty resulting from consumer benefits, it is necessary to carry out a survey of consumers and their energy consumption, stratified by poor and nonpoor groups.

Additional research sponsored by DFID has developed a toolkit for the selection of appropriate combinations of energy services to meet the needs of poor communities on a sustainable basis.[16] Use of this toolkit (called "Enpower") begins with a participatory analysis of the energy needs of the community. The kit provides information on the financial and nonfinancial benefits associated with different energy options to meet identified needs. (Financial benefits are cost savings; nonfinancial benefits have to do with the quality of service provided.) Combined with information on current energy expenditures and aspirations for the future, the toolkit helps assess the affordability of different options for different members of the community. Alternative scenarios are then used to support community-based decision making. The goal is to encourage the development of more inclusive approaches to energy supply, by enabling the community to balance the needs of all stakeholder groups. The toolkit has been piloted in Namibia, South Africa, and Tamil Nadu, India; a final version is in preparation.

Summary

It seems likely that biomass will continue for many years as poor people's main source of energy for cooking and space heating , notwithstanding the developed world's best efforts. However, it is important to recognize that biomass supply is limited and may not always be sufficient. The arguments in favor of making modern energy, electricity in particular, available to all are many, but the expense is currently prohibitive. The poorest people will not be able to use electricity in their homes until they have

[16] An electronic version of this toolkit can be downloaded from: http://www.etsu.com/energy_voices.

improved their income levels to a point where they can afford the energy, although even then they are not likely to be able to afford the full installation and connection cost. Hence, when a rural electrification scheme is being planned, the broader energy needs of the community should be considered. The program might include improving the source and cost for kerosene and LPG and the introduction of more efficient stoves for those who must continue to use biomass.

Various models have been examined as ways to involve the private sector in the supply and maintenance of equipment, and different financing mechanisms, involving either utilities or the private banking system, have been tried. The same institutional arrangements have been examined as vehicles for well-targeted subsidy of the systems. As most countries seek to restructure their energy supply systems, in particular their electricity supply systems, debate has been renewed over whether the involvement of the private sector in the provision of services is likely to improve access by the poor. However, it can be argued that the long-run effects will be positive, on the basis that efficiency improvements will stimulate general economic growth and that this will have a positive impact on poverty reduction. In addition, the removal of a major cost to the national budget may bring direct benefits to the poor, as the funds released can be directed to well-targeted social programs.

Transport and Energy

Most of the literature concerning infrastructure impacts on poverty reduction is focused on one sector: transport, water, energy, irrigation, telecommunications, etc. However, some studies have looked at the composite effects of infrastructure investments (together, in many cases, with investments in the social sectors) on economic growth, particularly in rural areas, and on poverty reduction. These studies are particularly valuable in assessing the relative importance of different types of investments and their appropriate sequencing and timing for optimal impact.

Some difficulties arise in comparing the results of these studies because of their differing definitions of "infrastructure." Most studies have included both transport and energy investments in this definition, although some have looked only at utilities (e.g., Houskamp [2000], and Komives, Whittington, and Wu [2000]). Most studies also distinguish "physical infrastructure," which includes transport and energy, from "social infrastructure," including schools, clinics, and other public buildings. In addition to transport and energy, the physical infrastructure "bundle" usually includes water, sewer, and telecommunications systems, and sometimes irrigation as well.

Sawada (2000) took a dynamic approach to poverty in a study evaluating the role of infrastructure in reducing both transient and chronic ("structural," as defined above) poverty. The study concludes that infrastructure, including both roads and irrigation, has a role to play in relation to both types of poverty. In addition to increasing economic opportunities to alleviate structural poverty, infrastructure helps to minimize the risks of agricultural production, which are the main cause of transient poverty in Asia. Infrastructure increases information flow, lowers transaction costs, and increases personal mobility, providing access to a wider labor market. The study also cites the role of infrastructure in generating employment; reducing the risks of natural disasters; and stabilizing production, prices, and wages across the national economy.

Pouliquen (1999) stresses the role of rural infrastructure projects in building social capital at the community level, but points out that this does not necessarily result in poverty reduction. Projects may target poverty areas or aim to generate employment for the poor through the use of labor-based methods. However, these are blunt instruments, and the benefits are subject to capture by local elites. Greater community participation, together with more decentralized administration, may help to empower the poor, but only to the extent that the poor participate effectively in decision making at the local level.

A comprehensive review of the literature on rural electrification, with an emphasis on the evidence concerning poverty reduction, showed that poor beneficiaries perceived important noneconomic benefits, even when the investment had little impact on their agricultural productivity (Songco 2002). This review, which also covered irrigation, rural roads, rural water supply, and sanitation, emphasizes the importance of complementary investments in equipment, services, and credit to enable the poor to access the benefits that improved infrastructure provides. Complementary inputs would also include education or technical training, as well as provisions for participation by the poor in project planning and management. The study specifically confirms the conclusion that multiple sector investments benefiting the same target group have synergistic effects, especially when infrastructure investments are combined with education initiatives.

Case Studies

A study carried out in India by the International Food Policy Research Institute (IFPRI) (Fan, Hazell, and Thorat 1999) looked at the allocation of public funds in relation to growth and poverty reduction goals in rural areas. The study used an econometric model to evaluate the effects of government expenditure in a number of sectors plausibly related to rural poverty: agricultural research and development (R&D), irrigation, roads, education, rural and community development, power, health care, and soil and water conservation. This study found that investment in rural roads, followed by agricultural R&D, had the greatest effect in reducing poverty. Furthermore, rural roads were second only to agricultural R&D in explaining increases in agricultural productivity. Investments in education followed in third place for poverty reduction. In contrast, expenditures on electricity had little impact on either farm productivity growth or poverty, while expenditures on irrigation were related to productivity growth but only marginally to poverty reduction (Box A.8).

The lack of energy impacts was attributed to the fact that the government had already invested heavily in rural electrification, so that the marginal returns from additional investments were low. About 90% of India's rural villages were already electrified by the time of the study. Most of the measured effects of energy expenditures derive from nonfarm employment rather than from farm productivity increases. The study also found that public investment in health services had a statistically insignificant impact on (income-based) poverty and on agricultural productivity, at least over the time frame of the study (20 years).

The formulation of the IFPRI model illustrates the multiple linkages between road expenditures and poverty reduction. Investment in roads acts on three major variables: total factor productivity in agriculture (because of cost savings in transport of inputs and outputs); agricultural wages (because of structural transformations in agriculture placing a greater premium on wage labor); and nonagricultural employment (due to the employment-generating impact of road works, the stimulus to nonfarm commercial and industrial activities, and greater efficiencies in the rural labor market). In India, the growth in total factor productivity helped to keep prices of foodgrains low, benefiting the poor. It was also hypothesized that growth in total factor productivity would increase the value of land, leading to increasing landlessness among the poor; this hypothesis was not confirmed by the data, however.

An interesting byproduct of this research was the ability to estimate the time lag for investments to have their maximum impact on poverty. The lag times determined by the model are 7 years for roads and power, 8 years for irrigation, 10 years for health, 11 years for education, and 13 years for agricultural R&D. The study notes that these lag times are actually short compared to similar lag times calculated for the United States.

A similar study (Fan, Zhang, and Zhang 1999) was carried out for the PRC, although the specification of the model was slightly different. In the PRC, community development, health care, and soil conservation expenditures were not included in the model, but telecommunications expenditures were included. In this case, education expenditures had the greatest impact on poverty reduction, followed by rural telephones, agricultural R&D, and then roads and power, having approximately equal effects. For agricultural productivity, R&D was most important, followed by education and rural telephones, with roads and electricity again in fourth and fifth place. As in India, irrigation investments had a small positive impact on agricultural growth, but little effect on poverty. The poverty reduction effects of infrastructure investments (telecommunications, roads, and power) came about mainly through increased nonfarm employment and improved wages in the agriculture sector, due to a more competitive labor market.[17]

Recent research on poverty reduction in the Philippines (Balisacan 2001) examined why agricultural growth failed to stimulate the growth of the rural nonfarm economy, and thereby achieve the positive effects on poverty experienced in many other Asian countries. Rural infrastructure was postulated as one of several factors affecting the response of the rural nonfarm sector to agricultural growth. Other factors cited include the distribution of assets and incomes, the quality of human capital, and the macroeconomic and political environment. Based on data from 73 rural provinces in the Philippines, road infrastructure endowments proved to be by far the strongest predictor of successful poverty reduction. The model also included changes in access to electricity, but this did not prove to be a significant determinant of poverty reduction.

This work was expanded to disaggregate the effects on poverty of different sector endowments (Balisacan and Pernia 2002). The second study finds that while education endow-

[17] An earlier study carried out in Mexico (Cook et al. 1983) confirmed the synergistic effects of transport and telecommunications investments in rural areas, especially with regard to nonfarm employment.

Box A.8. The IFPRI Model

The "International Food Production Research Institute (IFPRI) Model" uses a set of simultaneous equations to estimate the effects of different types of government expenditures (including both investment and recurrent expenditures) on rural production and rural poverty. Poverty is defined as the percentage of the rural population falling below the poverty line. In these equations,

- Rural poverty reduction (DP) is estimated as a function of changes in agricultural production, rural wages, nonagricultural employment, rural/urban terms of trade, and population growth (lagged by 1 year).
- Agricultural production is estimated as a function of agricultural land, agricultural labor, use of fertilizer, agricultural machinery and animal traction, percentage of irrigated agricultural land, current and lagged expenditures on agricultural research and development (R&D), road density, electricity supply, average years of schooling in the community, and annual rainfall.
- Rural wages are estimated as a function of road density, electricity supply, average years of schooling, agricultural production (lagged by 1 year), and growth in nonagricultural gross domestic product (GDP) (lagged by 1 year).
- Nonagricultural employment is estimated as a function of road density, electricity supply, years of schooling, agricultural production (lagged by 1 year), and growth in nonagricultural GDP (lagged by 1 year).
- Rural-urban terms of trade are estimated as a function of local and national agricultural growth, as reflected in food prices, divided by a relevant nonagricultural GDP deflator.

In turn, road density is related to current and lagged public expenditures on roads, electricity supply to current and lagged public expenditures on electricity, average years of schooling in the community to current and lagged expenditures on education, and percentage of irrigated land to current and lagged expenditures on irrigation.

The independent variables are government expenditures in different sectors. Growth in nonagricultural GDP, population, and rainfall are exogenous (contextual) factors affecting outcomes. Availability of agricultural land, labor, and technical inputs (fertilizer, machinery, and animal traction) is a situational factor that is endogenous to the model, affecting outcomes in terms of agricultural productivity. Expenditures on agricultural R&D and on irrigation are also related to agricultural growth but not to growth in nonfarm employment. Other types of public expenditure affect both the farm and nonfarm sectors of the rural economy.

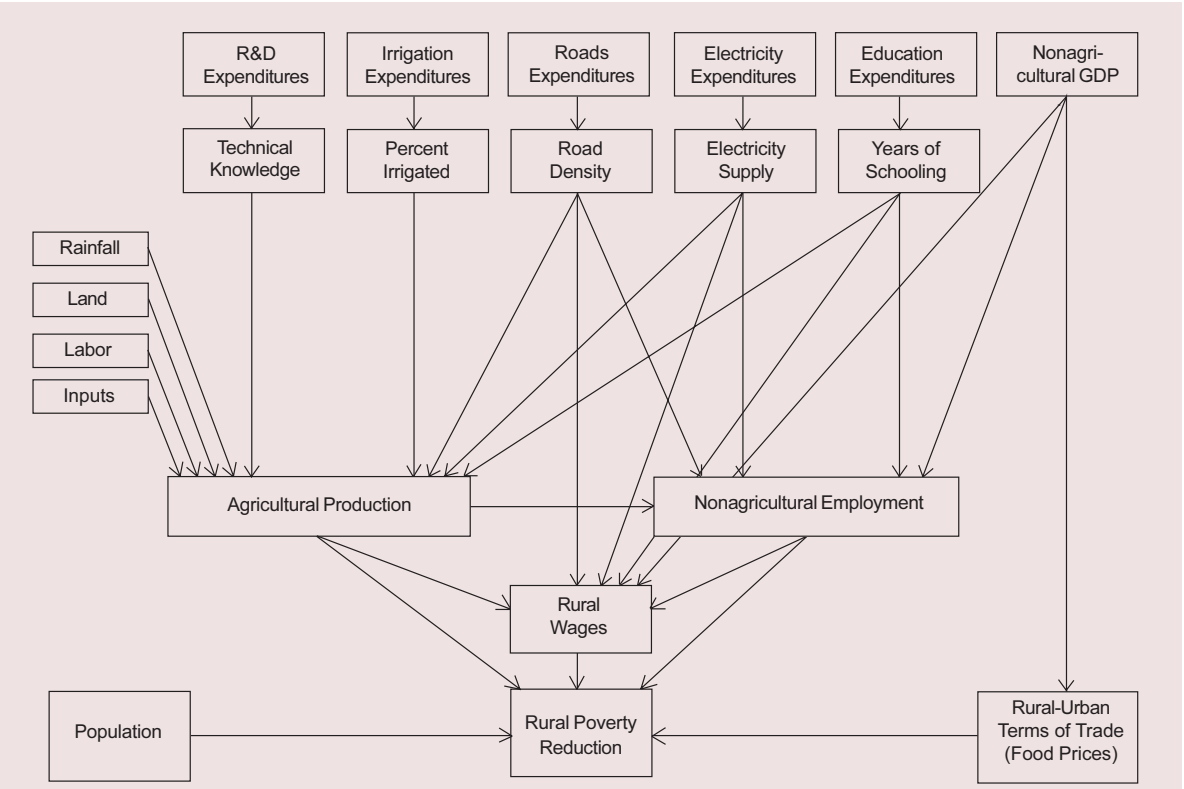
The model has been applied in different countries with some variations. In India, health expenditures were included; in the People's Republic of China, expenditures on rural telephones were included; in Thailand, rural-urban migration was included. However, the results are fairly consistent across countries. They suggest that public expenditures on infrastructure are significant determinants of rural poverty reduction, partly through their positive effects on agricultural productivity, but much more importantly, through their effects on nonagricultural employment, wages, and rural/urban terms of trade.

ments alone are unrelated to poverty, and roads alone may even be negatively related, the combination of roads and education has a positive effect on poverty reduction.[18] Electricity does not have a significant effect, either alone or in combination with education. However, irrigation infrastructure had a significant positive effect, although farm size did not, indicating that land quality matters more than quantity for poverty reduction. High transport costs in landlocked provinces and the frequency of typhoons were also significant, indicating the vulnerability of the poor to conditions that can be partially addressed through infrastructure investments. Governance factors, captured by variables on the presence of local political dynasties and party affiliation of local authorities, also had significant effects on poverty reduction performance.

The evidence regarding rural transport, energy, and irrigation investments is summarized in Ali and Pernia (2003). This review concludes that rural infrastructure investments offer the potential for a major impact on poverty reduction through promoting economic growth. However, it stops short of suggesting ways in which the policy environment could be altered to improve the distribution of the benefits of growth. It also highlights the importance of considering country specificities in establishing sector priorities for rural infrastructure investments.

ADB's Economics and Development Resource Center led another study carried out in Indonesia. Stage 1 of this study looked at public expenditures in the 25 provinces of Indonesia from 1976 to 1996 (Kwon 2000). The study considered government investments in irrigation, roads, health care, science and technology, agriculture and forestry, and education. The rate of decline in poverty was found to be most sensitive to road investments, followed by education, agriculture, and irrigation. In addition to the indirect effects of roads on poverty through intervening variables, the study was able to isolate a significant direct effect of road density in reducing poverty in Indonesia. Thus, road capital may be considered one of the assets of the poor, improving the functioning of labor and product markets. The study also highlights the direct impact of road construction on poverty by providing employment opportu-

[18] The authors point out that the results might have been different if the independent variables had been public expenditures on education and roads, rather than current endowments.



Source: Fan, Zhang, and Zhang 1999; Fan, Hazell, and Thorat 1999.

nities for large numbers of the rural poor. The findings of this study have been strengthened by the Stage 2 research using more disaggregated data (Balisacan, Pernia, and Asra 2002).

A major study on ways to support rural poverty reduction through projects has recently been completed in the PRC (ADB 2004c). The study looks at policy, rural industry, microfinance, rural infrastructure, and rural mobility. Its main report (Biotech Consultants Ltd. and Harvard Institute for International Development 2000) focuses on policy recommendations. The study notes that past rural infrastructure investments in the PRC have been undertaken more as a way of generating income for poor people (through Food for Work programs), than as part of a broader strategy to stimulate economic growth and reduce poverty in rural areas. Consequently, little work has been done to evaluate the broader impacts of such investments. Given the need to learn more about the link between infrastructure and poverty reduction in the PRC as a guide for more coordinated planning, the study proposes a pilot project to test the impacts of small-scale infrastructure at the village level. This pilot project is currently being carried out.

A study of water and electricity service provision in Peru looked explicitly at the question of whether synergies can be obtained by "bundling" infrastructure services (Grootaert and Oh 2001). Based on data from the Living Standards Measurement Surveys (LSMS) of 1994 and 1997, the study constructed a panel of rural households. Previous analysis of the larger data set (urban and rural) showed not only that access to basic services was a key determinant of growth in per capita consumption, but also that the impact of each service increased as new services were added. However, when the data were disaggregated into urban and rural groups, this effect did not hold for urban households, and was much weaker for rural households as well. The research reported here considered four services: water, sanitation, electricity, and telephone. Water and electricity were the most widely available and most likely to occur in combination. This study showed that the combination of water and electricity increased

incomes by much more than either service alone or the simple addition of the two separate effects.[19] This synergistic effect occurred for both poor and nonpoor households. While the data in the LSMS on quality of services is scant, it was possible to test the impact of water availability for at least 12 hours a day, which had an even stronger synergistic effect.

It is often argued that the introduction of market-oriented reforms will make the growth process more inequitable, because the benefits of infrastructure investments are more likely to be captured by higher-income households. The investment opportunities for poor households are constrained by land, labor, and credit market imperfections, as well as by disparities in educational attainments. A recent study uses data from Viet Nam to test the hypothesis that educational differences and labor market failures interact to create inequalities in the returns to investment in physical capital (irrigation), with poorer and less educated families receiving lower returns (van de Walle 2000b). The results support this conclusion. They suggest that increasing investment in education for the poor, as well as targeting public investments to areas of lower returns, would enable the poor to capture a greater share of the returns to irrigation. The paper also notes that infrastructure deficiencies—in roads, electricity, and communications—reduce the impacts of irrigation investments, and make the case for a multisector approach to development planning.

Additional research on irrigation and poverty was carried out by the International Water Management Institute in India, Philippines, Thailand, and Viet Nam (Bhattarai, Sakhitavadivel, and Hussain 2002). This work shows that poverty levels are generally lower in irrigated areas than in unirrigated areas, even though the bulk of the irrigation benefits may be captured in the first instance by the nonpoor. It emphasizes the importance of multiplier effects in spreading the benefits to the poor through increased farm and nonfarm employment. Additional work undertaken by Japan Bank for International Cooperation Institute in collaboration with the International Water Management Institute and Sawada in Sri Lanka focuses on the role of irrigation in ensuring sustainable poverty reduction, by permitting dry-season cropping and thereby mitigating seasonal fluctuations in income that otherwise could create at least transient poverty for many farm households (Sawada and Shinkai 2002). The study also found that access to credit was a key determinant of the ability to hedge against seasonal risks, and that access to credit was more constrained for female-headed households, households with a high proportion of female members, and households in nonirrigated areas.

Summary

Strong evidence is now available that (i) investments in infrastructure (including transport and energy), education, and agriculture work together to improve rural productivity and reduce rural poverty; (ii) roads may be the single most important sector investment in pursuing a program of rural poverty reduction; and (iii) investments in irrigation and power may also influence agricultural productivity, but are likely to have only marginal effects on rural (income) poverty. These findings in no way invalidate the benefits to the poor of earlier large-scale investments in irrigation and agricultural inputs that underpinned much of the green revolution in Asia. However, as modern agriculture expands into less suitable (and therefore poorer) areas, returns to such investments are likely to diminish, and this may also impose long-term environmental costs. Initial findings from the latest studies suggest, however, that rural roads and electrification also have significant, unmeasured effects on the quality of life of the rural poor.

[19] Water service increased incomes (measured by consumption) by 3 percentage points, and electricity by 19 percentage points, but the combination increased incomes by 28 percentage points.