Scaling-Up Poverty Reduction Potential of Infrastructure Projects: Lessons from the Asia-Pacific Region

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Asian Development Bank
Regional and Sustainable Development Department
ABBREVIATIONS

ADB - Asian Development Bank
ASEAN - Association of Southeast Asian Nations
CAREC - Central Asian Regional Economic Cooperation
DMC - developing member country
GDP - gross domestic product
GMS - Greater Mekong Subregion
Lao PDR - Lao People’s Democratic Republic
PPP - purchasing power parity
PRC - People’s Republic of China
RETA - regional technical assistance

NOTE

In this report, “$” refers to US dollars.
EXECUTIVE SUMMARY

1. This paper presents a sector case study on the impact of infrastructure on poverty reduction. While the contribution of infrastructure to augmenting an economy's productive capacity is well known, its impact on poverty reduction is considered mainly to be indirect, working through the poverty reduction effects of growth. However, there is increasing realization that infrastructure can also directly facilitate the access of the poor to basic services and help to increase their income-generation capacities. Since ADB adopted poverty reduction as its overarching goal in 1999, all aspects of its operations are geared toward that objective. Infrastructure lending accounts for about one third of ADB's total lending; hence, its impact on poverty reduction is a key issue.

2. The paper draws on ADB's experience in infrastructure development in Asia and the Pacific, both in the country context as well as the regional cooperation context, under which much infrastructure lending is taking place. It draws upon findings from country case studies and ADB's impact evaluation studies in roads and electricity. Despite differences in the underlying methodology, both studies show similar results that reinforce each other's findings. The impact of the Greater Mekong Subregion (GMS) Program is provided as a special case to illustrate the impact of networking on infrastructure investments in the regional cooperation context.

3. An important conclusion is that under favorable circumstances, some of which can be influenced by public policy, infrastructure projects can assist significantly in poverty reduction. This conclusion is based on both the country studies on infrastructure provision in general and a large body of ADB project experience in the road transport and energy sectors. However, it does not mean that any infrastructure will do. The paper emphasizes the cautions and points out preconditions necessary to ensure that infrastructure projects are indeed poverty reducing.

4. It was found from both studies that both road transport and electricity helped reduce income poverty, with road transport improvements having a stronger impact. Access to roads reduced prices under conditions of competitive transport services provision, increased mobility, reduced labor market imperfections, enabled the poor to find better paying work, and allowed production of higher-value cash crops and supply of cheaper agricultural inputs. Rural electrification helped stimulate the rural economy and increased opportunities for off-farm employment of the poor. Use of television led to improved information on crops and contributed to improved farm productivity. Lighting allowed longer work hours. All rural infrastructure projects also contributed directly to employment of the poor. Infrastructure provision was noted to have generally contributed to increased trade and growth in countries in the regional cooperation context. The impact on non-income poverty was also found to be significant. Roads reduced travel time and provided better access to basic education and health services. Electricity also impacted on non-income poverty. Better lighting increased the time for studies and years of schooling. It increased safety and security and provided better medical services in rural areas.

5. However, these favorable results do not have universal applicability and occur only with complementary public actions. When scaling-up rural infrastructure provision, several considerations have to be kept in mind. Strong poverty reduction outcomes from infrastructure projects can come about only if there is a strong pro-poor policy environment. Indications of such a policy include location of projects in areas of high poverty concentration, designing complementary interventions to increase the poverty reduction impact of infrastructure projects, creating market conditions for competitive reduction of transport prices, and attempting to
increase the affordability of electricity prices for rural consumers. In the regional cooperation context, the role of complementary agreements to facilitate cross-border trade, for example, illustrates the importance of complementary policy action to increase the impact of infrastructure projects.

6. No discussion on infrastructure can be complete without addressing issues relating to the sustainability of infrastructure services. If roads deteriorate and electricity services become erratic, all users are affected, including the poor. Thus, much greater attention has to be paid by developing countries to road maintenance than is being provided now. The sustainability of electricity services requires that the electric companies are financially strong and tariff policy is depoliticized. Necessary institutional changes and capacity building are also important actions to ensure sustainability.

7. Finally, the impact of infrastructure on growth and poverty reduction can be considerably increased in situations that call for regional cooperation by freeing the provision of infrastructure from artificial confinements within national boundaries. The GMS case provides good illustration of this and is a worthy model for scaling-up.
I. INTRODUCTION

1. This paper investigates how infrastructure investment can be scaled-up to contribute to poverty reduction. While the contribution of infrastructure to augmenting an economy's productive capacity is well known, its impact on poverty reduction, being largely indirect, is difficult to establish empirically. The literature suggests that many factors influence this impact, and that there are big variations in impact within and between countries. Further, it is found that the impact of infrastructure interventions on poverty depends on the broad socioeconomic environment.

2. Methodological difficulties complicate the use of much of the empirical literature. One problem is the conceptual and practical difficulty of separating out which final impacts are attributable to (for example) transport or energy investments, and which are due to other factors. Moreover, the larger the infrastructure intervention, the more difficult is this exercise. Several other problems are common to many of the existing studies. Usually the period examined was too short to identify longer-term, sustainable impacts. Also, few studies have tried to distinguish the impacts on the poor from those on the non-poor. There was also a tendency to neglect the non-income dimensions of poverty and poverty reduction.

3. Notwithstanding these conceptual and analytical difficulties, there is little question that infrastructure directly helps the poor to access basic services and to increase their income-generation capacity. In 1999, the Asian Development Bank (ADB) made poverty reduction its overarching goal. Infrastructure lending accounts for more than one third of ADB's total lending; thus, its impact on poverty reduction is a key issue.

4. This paper draws upon ADB's experience in infrastructure development in Asia and the Pacific, based on three kinds of sources: country case studies, project evaluation, and regional cooperation studies. Because of the differences in methodology and databases used, caution is needed in pooling the findings. In the paper, this demarcation is maintained, while common lessons are teased out. The focus is on transport, especially the road subsector, and energy. Chapter II discusses ADB's general experience in implementing infrastructure projects. Chapter III describes how transport infrastructure impacts on poverty reduction using evidence from several country studies and project evaluation studies. Energy sector findings are discussed in Chapter IV. Regional cooperation data are summarized in Chapter V. Factors driving the poverty reduction experience and the lessons learned are outlined in Chapters VI and VII, respectively. The last chapter provides some concluding observations.

II. INFRASTRUCTURE AND ADB

5. By first quarter of 2004, ADB had lent $44.4 billion for projects in the infrastructure sector, which includes energy, roads and road transport, ports and shipping, airports and civil aviation, and railways, representing 35 years of assistance since ADB commenced lending...
operations. Of the total, lending for power and roads has been most important and has accounted for 48.1% and 35.5%, respectively. Energy projects totaled $21.4 billion, delivered through 280 projects. Roads accounted for $15.8 billion, involving 177 projects in 28 countries. Figures 1 and 2 provide more details.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Lending Activities</th>
<th>%</th>
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<tbody>
<tr>
<td>Agriculture and Natural Resources</td>
<td></td>
<td>17%</td>
</tr>
<tr>
<td>Infrastructure (Energy and Transport &amp; Communication)</td>
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<td>43%</td>
</tr>
<tr>
<td>Multisector</td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>2%</td>
</tr>
<tr>
<td>Social Infrastructure</td>
<td></td>
<td>16%</td>
</tr>
<tr>
<td>Industry and Nonfuel Minerals</td>
<td></td>
<td>3%</td>
</tr>
<tr>
<td>Finance</td>
<td></td>
<td>14%</td>
</tr>
</tbody>
</table>

**Figure 1: Sectoral Share of ADB Cumulative Lending Activities As of 31 March 2004 (%)**

6. In transport, roads have been most important, with funds used for construction and improvements of primary, secondary, and feeder roads; bridges; restoration of damaged infrastructure; and maintenance operations. Most loans have been for inter-urban and rural roads. However, there has been a change in the pattern of investments over the past three-and-a-half decades, reflective of development trends in the region. During the 1970s, loans in the road subsector were mainly for the construction of new highways and rural roads. In the 1980s, the focus moved toward improving existing roads. The 1980s projects increasingly included components aimed at improving road maintenance, and also saw the introduction of the sector lending modality, which funds portions of national road improvement and rehabilitation programs over specific time periods.

**A. Performance**

7. Infrastructure projects in ADB have performed better than loans to other sectors. Of the 19 road infrastructure projects evaluated by the end of first quarter 2004, 37% were rated highly successful, 53% successful, and the other 10% partly successful.
8. Evaluation of ADB road projects shows that most were successful in producing their expected outputs. Cases of underachievement of physical targets were relatively few; the envisaged roads were constructed and the improvements made. Construction quality was generally good.

9. ADB’s energy projects have also had a high level of success. Of the 172 completed public sector energy projects, 103 or 59% were subject to post-evaluation by ADB. Of these, 72% were rated generally successful, 2% highly successful, 7% successful, 17% partly successful, and 2% unsuccessful.

B. Poverty Reduction Orientation

10. Successful implementation of infrastructure projects does not, of course, automatically translate into significant poverty reduction impact. Such impact depends significantly on their design, location, complementarity with other projects, supporting policy environment, and the manner of implementation (Prakash 2003). Infrastructure projects in the rural area or in locations with a high concentration of the poor may have greater poverty reduction impacts than projects elsewhere. In several projects, a definite prioritization was made to impart greater pro-poor orientation (see the Lao PDR projects in Box 1, and the Thai Rural Electrification Project in Box 2).

III. EVIDENCE OF POVERTY IMPACT OF TRANSPORT INFRASTRUCTURE

A. Comparative Country Studies

11. A study was launched in 2001 to assess the impact of transport and energy infrastructure on poverty reduction (Cook et al.). Practitioners, in particular the governments of developing member countries (DMCs), had a strong sense that infrastructure plays a major role in poverty reduction. But there was little reliable research to support this view. Skeptics argued that ADB should not continue to invest heavily in transport and energy without evidence that these investments do reduce poverty.

12. The studies were conducted in Thailand, Shaanxi Province of the People’s Republic of China (PRC), and Gujarat state in India. The methodology followed is in Appendix 1. The studies found that infrastructure development, particularly in transport and to a lesser extent in energy, had significant impacts on poverty reduction. Transport had the greatest influence. It was especially important for providing access to nonfarm employment and supporting educational enrollment and quality. Energy was also important, but its effects were more long term—by enabling productivity and efficiency improvements. Some of the main findings are summarized below.

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2 This study under RETA 5947 was implemented by ADB in collaboration with the Department for International Development of the Government of the United Kingdom, Japan Bank for International Cooperation, and World Bank.

3 Keeping in view the goal of the Conference, the findings have been presented in the paper in a broad brush manner. For a more precise and nuanced articulation of findings, please refer to the main research reports at http://adb.org/Documents/Events/2001/RETA5947/default.asp.
Impacts on Income Dimensions

13. As expected, the main effects on income dimensions of poverty were through the lowering of transport and other costs; productivity gains; and from improved access to markets, technology, and employment.

14. In the PRC study, the major factors related to poverty status were having paved village roads and the density of roads. Reducing the distance from major highways also helped to bring about poverty reduction. The major exception was that extreme poverty was not influenced by road status—perhaps because the extreme poor suffer from structural and demographic...
problems that prevent them taking up opportunities made accessible by roads. Rural roads in Shaanxi completed during 1998–2001 were found to be associated with a much higher rate of poverty reduction than roads in general, and with higher growth in the poor’s per capita incomes and assets. After road improvement, both the poor and nonpoor increased their production of cash crops, vegetables, and livestock. Improved road access played an important role in their being able to increase their use of technical training and credit. It was found that people strongly associated transport improvement with increased employment in the village, as well as outside of the village, rising living standards and income, and access to technical services.

15. In the PRC, the impact of a newly built railway was also examined by comparing counties on and off its alignment. Per capita income growth was much higher in counties on the alignment because of induced economic growth, such as through mining and tourism development along the rail corridor. Railway construction also provided a significant injection of employment and income for poor and nonpoor alike, which served as a catalyst for sustained higher growth in these counties. However, there was only limited influence on other counties. The main influence zone was found to be within 5 km of railway stations. Railways were also found to support long-distance migration to employment, including among those living further from railway stations.

16. In India, the study found that poverty rates were lowest for households with good roads and electricity and highest for households with neither. In households with electricity there was a statistically significant relationship between transport interventions and poverty status, and with literacy, primary education, and cropping patterns. For households without electricity, these relationships were much weaker. About one third of households surveyed in Gujarat reported changes in income due to transport improvement. The change was generally higher for those farther from the road and not consistently different between poor and nonpoor. Factors cited were improvement of the village economy, better prices, more sales, better wages, and more wage jobs in and outside the village.

17. The Gujarat study depended more on qualitative interpretation of a survey than did the PRC and Thailand studies. Improved market access through road improvement seems to have contributed to changes in cropping patterns from food crops to cash crops, and to declines in prices of agricultural inputs. Villagers reported increases in wages, perhaps because road improvement reduced labor market imperfections. They were now able to obtain wage employment in neighboring towns; some now commuted to work; and contractors now visited villages to recruit labor. However, overall changes in occupation were quite small.4

18. The Thailand study also found significant links between transport and poverty status, but these were weaker than in the PRC and India. Regression analysis was used to test links between transport status and household income and household assets. For household income, only length of paved roads to the district office had statistically significant results. This applied to the poor and nonpoor alike. Village dummy variables yielded significant results, suggesting that other situational factors also had an important influence. A series of indicators of transport coverage and quality, including average travel time and length of roads, was found to be related to amount of household assets, but less for the poor than the nonpoor. Econometric tests of improved and unimproved roads for 1992–2001 found that road improvement helped to raise

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4 The India study also examined the private port development at Mundra. This led to significant employment creation at the port and in factories established nearby, and in provision of additional education and health facilities. However, the communities interviewed were not benefiting from this employment because they had been replaced by outside labor following a dispute over unionization. The outside labor was probably also poor, so the development has helped toward state- or national-level poverty reduction, even if not in the communities surveyed.
the income of both poor and nonpoor households. Improvement of laterite roads to paved standard had greater impact on the poor's incomes than improving roads to laterite standard only.

2. Impacts—Non-income Dimensions

19. One of the most striking findings is the impact of infrastructure on non-income dimensions of poverty. Transport and to a lesser extent energy led to significant improvements in the poor’s status in terms of education, health, safety, access to information, social interaction, and security.

20. In the PRC, statistically significant links were found between road access and the proportion of trained teachers in schools and school attendance by children. The incidence of disability and chronic diseases was higher in villages without access, and may be linked to difficulties in accessing health services. The Shaanxi participatory assessment found that people strongly associated transport improvement with better medical services, schooling, and even improved marriage prospects. In India, improved transport services and all-weather access were considered important for accessing health facilities at critical times, such as childbirth. Availability of bus services also seems to have contributed to sharp increases in school enrollment, especially for girls. In Thailand, lower travel time and the number of roads were found predictive of higher average years of schooling, including for the poor.

3. Changes in Use of Transport

21. Improvements in transport infrastructure and services led to changes in transport use by both the poor and nonpoor. In each of the countries, road improvement was followed by expansion of bus services and increased use of mechanized vehicles. As a result, many of the poor changed from walking or using bicycles or draft-animals to using buses to travel to market. This was because they valued the time they would save. There was also a general increase in frequency of travel outside the village. Changes in transport use were greatest in the PRC, where road coverage was poorest prior to improvement, and least in Thailand, where initial road coverage was highest. The extent to which there was change in the use of different transport modes was affected by the conditions of competition among service operators—services in Thailand were competitive; lack of competition led to relatively high fares in the PRC; and in India, the services were publicly run and not very reliable.

B. Project Evaluation Studies

22. Some of these findings on impacts of transport and road projects on poverty reduction are further corroborated by ADB’s project post-evaluation studies. These are briefly summarized in this section.

1. Economic Impacts

23. Impact evaluation, although systematically carried out, commonly does not quantify the broader economic impacts of road projects. However, various examples of broader welfare impacts have been noted for completed road projects (ADB 2001a). For example, ADB’s impact evaluation study of the road sector in Nepal, completed in 2000, tracked vehicular operating cost savings from road upgrading to lower bus fares and freight rates, and subsequently to reduced prices of general consumer goods. As expected, the extent to which the benefit was passed on in the form of lower fares and freight rates was higher where transport competition
was greater. Parallel development of agriculture was seen to have occurred in some areas but not everywhere, and a direct link between road improvements and dairy output was apparent in the east of the country.

24. Other specific examples of broader economic impact are found in the Seventh Road (Sector) Project in Indonesia (ADB 1996b), where an increase in tourism occurred because road upgrading allowed tourist coaches to be used; and the Third Road Improvement Project in the Lao PDR (ADB 1997), where factories were built along the road.

25. Qualitative reviews of projects in the Philippines and Papua New Guinea, however, revealed that a disappointing number of road improvement projects, which aimed at stimulating agriculture, failed to produce any noticeable impact on rural output. The mixed results prompt the conclusion that road improvements can stimulate broader development, but they are not always sufficient by themselves. Complementary development of a more direct nature may be needed to produce the desired poverty reduction and to enhance its scaling-up potential.

2. Social Development

26. As shown in many project evaluation studies, the disadvantaged and poor also benefit from improved access apart from the improvements through cheaper transport, easy availability of local goods, and increased employment during the construction phase. Roads bring improved access to health, education, and public services; encourage the expansion of services like electricity, telephones, schools, and clinics; and enable greater contact between people of different areas. The importance for poor groups of more reliable and faster bus services, apart from any reduction in bus fares, has been noted in many studies of road projects. While these social benefits are frequently recognized, they are often not quantified. The benefit of good public transport is even higher for women who do not often use other modes of transport, such as bicycling, or riding in others’ vehicles.

3. Safety and Security

27. Improved roads as a result of ADB’s projects have enabled faster travel and in the process have also resulted in accidents and an increase in fatalities, especially of low-income pedestrians. ADB’s road projects began to address safety concerns more actively in the 1990s, but road safety remains a major issue that has not been accorded the importance it deserves. This is an area that needs greater attention.

4. Institutional Development

28. Infrastructure that decays before its economic life has expired does little good to either the poor or nonpoor. Institutional development and capacity building of infrastructure agencies is key to the sustainability of infrastructure interventions for poverty reduction. ADB’s road projects have contributed to the establishment of road sector policies and regulations and to the strengthening of both public sector agencies and private sector road contractors and consultants, encouraging a shift toward the greater use of local private contractors and consultants in infrastructure development.

29. The main sector policies of concern are those related to maintenance, such as vehicle overloading, and appropriate laws have been introduced in a number of countries. The contribution of most projects to institutional development, however, has been limited to technical and administrative aspects. An important lesson in this context is that success in upgrading the
technical and administrative capabilities of road agencies depends upon governments’ maintaining an appropriate policy environment, allocating appropriate staff for training or participation in technology transfer arrangements, and allowing trained staff to remain in positions where their new skills can be used.

IV. EVIDENCE OF POVERTY IMPACT OF ENERGY INFRASTRUCTURE

30. Since 1966, ADB has made 280 public sector loans in the energy sector, totaling $21.4 billion. Of these loans, 54 were approved in 1995–2001, with a total value of $6.4 billion, or more than $0.9 billion per year. This accounted for about 15% of total ADB lending in terms of value. The loans were mainly for electricity (mostly power transmission, followed by power sector restructuring), with gas in second place.

A. Evidence from Country Studies

1. Impacts—Income Dimensions

31. The PRC study found that electrical connection had less impact on the incomes of the poor and nonpoor than did transport. Households with electricity were found to have higher incomes, but the link between electricity connection and poverty reduction was not clear. This may have been because households without electricity tended to be in more remote locations, and were more willing to seek nonfarm employment outside their villages than were households with electricity. It may also reflect the poor quality of the rural electrical system, which meant that much of the potential for using electricity to enhance income-earning activities (other than through lighting) could not be exploited.

32. The analysis of the Thailand experience also did not identify a clear link between electricity connection and income as it had between transport and income. Electricity connection was linked with higher consumption expenditure as a result of electricity bills and the steady accumulation of electrical appliances. In the household survey, about 40% of respondents associated electricity with increases in income. The main mechanism identified was through increases in nonfarm employment, both within and outside the village. The nonpoor were considered more likely to exploit the economic opportunities created by electrification because they had more resources to invest. Few respondents associated electricity with occupational change among the poor.

2. Impacts—Non-income Dimensions

33. Non-income impacts of electricity were mainly those associated with lighting and power for electrical appliances. Electric lighting allowed children to study longer each evening. In Thailand, electrical connection was found to be predictive of higher average years of schooling, including for the poor. Electricity coverage, years electrified, and the value of electricity bills were found to be predictors of educational attainment, although only one of these—electricity bills—was statistically significant for the poor. Similar to the PRC, participatory assessment found strong perceived links between transport and electricity improvements and education and health status, particularly as a result of electric lighting, and the effect of refrigeration on food hygiene and medical services.
3. **Other Impacts—Time Savings**

34. Energy interventions enable use of labor-saving electrical appliances and lighting to extend the time available for production and education. In the past, there was a tendency to assume that the value of poor people’s time must be low. However, it was found that time savings can be central to poverty reduction. Lack of time often hampers participation in income-earning activities and weakens household support systems. Time savings through electrification help the poor to overcome these problems.

4. **Changes in Use of Energy**

35. When electricity became available it was used mainly for consumption purposes, such as lighting, television, and other appliances. To a much lesser extent, it also supported income-earning activities, such as food processing and irrigation, but this required investment in appliances, and was more common among the nonpoor than the poor. In each country, electric lighting extended the day for productive activities, homework by children, and social activities. Television was one of the most common appliances owned by the poor and nonpoor, and was an important source of information.

36. After electrification in the PRC, two thirds of poor households in the affected areas changed to use of electrical pumps for irrigation purposes. Half of the poor households surveyed used information on farming technology obtained from public television programs to raise their farm incomes. In PRC, India, and Thailand, energy spending was correlated with income. In India and Thailand, this was also the case for electricity. In PRC, electricity spending was not significantly different between the poor and nonpoor, but the nonpoor spent more on other energy types, such as kerosene. This was linked to the problems of low voltage and poor reliability of the rural electricity supply in PRC that made it unsuitable for many productive uses.

37. Use of electricity by the poor was influenced by the regulatory framework and tariff policy. In Thailand and the PRC, electrical connection by the rural poor was encouraged by public investment programs to achieve universal household coverage. During 1990–2000, the proportion of households with electricity in the areas studied rose from 70% to 100% in Thailand and from 42% to 100% in the PRC. In Thailand, this was complemented by a policy of keeping rural tariffs similar to urban levels by using a share of the profits of the electricity-generating authority to cross-subsidize rural consumers.

38. In the PRC, the strategy for extending rural coverage initially involved investing in a lower-cost, lower-quality system, and charging tariffs aimed at cost recovery. The quality limitations meant that the system was mainly limited to consumption uses rather than production, while the tariff policy caused rural tariffs to be three times those in urban areas. The Government has now changed its policy in favor of providing a higher-capacity rural system and equalizing rural and urban tariffs through cross-subsidy.

39. In India, although most villages were electrified, only about half the households were connected in the areas studied, and many poor households remained unconnected. The poor had difficulties affording the initial connection fees, and the tariff structure kept charges high for rural households while cross-subsidizing the agricultural sector, particularly irrigation use by large farmers. Another problem limiting use by the poor was that frequent outages made it necessary to invest in generators.
B. Evidence from Project Evaluation Studies

40. Rural electrification projects evaluated have noted the increase in economic activities that have resulted from these projects. The Thailand Rural Electrification Project (Box 2) resulted in new shops and rice mills, new kinds of nonfarm activities, and new occupations.

41. In general, the electrification projects reviewed indicate the following types of benefits, many of which relate to meeting basic human needs and enhancing the quality of domestic life:

   (i) lengthened working days through better lighting;
   (ii) expanded learning opportunities via radio and television;
   (iii) improved medical services and education;
   (iv) increased opportunities for economic activity, for example, by raising agricultural productivity via more electrically-pumped irrigation and powered milling; and widened employment opportunities, particularly in cottage industries;
   (v) improved food storage and supply via refrigeration;
   (vi) reduced workload through use of household appliances;
   (vii) reduced indoor pollution and a cleaner environment with the replacement of coal and/or coal briquettes, firewood, and biomass; this, in turn, has benefits on health, especially for women;
   (viii) reduced time gathering firewood and fetching water; and
   (ix) many other benefits, such as avoidance of the need to keep kerosene supplies and standby diesel, improved security as a result of street lighting, and added convenience.

42. Although energy projects are generally regarded as gender neutral, project evaluations revealed major benefits for poor women. For example, supplying electricity to dwellings reduced workload, increased cleanliness, and improved health through better indoor air quality. It was also observed that electricity supply reduced the burden of physical labor in such activities as milling; water and, to a lesser degree, firewood gathering; and other types of housework tasks typically performed by women in many DMCs.

43. In the energy sector, institutional changes through projects have had broad implications for long-term poverty reduction. These have been supported mainly through advisory technical assistance and policy-based lending. The changes have helped improve the financial and operational capacities of electricity companies and government institutions. Policy loans have helped institutional development through restructuring the sector, improving its regulatory framework, and strengthening the capacities of the sector’s regulatory bodies.

44. In some cases, negative impacts have been observed, including difficulties in relocating families displaced by hydroelectric projects; lower incomes in some of the new settlements; and some friction between the hosts and the resettlers. However, in general, there were greater employment opportunities after the resettlement as a result of the improved infrastructure.
Box 2: Thailand Rural Electrification Project

Thailand’s development over the past decades concentrated growth in the Bangkok Metropolitan Region. Although poverty incidence had declined substantially during 1960–1990, about 90% of the poor lived in rural areas. The Government was aware of this imbalance and took initiatives to promote economic growth in the rest of the country, including the development of adequate basic economic and social services in rural areas. In view of its socioeconomic impacts, the Government gave high priority to rural electrification, aiming to cover every household and thereby generating employment, establishing small-scale industries, and contributing to rural poverty reduction. The Rural Electrification Project directly supported this strategy.

Impact Analysis. The project enabled the Provincial Electrical Authority to react quickly to help mitigate the impact of the Asian financial crisis that began in 1997. The project served 477,379 new customers in rural areas, 20% more than original expectations. These customers, with access to the national grid, represented about 2.7 million people. It was estimated that the project improved the national household electrification ratio by about 4% to reach the current level of 90%. About 88% of the new customers connected under the project were located in the south, north, and northeast areas of the country, which have high levels of poverty. The Project Completion Mission estimated that 20% of the beneficiaries were poor.

Beneficiaries under the project acknowledged that improvement in the quality of life and convenience were major benefits of electrification. This was particularly true of household customers who worked at home, with major activities cited being reading in good light, rice cooking, and use of television sets. A considerable number of new businesses, commercial/retail shops, and rice mills were also established consequent to electrification. In a number of villages, the project opened up opportunities for new kinds of nonfarm activities and for wage employment. Electrification contributed to the establishment of new occupations, such as welding, food processing, and battery charging. Small-scale farmers were able to access irrigation through the use of electric water pumps, thereby increasing productivity in vegetable gardens and rice fields.

Lighting benefited education by better access to knowledge through radio and TV and availability of lighting for increased night studies and this applied to both poor and nonpoor households. Improved safety, consequent to household lighting and street lighting, and relatively less use of firewood, were other benefits that accrued to project beneficiaries. Some negative features were the increased costs due to electricity use which some of the poorer beneficiaries could not afford. Consequently, firewood, charcoal, and agricultural residues continued to be used as fuel, although on a reduced scale. Overall, as envisaged at appraisal, the project contributed to the sustenance of economic development, distribution of income and reduction of poverty, enhancement of the quality of life, and conservation of natural resources and protection of the environment.

Source: ADB (2001b).

V. NETWORKING INFRASTRUCTURE BEYOND BORDERS

45. It is well known that the development impact of such infrastructure projects as roads is expected to multiply when these are linked with each other. Networking of transport channels, in this sense, has a significant scaling-up potential for poverty reduction, subject to other preconditions for poverty reduction being followed scrupulously. In Asia and the Pacific, regional economic cooperation has helped networking across selected countries, thus enabling gains to be shared widely. In this chapter, the networking aspect of infrastructure projects beyond national boundaries is highlighted.
46. While infrastructure support has mainly been provided in the national context, and its benefits and impacts studied mainly at the project or country level, increasingly in Asia and the Pacific, infrastructure creation has been initiated by ADB through subregional economic cooperation initiatives. These initiatives have enabled many countries to scale-up poverty reduction by exploiting cross-border economies of scale, scope, and networks.

47. ADB’s regional cooperation initiatives began with the Greater Mekong Subregion (GMS) Program in 1992, and now span much of Asia and the Pacific. The GMS Program and other regional cooperation programs that followed have, inter alia, emphasized infrastructure provision, particularly programs that promoted physical connectivity between the countries and facilitated expansion of trade and other economic relationships. Of the total GMS loan program up to March 2004, all 17 projects that have been approved (national projects with subregional dimensions and purely subregional projects, amounting to $1.9 billion), are largely infrastructure projects in transport, energy, and tourism (although in later initiatives the “economic corridor” design was introduced). The case is similar to the other regional cooperation initiatives.

48. Since 1992, when the six member countries of the GMS program first embarked on the program, there have been many accomplishments. Economic linkages among the six countries have been strengthened through a series of infrastructure and associated projects. In turn, the emergence of a new trade area attracted investor interest, promoting economic growth and social development in the subregion. The GMS Program has also had a peace dividend—it contributed to trust and better relations among the member countries. Indeed, this contribution may be its most significant accomplishment: nothing could promote welfare for the people in the subregion better than peace and security.

49. Investment in transport infrastructure was complemented by attention to the regulatory framework. A framework agreement has been signed by the governments of Cambodia, Lao PDR, Thailand, and Viet Nam to facilitate the cross-border movement of goods and people. The agreement covers such issues as customs procedures, rights of cross-border passage for vehicles and drivers, vehicle and load specifications, insurance provisions, and transit or user fees. In addition, significant progress has been made concerning trade in energy and in establishing a telecommunications network for the subregion. The two hydropower projects—amounting to $380 million—were breakthroughs, both in terms of bilateral partnership (between Lao PDR and Thailand) and private sector participation. They have also promoted power-sharing arrangements on a multilateral basis, along with technical assistance.

50. The impact of these interventions is already being reflected in higher trade and investment flows for the subregion, with early signs of an emerging virtuous trade-investment nexus (see Appendix 2 for intraregional trade, growth, and poverty data of the GMS countries). The trend is similar for intraregional net foreign direct investment flows (ADB 2004b).

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5 Other subregional cooperation initiatives include Central Asian Regional Economic Cooperation (CAREC); South Asia Subregional Economic Cooperation; Central and South Asia Transport and Trade Forum; Brunei, Indonesia, Malaysia, Philippines East ASEAN Growth Area; and Pacific Islands Subregional Cooperation activities. See Iwasaki and Prakash (2002) for a review of ADB’s regional cooperation efforts.

6 In the case of CAREC, of the total regional cooperation program of $187 million approved so far, 86.6% is for infrastructure.

7 The countries are Cambodia, PRC, Lao PDR, Myanmar, Thailand, and Viet Nam.

8 This progression from simple construction of roads, to transport corridors and finally to economic corridors across nations, is itself a good example of scaling-up.
VI. DRIVING FACTORS FOR IMPROVED POVERTY IMPACT FROM INFRASTRUCTURE PROJECTS

51. Evidence from the country studies and ADB’s project evaluation experience suggests that many factors influence the extent of poverty reduction impacts from infrastructure projects.9 The main factors identified are listed below.

A. Commitment to Pro-poor Development

52. In DMCs with pro-poor policies and programs, better infrastructure led to expansion of economic and social development opportunities and the poor were often able to take advantage of these opportunities both directly and indirectly. Without such a pro-poor policy commitment, the infrastructure created may not have had as much of an impact on the poor.

B. Complementary Infrastructure Pricing and Services Policies

53. The approach to infrastructure pricing and service quality critically affects the impact on the poor. Use of cross-subsidies from nonpoor to poor, support for initial connection fees for the poor ensuring their access, and varying tariff bands are examples of pricing policies that can help scale-up the poverty reduction impact of infrastructure investments. In the absence of appropriate policies, there is a risk of resources being hijacked by nonpoor and vested interests.

54. Similarly, affordable transport tariffs can make improved road infrastructure accessible to the poor if a competitive environment is fostered for transport services. PRC, India, and Thailand have relatively open markets for transport services. This has helped to ensure that the private sector offers a wide variety of service options to meet different needs of the poor, and to keep prices competitive. Conversely, weaknesses in the broader policy framework for economic growth and poverty reduction, as well as governance, geographical, and other limitations, can imply that improved infrastructure will impact much less on expansion of economic opportunities for the poor.

C. Institutional Setting

55. Infrastructure services thrive better in the context of openness and competition that foster a good market environment, leading to increased production, trade, and growth. The country studies, project evaluation findings, and regional cooperation experience emphasize this. Thus, existence of a competitive transport environment enabled lower transport prices. One of the important factors in infrastructure provision in the subregional context as evidenced by the GMS program has been the strong commitment to improved functioning of markets and increased trade and investments for fostering growth.

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9 Notwithstanding the different methodology of the country studies and the evaluation studies, results and findings are broadly consistent and, thus, lend greater credibility to the findings of both.
VII. MAJOR LESSONS FOR SCALING-UP POVERTY REDUCTION THROUGH INFRASTRUCTURE INVESTMENT

A. Infrastructure for Rapid Development

56. If the evidence presented above is indeed correct, it follows that millions of rural poor in Asia and the Pacific are being disadvantaged in the absence of even minimum infrastructure in the form of roads and access to electricity. Provision of these basic facilities has to be part of poverty reduction programs. Without them, progress in achieving the Millennium Development Goals is going to be slow and difficult. More investment in transport and energy is needed. The focus should initially be on achieving universal access. It should then move on to improving service quality for all. It is worth repeating, however, that utmost care is required to ensure that the infrastructure development is properly designed and the supporting policy environment is ensured for it to stay relevant for poverty reduction.

B. Service Provision Targeted to Users

57. The cases reviewed above confirm the advantages of encouraging private investment, market competition, and market-based pricing for services that use public infrastructure. The issue of providing affordable electricity to the poor without overburdening government budgets with subsidies, however, remains a challenge. Programs to supply the poor with more energy-efficient appliances should be considered.

C. Policy Framework for Ensuring Benefits to Poor

58. Establishing appropriate policies is key for ensuring benefits for the poor. This includes not only regulatory arrangements in the transport and energy sectors, but also the various policies and programs that govern other sectors in which transport and energy can create opportunities for the poor. At the time of formulating transport and energy investments, there is a need to assess the extent to which policies and institutions will enable improved services and an expansion in opportunities for the poor.

D. Design of Appropriate Investment Packages

59. Including complementary activities in the total infrastructure investment package can increase the scale of the poverty reduction impact. This can be accomplished in many ways. One option is to provide complementary facilities to connect the poor in the same infrastructure project. For example, in the PRC, feeder roads improvements are often included as part of expressway projects. There is also scope for increasing the area of influence of railway projects by improving transport connectivity in the hinterland around railway stations—even by including a feeder road in a railway project.

60. An important lesson is that the overall economic impact of a project and its impact on the poor can be increased by providing interventions that complement each other and increase synergies rather making interventions in isolation. It would also be desirable to coordinate transport and energy projects with other poverty reduction programs, such as microcredit and training, which can provide the poor with the missing ingredients they need to take up

\footnote{While the evidence presented is from mainly rural areas where most of Asia’s poor reside, similar studies from urban areas may also be revealing, given urbanization and growing urban poverty.}
opportunities created. Effective coordination mechanisms during project implementation would, however, be necessary to prevent problems (similar to the Integrated Area Development projects of the past, which ran into coordination problems) from emerging.

E. Maintaining Technical Quality and Standards

61. Lower technical standards in investment projects should be avoided, even if it is tempting to spread investment budgets more widely. These hurt the sustainability of investments and result in costly repairs and reconstruction efforts. Unless infrastructure projects are maintained well, they cease to yield benefits. A key factor in the maintenance is the availability of funds. Currently in many DMCs, road funds are being created for maintaining the road networks. Similarly, lack of appropriate technology or requisite skills could be a constraint on proper maintenance. Timely and appropriate adjustment of tariffs is also necessary for sustaining infrastructure projects. These measures will increase the operational efficiency of executing agencies and the sustainability of poverty reduction scaling-up.

F. Institutional Changes and Capacity of Infrastructure Agencies

62. Both in roads and electricity, project evaluation studies have repeatedly stressed the need for further capacity building and institutional strengthening. Despite the implementation of many projects and much training, DMC infrastructure agencies still suffer from weaknesses in planning and implementing projects. Hence, this remains an area where much support is required.

63. Institutional changes appear a special priority in electricity. ADB’s earlier advisory work had limited impact because it mostly tried to improve management and efficiency within state-owned enterprises or agencies through training, improving accounting systems, and financial discipline, and getting tariffs right, but not addressing the key need to encourage reforms to bring in competition to provide built-in incentives to improve efficiency and reduce costs. A major sector lesson is that more attention should be given to these broader issues of restructuring utilities that can produce more sustainable results.

G. Private Sector Involvement

64. Development agencies are looking more and more to the private sector to finance and develop large infrastructure projects jointly with the public sector. Road development, however, entails substantial construction and traffic risks, which can inhibit private sector financing. One lesson from ADB projects is to involve the private sector after construction, when the construction risks have passed and the traffic load risks are more or less known. An important aspect is the ability to impose a toll on the use of the road to cover operations, and which can be securitized, if needed, to form part of a debt financing package or to finance further road investments.

VIII. CONCLUSIONS

65. Under favorable circumstances, infrastructure projects can significantly assist in scaling-up poverty reduction. This conclusion is based on both country studies on infrastructure provision in general, as well as a large body of ADB project evaluation work in the road transport and energy sectors.
66. Evidence presented above based on the country case studies and the project evaluation studies suggests that road transport and electricity both help reduce income poverty, with road transport improvements having a stronger impact. Access to roads reduces prices under conditions of competitive transport services provision, increases mobility and reduces labor market imperfections, enables the poor to find better paying work, and allows production of higher-value cash crops and supply of cheaper agricultural inputs. Rural electrification helps stimulate the rural economy and widens opportunities of off-farm employment for the poor. Use of television leads to improved information on crops and contributes to improved farm productivity. Lighting allows longer work hours. All ADB rural infrastructure projects have contributed directly to employment of the poor. Infrastructure provision was also noted to have generally contributed to increased trade and growth in countries in the regional cooperation context.

67. The impact of road transport and electricity on non-income poverty is also significant. Roads reduce travel time and provide better access to basic education and health services. However, they also cause an increase in accidents, requiring better capacity to address road safety matters. Electricity also impacts on non-income poverty. Better lighting increases the time for studies and years of schooling. It increases safety and security and provides better medical services in rural areas.

68. However, these favorable results do not have universal applicability and occur only with complementary public actions. When scaling-up rural infrastructure provision, several considerations have to be kept in mind. Strong poverty reduction outcomes from infrastructure projects can come about only if there is a strong pro-poor policy environment. Location of projects in areas of high poverty concentration, designing complementary interventions to increase the poverty reduction impact of infrastructure projects, creating market conditions for competitive reduction of transport prices, and attempting to increase the affordability of electricity prices for rural consumers, are all indications of a pro-poor inclination in policy. In the regional cooperation context, complementary agreements to facilitate cross-border trade, for example, illustrate the importance of complementary policy action to increase the impact of infrastructure projects.

69. No discussion on infrastructure can be complete without addressing issues relating to the sustainability of infrastructure services. If roads deteriorate and electricity services become erratic, all users are affected, including the poor. Thus, much greater attention has to be paid by developing countries to road maintenance than is being provided now. The sustainability of electricity services requires that the electric companies are financially strong and that the tariff policy is depoliticized. Necessary institutional changes and capacity building are also important actions to ensure sustainability.

70. The impact of infrastructure on growth and poverty reduction can be considerably increased in situations that call for regional cooperation by freeing the provision of infrastructure from artificial confinements within national boundaries. The GMS case provides a good illustration of this and is a worthy model for scaling-up.

71. Finally, the poverty reduction impact of infrastructure investments hinges on the way in which they connect to the poor, and if investments are designed to address both the immediate infrastructure requirement and the imperative for an infrastructure provision context that ensures that investments pay-off, are sustainable, and are complemented by supportive sectoral policies. Learning from past experience, understanding the needs of the poor, understanding the context in which infrastructure is to be provided, and designing interventions that tackle both
the provision of infrastructure and its enabling context, are central to the role that infrastructure plays in poverty reduction. Operating in a catalytic manner has the potential for fast and broad-based scaling-up because constraints that impede all stakeholders from making progress are eased.

72. The effectiveness of this broad role for infrastructure hinges very much on the quality of the knowledge base used to identify those factors that are binding constraints to scaling-up poverty reduction initiatives and to determine whether poverty is responding to particular interventions. This requires deep knowledge and understanding of poverty conditions and the context for poverty reduction, and explains why enhancing country focus, on the one hand, and knowledge management and capacity, on the other, underpin the search for effective interventions to enhance the scaling-up potential of poverty reduction projects.
REFERENCES


A. Approach to Country Studies

1. Retrospective studies of transport and energy interventions were conducted in three countries in developing Asia: People’s Republic of China, India, and Thailand. Choice depended on whether there was a likelihood that transport and energy had contributed to poverty reduction; availability of poverty data; the capacity of domestic research institutes to carry out the research; and having a broad mix of countries. For the PRC and India, it was decided to concentrate on a region rather than the whole country.

2. Shaanxi Province, PRC, has a population of 36 million. Most people are self-employed farmers, although off-farm employment is growing quickly. Like much of the PRC, Shaanxi has experienced rapid economic growth and poverty reduction. Using the local poverty line, the rural poverty rate was 17% in 2000. In the 1990s, the total length of roads increased from 38,000 km to 44,000 km, with the paved proportion rising from 70% to 80%. The length of railway lines also increased by 30%.

3. The state of Gujarat in India has a population of 50 million. The economy is diversified, with only 17% of state domestic product due to the primary sector; chemicals and industry have a leading role. Gujarat has invested relatively heavily in roads, and since 1995 encouraged the development of private ports. In the last three decades, poverty declined from about 50% to about 15%, although substantial pockets remain with much higher poverty rates.

4. The Thailand study examined selected rural communities in the northeastern and southern regions, and urban slums in the northeast and Bangkok. Poverty has already been greatly reduced in Thailand, with rural poverty standing at 20% in 2000 and urban poverty at 6%. Poverty is concentrated mainly in the rural north and northeast.

B. Methodology

5. The case studies examined poverty reduction impacts at the community and household level. Such micro-level studies cannot identify the aggregate impacts of the intervention but can provide a detailed picture of what happens to selected communities and households falling within the lens of the study. Where possible, the case studies used the double-difference method (i.e., with, without, before, and after) to try to separate the impacts of the intervention from other influences.

6. The Shaanxi case studies focused on the impacts of interventions in rural villages in two mountainous prefectures, where there were major highways and railway investments in the past 10 years. The villages were in quite isolated areas that still have significant poverty, but they have been experiencing poverty reduction through growth of both farm and off-farm incomes, and have received strong support from state poverty reduction programs. The study premise was that effective use of transport and energy services by the poor is necessary for transport to contribute to poverty reduction. The use of transport services by the poor and nonpoor was examined under different conditions of transport infrastructure and service availability, and by investigating the impact on various indicators of their well-being. Household survey data for 1998 and 2001 were used to examine how village transport status affects the poor and nonpoor, and then to compare

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1 Cook, Duncan, Jitsuchon, Sharma, and Wu 2004.
the impacts of selected road and rail investments on the poor and nonpoor. Focus groups and participatory assessments were used to clarify the findings.

7. In Gujarat, a household questionnaire and focus groups were used in four districts—one that achieved high poverty reduction over the last 15 years (Jamnagar); one where poverty was low throughout the period (Bharuch); one with persistently high poverty (Panchmahal); and one where private ports were developed (and there was also significant poverty reduction) (Kuchchh). Communities were selected where road improvements were completed in 1997/98, distinguishing between those living near the road and those living farther away.

8. In Thailand, a double-difference approach was used to examine both objective and subjective indicators of poverty status. The survey questionnaire covered socioeconomic information, information on transport, and perceived impacts of transport improvements. Focus groups were used to validate the survey findings.

9. Each country study began with sector studies, an assessment of contextual factors, and proposals for case study methodology. In each country, up to five interventions were selected for preparation of the case studies, each one having been completed for about 5–10 years.

C. Case Studies

10. The transport interventions covered roads, railways, and ports. The energy interventions covered rural and urban electrification. A separate study was also conducted of the impact of complementary investments alongside transport and energy. The case studies in each country are shown in Table A1.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>People’s Republic of China</th>
<th>India</th>
<th>Thailand</th>
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<tr>
<td>Secondary/rural road</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Railway</td>
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</tr>
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</tr>
<tr>
<td>Private port</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Rural electrification</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
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<td>Urban slum electrification</td>
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<td>Complementary credit, training</td>
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### SELECTED DATA FROM THE GREATER MEKONG SUBREGION

#### Table A2.1: Share of Intraregional Trade to Total Trade (%)

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<td>22.0</td>
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<td>24.5</td>
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<td>1.2</td>
<td>1.3</td>
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<td>1.7</td>
<td>1.8</td>
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<td>1.7</td>
<td>2.1</td>
<td>2.1</td>
<td>1.9</td>
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<td>Lao PDR</td>
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<td>55.8</td>
<td>57.3</td>
<td>61.1</td>
<td>66.8</td>
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<td>8.9</td>
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<td>7.2</td>
<td>7.6</td>
<td>6.7</td>
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<td>8.3</td>
<td>9.5</td>
<td>10.7</td>
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<td>12.6</td>
</tr>
</tbody>
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PRC = People’s Republic of China, GMS = Greater Mekong Subregion, Lao PDR = Lao People’s Democratic Republic.

\(a\) Ratio of total trade with GMS countries (total trade with the entire PRC was used) to total trade with the world.

\(b\) Ratio of total trade of the entire PRC with the other GMS countries to total trade of the entire PRC with the world.

\(c\) Weighted average based on purchasing power parity (PPP) gross national income shares.

Source: International Monetary Fund 2003.

#### Table A2.2: GDP Growth, 1999–2003 (%)

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<th>2002</th>
<th>2003</th>
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</tr>
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<td>6.5</td>
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<td>–</td>
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<td>Lao PDR</td>
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<td>5.7</td>
<td>5.8</td>
<td>5.9</td>
</tr>
<tr>
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<td>10.9</td>
<td>13.7</td>
<td>13.0 (a)</td>
<td>9.7 (a)</td>
<td>–</td>
</tr>
<tr>
<td>Thailand</td>
<td>4.4</td>
<td>4.6</td>
<td>1.9</td>
<td>5.2</td>
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<tr>
<td>Viet Nam</td>
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<td>6.3</td>
<td>4.8</td>
<td>6.2 (c)</td>
<td>–</td>
</tr>
</tbody>
</table>


\(a\) Source: Ministry of National Planning and Economic Development Statistical Yearbook, various issues.

\(b\) Weighted average based on purchasing power parity (PPP) gross national income shares.

\(c\) Weighted average does not include Yunnan Province, PRC, in 2002 because data are not yet available.

Lifted from ADB 2004a.

#### Table A2.3: Population Below the National Poverty Line in Urban and Rural Areas (%)

<table>
<thead>
<tr>
<th>Country</th>
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<th>1997</th>
<th>Latest Figure</th>
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<td>Rural</td>
<td>Urban</td>
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<tr>
<td>Cambodia</td>
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<td>–</td>
<td>21.1</td>
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<tr>
<td>Lao PDR</td>
<td>24.1 (b)</td>
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<td>26.9</td>
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<td>–</td>
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<td>Viet Nam</td>
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</table>

PRC = People’s Republic of China, Lao PDR = Lao People’s Democratic Republic.

\(a\) 1999 figure.

\(b\) 1994 figure.

\(c\) 2000 figure.

\(d\) 2002 figure.

Source: ASEAN 2003.