Beyond markets in infrastructure

Commercial and competitive provision of infrastructure can effectively deliver the services needed to meet social goals such as economic growth, poverty reduction, and protection of the environment. But a number of problems arise for which markets cannot guarantee solutions. Many infrastructure services, especially those that resemble public goods (as described in Chapter 1), will be undersupplied if markets alone are left to determine their provision. Market outcomes may allocate fewer infrastructure services to the poor than society desires. Environmental consequences of infrastructure provision are unlikely to be fully anticipated and incorporated in market allocations. Coordination within and across sectors may not receive adequate attention. Although these problems have little in common, government action appears to be the obvious solution in each case. Admittedly, governments often have failed to distinguish themselves in providing adequate public goods, safeguarding the interests of the poor, protecting the environment, and coordinating sectors. But such failure has not been universal. Nor is it inevitable.

A variety of responses and policy initiatives can help overcome the limitations of both markets and governments. This chapter discusses five such initiatives:

- **Decentralization and local participation** to increase the benefits derived from local public goods, such as feeder roads, and improve collective activities, such as maintenance.
- **Narrowly focused subsidies** to make services affordable to the poor.
- **Changes in pricing, regulations, and project design to address externalities** and to reduce the adverse environmental consequences of infrastructure.
- **Project-planning techniques** to take account of economic, environmental, social, and sectoral concerns not addressed in individual commercial or local decisions.

**Decentralization and participation: involving users**

In order for public goods, such as local feeder roads, to be provided, three things must happen. First, the amount and type of infrastructure to be supplied must be decided. Since the product will be available to all, individual choices expressed in the market cannot be relied on for this decisionmaking. Second, investments must be made and the infrastructure must be provided. Since user charges that fully recover costs are not always feasible, private entities cannot always be relied on to make the investment. Third, infrastructure facilities must be maintained. Because many infrastructure services benefit the public at large, individuals in a market setting cannot be expected to perform this task.

Although the market clearly would fail in these functions, centralized public infrastructure bureaucracies have not proved particularly adept at performing them either. Investment decisions often result in too little infrastructure in rural areas. When rural infrastructure is provided, priorities are often set centrally—resulting in inadequate responsiveness to local concerns and inappropriate provision for local conditions. For example, road design by
transport ministries in Africa is often more sensitive to technical—as opposed to service—considerations. This leads to excessive rural road width and cost and hence to fewer roads. Moreover, without sufficient local commitment to the infrastructure that is supplied, investments are not maintained and thus deteriorate rapidly. Soon after Côte d'Ivoire spent $115 million constructing 13,000 water supply points, a survey found that barely half of the handpumps involved were functioning—an experience all too common in the rural water sector.

In most situations, infrastructure provides public goods of a localized nature. Decentralized responsibility, in which government authority is moved to subnational levels of government, offers an opportunity to improve the provision of such goods. Provision of local, and to some extent even national, public goods can be more effective when participation provides a voice for infrastructure users and stakeholders.

Decentralization

Mexican experience with a municipal fund program reveals the potential for improving service delivery by decentralizing government authority to independent subnational governments. Funds are made available to local governments for projects that are chosen, planned, and executed by local communities. Many of the projects involve infrastructure, such as roads, bridges, and water supply systems. A review shows that projects are executed at one-half to two-thirds the cost incurred by centralized agencies. Since 1990, the municipal fund program has spread to all but two Mexican states (Box 4.1). Because local governments are better placed to determine and respond to local preferences, decentralization can increase user satisfaction, too.

The group of countries undertaking decentralization reforms is expanding and is not limited to industrial countries or to large developing countries (such as Brazil and India). A study using comparable data from twenty industrial and developing countries found that decentralized expenditures accounted for one-half of infrastructure spending in industrial countries and one-quarter in developing countries. While local expenditure has always been common in some sectors, such as solid waste disposal by municipal authorities, the scope for decentralized control extends to other sectors, such as roads and water, especially when responsibility for various activities can be divided among national, regional (provincial), and local authorities.

**Decentralization in Roads.** Since roads in a city or rural region chiefly benefit local residents, while the benefits of primary highway networks are more broadly spread, decentralization of responsibility for local roads is quite natural. Decentralization should include implementation of maintenance and also fi-

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**Box 4.1 Mexico's municipios help themselves**

Until 1990, Mexico's experience with rural infrastructure was typical of that in many other countries trying to promote rural development. Projects managed by state and federal agencies were often poorly selected and designed and were implemented with inadequate supervision. Furthermore, there was no commitment to ongoing operations and maintenance by the agencies, local jurisdictions (municipios), or communities. As a result, expectations often outstripped performance.

Many of Mexico's priority projects are relatively small and located in inaccessible places. Yet the municipal fund program, introduced in 1990, demonstrated that a locally managed grant fund can become a successful alternative for managing rural investment in technically simple infrastructures such as small water supply systems, rural roads, and bridges, and school buildings.

The municipal fund program requires community participation in project selection and execution. Every year each municipio receives an allocation to finance projects selected with the participation of its communities. Execution is usually managed by community committees (Comités de Solidaridad), which hire and supervise local skilled workers and purchase materials. Communities must also contribute a minimum of 20 percent of costs (usually in the form of unskilled labor and local materials), which helps to ensure that only projects of local priority are selected. Studies have found that municipal fund projects often cost one-half to two-thirds as much as similar projects managed by state or federal agencies. In Mexico this success may be explained in part by the presence of skilled workers in many communities and a tradition of volunteer community labor.

Currently operating in all but two of Mexico's thirty-one states, the program has financed approximately 75,000 projects over the past four years at an average cost of $11,000 each. Mexico's four poorest states have received $32.5 million in municipal funds—an average investment of $8 per capita, spread across 653 rural municipios.
nancing to ensure that communities are willing to pay for the quality of road service provided—if all costs were borne by higher government levels, local residents would prefer paved roads. A review of forty-two developing countries found that, where road maintenance was decentralized, backlogs were lower and the condition of roads was better (although the effect of financing decentralization was not included) (Figure 4.1). The decentralized cases also had higher proportions of paved roadway. But decentralization was also associated with higher unit costs of maintenance (partially reflecting the higher share of paved roads) and with wider differences in quality across regions (reflecting interregional differences in institutional or human capacity).

**Decentralization in Water and Sanitation.** An analysis of World Bank-funded projects demonstrates that a division of responsibilities, provided that there is suitable coordination, leads to better performance and maintenance in the water and sanitation sectors than would be the case in more centralized frameworks. Data for a group of developing countries reveal that per capita water production costs are four times higher in centralized than in fully decentralized systems and are lowest when decentralization is combined with centralized coordination. Most water sector studies recommend a three-tiered organization, with a national agency responsible for finance, long-term planning, standard setting, and technical assistance. Under the national agency, regional utilities function as operators, monitoring compliance with national standards and regulations, supervising local systems, and training local managers and technical staff. The third tier consists of local agencies that manage the local system, collect fees, monitor use and maintenance, and plan local budgets. An alternative decentralized arrangement found in France and Germany (and emerging in Brazil and Poland) moves management of each activity to the lowest appropriate level. For example, water resource management—including regulation, emission standard setting, and investment decisions—is at the water basin (rather than the national) level, while the provision of services is left to municipalities.

Of course, technical considerations may dictate collaboration and planning across government levels. For example, water and sanitation investment decisions made by regional utilities have to be coordinated with local land-use planning. And limitations are often imposed by local capacity. In Brazil, although municipalities are constitutionally assigned responsibility for delivery of urban water, regional public utilities often take over local functions on contract from those municipalities that lack the necessary scale of operation to be economic.

Decentralization is not inherently good or bad. As with all arrangements, its success depends on the incentives it creates, the capabilities it can draw on, and the costs it imposes. To improve incentives, public accountability is essential and can be enhanced by local choice of leaders, local control of finances, and other forms of local responsibility. Elections are one mechanism for involving citizens in choices—electoral reform in Colombia and Venezuela has produced a resurgence in local leadership. Newly elected mayors have been able to mobilize private sector financing for investment programs. In order to be held accountable, local leaders must have control. This includes control over revenues, which in turn requires adequate local finance laws (covering budgeting, financial reporting, taxation, contracting, and dispute settlement). In many countries, key responsibilities of local governments—including the ability to tax or to charge user fees—can be suspended by the central bureaucracy without consultation. This lack of autonomy discourages local administrators and contributes to a popular image of local government inefficiency or even corruption. Accounts and audits are important sources
Unlocking local effort through decentralization requires creating new technical and institutional capacity. Many poor communities lack requisite skills and cannot take up the opportunities offered by decentralization. This lack of capacity remains an important constraint. Adequate technical support is needed, including access to engineering, project design, and administrative skills. Organizations such as AGETIP (Agences d’Exécution des Travaux d’Intérêt Public) in Africa or the Brazilian-based IBAM (Instituto Brasileiro de Assistência Municipal) help develop local capacity, prepare projects, and monitor project execution and operation.

Participation

The importance of participation in effective delivery of local public goods is well recognized, and it is central to community provision of service (Option D as presented in Chapter 1). A 1985 World Bank review of twenty-five projects (mostly in agriculture and rural development) five to ten years after completion found that participation by beneficiaries and grass-roots institutions was a key factor in those projects’ long-term success. Without local participation, projects often either foundered at the implementation stage or were not maintained and failed to produce sustained benefits. This experience has not been unique to World Bank projects; it is mirrored by other development agencies. Statistical analysis reinforces the impression from project reviews—a 1987 analysis of recent World Bank projects and a 1990 analysis of USAID-funded projects found strong evidence for the importance of participation.

Participation in project formulation is particularly important for the maintenance of facilities. A study of 121 completed rural water supply projects in Africa, Asia, and Latin America, financed by various agencies, showed that projects with high participation in project selection and design were much more likely to have the water supply maintained in good condition than would be the case with more centralized decisionmaking (Figure 4.2). A review of eight rural water projects in Nepal, comparing government-designed projects and those designed with (rather than for) the community, found that the latter were smaller, made greater use of community resources, and had more sustained outputs.

There are three keys to using participation to improve project performance: involve the beneficiaries directly; seek their early consensus on the project; and mobilize cash or in-kind contributions from them. Consultation with officials or voluntary orga-
organizations is not a substitute for involving the ultimate beneficiaries directly, for example, through town meetings. For the water supply projects studied, the effect of increased reliance on intermediary nongovernmental organizations or local government units that did not involve users directly was either insignificant or negative, while direct reliance on local organizations whose members included users had a positive impact on project performance. It is particularly important to ensure that participatory processes involve all groups of beneficiaries, including women (who are often the primary users of water and irrigation facilities) and others who may be disenfranchised, such as the very poor and landless.

Reaching consensus on user needs often leads to infrastructure that is lower in cost, less technologically complex, and more labor-intensive. In Korea, sixty-two suspension bridges using a modest standard—they are gravel-surfaced and only 2 to 3 meters wide, with standard designs for culverts and bridges. Brazil and Indonesia have both found that using participatory approaches to identify appropriate low-cost technologies requires flexibility in planning and engineering, and in donor attitudes as well (Box 4.2).

Improved consensus on a project among intended users not only increases their satisfaction and willingness to contribute, but also helps mobilize their involvement in construction and maintenance. In many rural areas, collective contributions are often in forms other than cash. In the Banglung district in Nepal, for example, local communities constructed sixty-two suspension bridges using a median of village water committees to act as decentralized water utilities. The village committees can choose from alternative levels of service and an array of tested technical solutions, depending on how much the village is willing to contribute to basic investment funds provided by the WSSSLIC project.

Engineers need to adapt. In PROSANEAR, the participatory process directly affected the kind of engineering advice used. For example, water companies were required to award project design consultancies to a consortium of engineering firms or firms working with nongovernmental organizations that specialize in community participation. The supervision team at the national level encouraged project design consultants and water company engineers to discuss plans with beneficiaries before agreeing on final proposals. In Indonesia, nongovernmental organizations with experience in the relevant sector are helping the project management team and engineering staff to be responsive to the demands of low-income communities.

Donors have to adjust their practices. The Brazilian and Indonesian projects were approved by the World Bank without blueprints of targeted service levels or delivery systems. Instead, their appraisal reports provided broad principles for project execution and indicative targets for benefits and costs, leaving much of the design to be developed during implementation. The external donor must provide intensive supervision to work out details of the subprojects as chosen by the communities and to monitor and evaluate implementation. Experience so far shows that these learning-intensive, participatory projects can reduce capital costs, although they also entail increased investment of staff time from the donor.
much as threefold. The higher charges have led to financial resources for improving and maintaining roads and other infrastructures overlooked by governments. A nongovernmental organization, GRCO was founded in 1962 to improve and maintain roads and bridges in the Sebat Bet Gurage region southwest of Addis Ababa. GRCO mobilized funds from local Gurage villages and towns and from Gurage migrants living in Addis Ababa. Since starting operations, it has financed improvements on more than 350 kilometers of roads and spent about 7.2 million birr ($3.5 million). In addition, members have contributed an estimated 8 million birr in professional services and labor. In total, GRCO contributed about 70 percent of the cost, with government contributing 30 percent through budget allocations to the national roads authority, which carried out the road improvements.

Why is the Purang project successful? Because of private citizens' participation in road improvement and maintenance works succeeded in GRCO because local people were provided not only with adequate information but also with the opportunity to set their own priorities for development and to contribute both financially and in kind—thus maintaining their commitment and ownership. Government also supported local initiatives with funds and technical assistance.

Box 4.3 Power in Purang and roads in Ethiopia

There is a pressing need for electricity in the village of Purang in Nepal's Mustang district—and not just because the winters are dark and cold and fuelwood is scarce. During the winter months, when villagers are housebound by bad weather, electric lighting permits indoor income-generating activities, such as carpet making.

Without initial external assistance or even a bank loan, Purang has established a 12-kilowatt installation that is owned and managed by the community. The plant runs twenty-four hours a day and supplies about 100 houses with, on average, 120 watts each. Consumers are charged to cover operation and maintenance costs. Given the icy-cold weather conditions, the heated discharge water is an added benefit.

Why is the Purang project successful? Because of community participation, the management of the installation is well integrated into social, political, and economic structures, ensuring that all participants have access to the decision-making process. The community not only owns the installation but also feels responsible for it. Operators are chosen from among the villagers and trained by a local firm.

Ethiopia's Gurage Roads Construction Organization (GRCO) is a community organization that has mobilized financial self-sufficiency in most districts and improved the efficiency of water use.

Participation is not a panacea even in the sectors where it is most relevant, nor is it costless and without risk. Participatory processes take time and often require the skills of professional intermediaries who interact with formal sector agencies, explain technology options, and help resolve disputes. Participation works best together with, not in place of, good governance. Special interests, local elites, or combination of local materials, labor inputs, and government funds. Households unable to participate directly in the construction were asked to contribute food or money. Costs to the government totaled only about $50,000, while the amounts mobilized locally were substantially higher. Similar self-help initiatives supply power in rural Purang, Nepal, and roads in Ethiopia (Box 4.3).

Cash or in-kind contributions from beneficiaries also enhance project effectiveness by increasing local commitment. Statistical evidence from the rural water supply projects study mentioned above indicates that the larger the share of investment costs paid by water users, the more effective the overall project will be. Until 1990, Mexican irrigation operations followed a vicious circle—a para-statal organization operated and maintained the facilities poorly, so farmers rarely paid the (highly subsidized) charges, leaving the operator even more cash-strapped. Service then declined even further, and farmers became even more reluctant to pay. Since 1990, responsibility for more than 2 million hectares has shifted from the government to water-user associations. In order to improve maintenance, these groups voluntarily raised water charges as much as threefold. The higher charges have led to financial self-sufficiency in most districts and improved the efficiency of water use.

Self-help in the construction and maintenance of infrastructure is most feasible with relatively small-scale projects undertaken at the initiative of a well-defined group or community for its direct and exclusive benefit. With works that benefit a wider public, such as feeder roads, self-help is much more difficult to sustain over the long term, especially if heavy reliance is placed on unpaid labor. There are risks of exploitation of the poor and of low labor productivity under the banner of self-help and voluntarism. Moreover, some types of infrastructure, such as dams and major canals, power and telecommunications systems, trunk highways, and water and sewer mains, are technologically complex networks for which local participation cannot ensure adequate design and implementation.

Participation is not a panacea even in the sectors where it is most relevant, nor is it costless and without risk. Participatory processes take time and often require the skills of professional intermediaries who interact with formal sector agencies, explain technology options, and help resolve disputes. Participation works best together with, not in place of, good governance. Special interests, local elites, or
powerful minorities can capture the process to the exclusion of others. Finally, local communities cannot be expected automatically to take into account the environmental costs they impose on others, any more than a private firm would.

**Improving budgetary allocations**

Decentralization and participation can be useful instruments for overcoming market failure, particularly when the public goods provided are local. When the public goods are at the national level—say, a highway network—the central government maintains direct involvement in allocating resources and in the planning and selection of projects. The process and criteria underlying central governments’ decisions on budgetary outlays for national public goods and for transfers to subnational governments are described in this section. Strategic and project planning are discussed in a later section.

In many developing countries, the basic process for allocating and controlling public funds for capital investment and recurrent operations is often difficult to reconcile with professed development objectives. An analysis of budgetary allocations in Uganda revealed that the budgetary process there largely replicates historical allocations and does not allow for increased emphasis on particular activities or the phasing out of others. In Cameroon, Nepal, and Zambia, transport sector allocations have emphasized the construction of new roads over maintenance or rehabilitation of existing networks, even though the latter is a clear priority.

Comprehensive and centralized medium-term planning with strong backing from political authorities was attempted in many developing countries during the late 1950s and 1960s, without conspicuous success. An excess of ambition spawned large public projects, many of which remain a costly burden for the economies concerned.

In some economies, including many in East Asia, government decisionmaking of a more intermediate nature has been practiced. In Japan, Korea, Malaysia, Singapore, and Taiwan, China, authorities focus on directing public expenditures and actively cooperate with a strong private sector. Flexibility and adaptability to changing circumstances are characteristic, with formal plans being indicative rather than prescriptive. In Malaysia, government decisionmaking involves different levels of government, with each level focusing on those issues for which it is best qualified (Box 4.4).

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**Box 4.4 Centralized and decentralized infrastructure planning in Malaysia**

The Malaysian approach to infrastructure planning blends centralized and decentralized forms. First, at the central level, national development objectives and targets are formulated by the National Economic Council (a ministerial council chaired by the prime minister) and the National Development Planning Committee (composed of top civil servants from federal ministries). Alongside these two groups, the Economic Planning Unit, located in the prime minister’s department, acts as a coordinating and integrating agency rather than an initiator of sectoral plans.

Following deliberation by these two groups, the federal government’s development policies and sectoral priorities are conveyed to ministries, statutory bodies, and state governments, which are then invited to submit their programs for the next five-year plan. This second stage constitutes the decentralized approach to planning. Agencies that are located in the states are required to discuss their development programs with the appropriate State Economic Planning Unit before submitting them to the relevant federal ministry. This ensures that the state governments are aware of the development proposals of the federal agencies operating within their boundaries. The National Development Planning Committee has ultimate jurisdiction over the selection of expenditure programs for the five-year plans.

The institutional framework for infrastructure development in Malaysia has been effective in ensuring that public provision of infrastructure has reflected both broad national priorities and local needs. Infrastructure provision was sufficient to sustain strong economic growth up to the 1980s.

By that time, however, the emergence of strong private sector capacity convinced the government that direct involvement in some sectors and activities was no longer necessary. Fresh approaches were also perceived to be desirable in dealing with growing infrastructure bottlenecks. The government responded flexibly to these changing circumstances, placing infrastructure sectors at the forefront of its privatization program. To date, eighty-five projects have been partly or completely privatized, including the 900-kilometer North-South Highway, the container terminal in Port Kelang, Telekom Malaysia, and the National Electricity Board. The government’s “Guidelines on Privatization” issued in 1985 and “Privatization Master Plan” formulated in 1989 clearly confirm its view of infrastructure privatization as yet another means to achieve its underlying development strategies.
Decisions on expenditure allocation within infrastructure sectors as well as across sectors should be guided by consideration of the country's underlying development goals. Governments must choose between new construction and maintenance, and between rural and urban sectors among regions. Allocating expenditures to different activities on the basis of social rates of return is an important method of establishing priorities. Analysis of such returns in most developing countries reveals the critical importance of maintenance over new construction. A study of irrigation expenditures in India identified maintenance of irrigation canals as a top priority, with returns as high as 40 percent. Other activities that deserved priority over new investment included drainage and completion of unfinished projects. In Indonesia, rates of return on operations and maintenance for irrigation and roads have been found to be as high as 100 percent, indicating that maintenance has been neglected.

In many countries, increasing spending on basic rural infrastructure is an economic priority that may contribute significantly to poverty reduction. China has been successful in integrating agricultural development with industrial development by building up rural industrial infrastructure. Consequently, rural industries have prospered and rural populations have become employed in industry without major dislocation. Township and rural enterprises in China now employ more than 100 million people and produce more than one-third of gross national output. In Indonesia and Malaysia since the late 1960s, an important priority for the government has been balancing regional development and reducing poverty. To this end, infrastructure expenditures—particularly in transport and irrigation—have been directed to rural areas. In Malaysia in 1965, earth and gravel roads represented 18 percent of the total length of the road network (15,356 kilometers). By 1990 such roads constituted 32 percent of the 50,186-kilometer network in the country. During this period, poverty in Malaysia fell dramatically. Rural poverty, which in 1973 affected 55.3 percent of the population, had fallen to 19.3 percent by 1989. A World Bank study of poverty in Malaysia identified the government's programs to raise land productivity as a primary factor in this impressive improvement, and noted the importance of rural road and irrigation infrastructure.

Subsidies and transfers to the poor

Although the relationship between infrastructure and poverty is pivotal, infrastructure is nevertheless a blunt instrument for intervening directly on behalf of the poor. Adequate budgetary allocations to particular sectors or to poor regions, removal of price distortions which support biases against the poor, and the selection of appropriate standards and design are generally the most effective ways to ensure that infrastructure realizes its potential for fostering labor-intensive growth and helping the poor to participate in the growth process. Subsidized provision of infrastructure is often proposed as a means of redistributing resources from higher-income households to the poor. Yet its effectiveness depends on whether subsidies actually reach the poor, on the administrative costs associated with such targeting, and on the scope for allocating budgetary resources.
Price subsidies to infrastructure almost always benefit the nonpoor disproportionately. In developing countries, the poor use kerosene or candles rather than electricity for lighting, they rely on private vendors or public standpipes rather than in-house connections for water supply, and they are infrequently served by sewerage systems. In Ecuador the electricity subsidy was found to be $36 a year for the 37 percent of residential consumers with lowest use but $500 a year for the better-off households with highest use. In Bangladesh subsidies on infrastructure services are roughly six times larger for the nonpoor than for the poor. Although poor people generally consume more water and sanitation services than they do power, a study of five Latin American countries found that water and sewerage subsidies are directed more to richer than to poorer households (Figure 4.3). Even in formerly centrally planned Algeria and Hungary, the rich have received more than the poor in the way of infrastructure service subsidies (Figure 4.4).

There are, however, ways in which infrastructure subsidies can be structured to improve their effectiveness in reaching the poor. For example, for water, increasing-block tariffs can be used—charging a particularly low “lifeline” rate for the first part of consumption (for example, 25 to 50 liters per person per day) and higher rates for additional “blocks” of water. This block tariff links price to volume, and it is more efficient at reaching the poor than a general subsidy because it limits subsidized consumption. Increasing-block tariffs also encourage water conservation and efficient use by increasing charges at higher use. These tariffs are most effective when access is universal. When the poor lack access, as is frequently the case, they do not receive the lifeline rate and typically end up paying much higher prices for infrastructure services or their substitutes.

Subsidizing access to public infrastructure services is often more useful for the poor than price subsidies. In Colombia in the early 1980s, water utilities in Bogotá and Medellín used household survey data to distinguish between rich and poor households and specifically targeted the poor with subsidized connection charges and increasing-block tariffs. This cross-subsidy scheme resulted in the poorest 20 percent receiving a subsidy equivalent to 3.4 percent of their income, financed by the richest quintile, who paid a “tax” equivalent to 0.1 percent of their income. Many low-income households cannot mobilize the funds needed to pay heavy initial connection costs to public services, especially when payment is required in advance of connection. In such circumstances, access to credit may be more important than subsidized prices. Utilities are often useful conduits for extending loans to finance connection costs because they can use their regular billing procedures to secure repayment. In Bangladesh the Grameen Bank provides credit to about 2 million poor and landless persons—most of them women. The Bank combines group lending, which allows the poor to substitute social collateral based on peer pressure for financial collateral, with financing mechanisms to extend credit for tubewells and sanitary latrines. In 1993 the Grameen Bank lent $18 million for this purpose and since 1992 has provided loans for about 70,000 suction tubewells.

In certain circumstances, programs providing employment to the poor represent a highly effective
way of achieving distributional objectives. Such schemes work because they mobilize large transfers rapidly, and, by offering relatively low wages in return for unskilled manual labor, they transfer income only to those without more attractive options. In India’s Maharashtra state, the Employment Guarantee Scheme, initiated in response to the severe drought in 1972–73, provides unskilled rural employment on demand. The scheme has provided almost 1.7 billion person-days of employment and is credited with playing a large part in averting calamity during numerous droughts. However, little evidence exists that such schemes produce the most economically useful infrastructure. Coordinating them with overall infrastructure priorities might strengthen their economic impact.

**Addressing externalities**

Infrastructure often has widespread indirect impacts—frequently, on the environment—which can be beneficial or harmful. Irrigation infrastructure can reduce pressure on land resources by permitting greater intensity of cultivation on existing plots, but it can also promote excessive water usage, resulting in groundwater salinization and land subsidence. Infrastructure can also reduce or increase public safety. Road improvements that raise traffic speed may expose nonmotorized road users to increased risk of accidents; traffic signals can improve pedestrian safety. Because markets often fail to reflect these externalities, their management usually falls to government. Environmental sustainability involves innovation in technology and organization, as well as improved efficiency in the use of infrastructure services through pricing and regulation. Regulatory efforts are also necessary for infrastructure services to be delivered in compliance with public safety standards.

**Innovation in design for affordability**

Worldwide, roughly 1 billion people lack access to clean water and more than 1.7 billion do not have adequate sanitation. Diarrheal disease, often caused by contaminated water, represents one-sixth of the world’s burden of disease (World Development Report 1993). The most widespread contaminant of water is disease-bearing human wastes. The environmental benefits of water supply depend not only on delivering safe water for drinking but also on providing enough water to permit good human hygiene. Equally important is reducing contact with human excreta by providing pit latrines, toilets, and sewers (Box 4.5).

Although even among the poor the willingness to pay for water is often sufficient to cover costs, this is not always so in the case of sewerage, both because conventional sewerage is often expensive and because certain costs of inadequate sanitation are not borne within the household. For limited public funding to benefit large numbers, adoption of technical and organizational innovations in low-cost sanitation is necessary. A study in Kumasi, Ghana,
Motivation of user efficiency

Efforts to mitigate environmental impacts through consumer investments in energy saving are hampered by the low consumer prices and subsidies described in Chapter 2. On average, developing countries use 20 percent more electricity than they would if users paid the incremental cost of supply. Once economic pricing is established, governments are able to promote the use of more energy-efficient technologies.

Similar price increases are merited in transport but are more difficult to implement. Cars using city centers at rush hour impose congestion costs many times higher than they do in off-peak periods, and the environmental costs of vehicle use are greater in urban than in rural areas. Urban car users can be made aware of such costs through the introduction of parking fees, area licensing, and tolls. Growing environmental consciousness and technological change are likely to increase the use of tolls and fees in the near future, which will encourage travelers to use public transit or nonmotorized modes.

Important user efficiency problems in the water sector stem from the underpricing of water. Domestic consumption, sanitation, irrigation, hydroelectric generation, and transport all create water demands and raise problems of overall supply and sectoral allocation. In India in 1985, 94 percent of all water used went to agriculture. Conflicts between industry and irrigation have emerged in some areas, and in cities such as Bombay, Delhi, and Madras problems of water scarcity have arisen. In many countries, raising the price of water to reflect scarcity levels (particularly in agriculture) and linking price to usage are important first steps in dealing with water scarcity as well as with problems of salinization, increasing fluoride concentrations, and land subsidence. Influencing demand through pricing allows the user to decide how much water to use and how to achieve conservation.

Regulation

Regulation is an additional means of reducing adverse environmental consequences. It is also important for securing infrastructure service delivery that meets public safety requirements. The two principal regulatory approaches are command-and-control measures and regulation based on economic incentives. Command-and-control measures—direct regulation along with monitoring and enforcement systems—are by far the most widely used technique in developing countries. An advantage is that they provide the regulator with a degree of certainty about, for example, how much pollution levels will be reduced. But they have the disadvantage of providing little incentive for innovation in pollution control technology once standards are achieved. In recent years, many countries have also adopted economic instruments. Setting prices to reflect full costs (the "polluter pays" principle) is the most powerful and obvious of such instruments. In some countries, experiments are under way using additional regulatory instruments, such as pollution charges, marketable permits, subsidies, deposit-and-return systems, and enforcement incentives, to introduce more flexibility, efficiency, and cost-effectiveness into pollution control measures. Some of these efforts appear promising.

Environmental regulation begins by specifying abatement standards based on the technical options available. For example, for power generation, technologies are emerging that effectively reduce noxious pollutants from coal—regulation can thus substantially reduce emissions. But clean technologies almost always add to the cost of coal-fired thermal power (by 10 to 20 percent on capital costs and 5 percent on operating costs). Consequently, such technologies are still far from universally used in developing countries. Where switching to gas is an economically viable alternative, there are many environmental advantages. Poland provides an example of market-based incentives to reduce noxious emissions. Its National Environment Fund, set up in 1980, levies charges on all polluters and imposes additional fines on owners of industries that violate region-specific abatement standards. The proceeds
are bundled into low-cost loans to industries to purchase pollution-reducing equipment. In 1992 the fund's income was $188.5 million, double the amount in 1991. Although collection rates for pollution charges and fines increased during the 1980s and early 1990s, a recent decline in compliance rates is raising concern.

Serious problems are posed by vehicle transport in Central and Eastern Europe, despite a per capita vehicle population only one-third to one-half the level in Western Europe. The legacy of fuel and vehicle underpricing, the high average age of vehicles, obsolete designs, inadequate pollution controls, dirty fuels, and poorly maintained vehicles—all are factors producing environmental degradation. This situation has prompted suggestions that the countries take direct measures to restrict road transport in favor of railways or river transport. A study of Hungary undertaken for the World Bank suggests, however, that alternative approaches can reduce vehicular emissions. If all new vehicles were to comply with available best-practice emission standards, the traffic growth accompanying economic growth (as far forward as the year 2020) could be accommodated at absolute emission levels below those presently experienced. However, limiting traffic growth may be necessary to control congestion.

In the Netherlands a transport sector strategy aimed at minimizing environmental stress and avoiding unnecessary investment mixes regulatory and market-based measures—for example, introducing pollution premiums on road users, encouraging the use of bicycles and public transport, creating vehicle-free precincts for pedestrians, providing incentives for higher vehicle occupancy rates, and instituting parking controls. In Japan and in several developing countries, including China, Ghana, and Indonesia, similar schemes to encourage nonmotorized traffic and pedestrian facilities are being considered.

Regulation to preserve safety standards in infrastructure service provision and delivery is an important priority. Studies have shown that road accidents are the first or second most important cause of death in many developing countries. Addressing road safety involves not only restricting speed and traffic flows, but introducing safety considerations into the design and collection of information for monitoring and analyzing safety conditions. Facility construction also requires special consideration. Because construction exposes workers to a high risk of injury and death, effective safety standards must be applied to the construction of facilities, not just to their operation.

Elements of infrastructure planning

Because most infrastructure uses geographically distributed networks, spatial, sectoral, and intersectoral coordination and planning are necessary for government activities. In addition, project selection, design, and evaluation are important steps in the overall decisionmaking process. Incorporation, at the earliest stages, of the social and environmental implications of projects is vital.

Sectoral and cross-sectoral strategies

Because infrastructure investments often have broad impacts on many groups, planning strategies should focus on coordinating the decisions of investors, including donors, while also gaining the broad acceptance of other stakeholders. Particular attention may be required to ensure that the concerns of women are not overlooked (Box 4.6). User groups and other interested parties need to be consulted by the public officials and technical specialists who usually lead the process, and mechanisms for conflict resolution are necessary.

In the case of watershed protection in the São Paulo region of Brazil, for example, a working group comprising municipalities, water suppliers, and environmental agencies was set up to solve water quality problems in the Guarapiranga reservoir so that it could meet rapidly growing demands for water. As part of the consultation process, a town forum was held with more than 120 city and state government officials, members of nongovernmental organizations and community groups, academics and researchers, leaders of professional organizations, and the press. Local consultants prepared an environmental profile of the region and interviewed city, community, and business leaders. The process resulted in a basin development strategy and an action plan that combined public and political commitment.

When an infrastructure system is owned by a single entity, planning is generally internalized by the owner. Once ownership of a system is unbundled (as described in Chapter 3), however, strategic planning becomes decentralized. To maintain the benefits of unbundling, the development of the natural monopoly segments—typically the primary (trunk) facilities—and the setting of technical standards should be coordinated at the sectoral level because of the market power that comes with the right to carry out these functions. In an unbundled network, this responsibility could be entrusted to a coordinating entity made up of representatives from government, suppliers, and users.
Box 4.6 Women can benefit from infrastructure, but success lies in the details

The beneficial impacts of infrastructure on women can be profound, often extending beyond the commonly cited impacts of water and sanitation infrastructure on household health or women's time allocation. But ensuring such outcomes requires foresight and attention to detail during project planning.

Women, as principal producers and marketers of food in many African countries, benefit from the improved access to markets that rural roads bring. Yet unless they can afford to transport their produce by truck, goods must be carried to markets by the farmers themselves. This sharply diminishes benefits from road infrastructure. Intermediate (nonmotorized) means of transport, such as bicycles and carts, can be attractive alternatives to head portage but involve high initial investment costs. In Ghana a pilot component administered by NGOs in the Second Transport Rehabilitation Project channels part of the wage earnings from labor-intensive road works to finance hire-purchase programs for intermediate means of transport.

In many countries, destitute women are eager to participate in road works programs that offer them opportunities to earn cash. In one of Bangladesh's main road maintenance programs, women comprise the bulk of the workforce, but in Kenya's Rural Access Roads Program, one of the oldest and most successful of such programs in Africa, less than 20 percent of the workforce are women. Similarly low participation rates for women have been observed in other African countries. Although it is sometimes argued that low participation by African women is due to their already oppressive burden of domestic duties and subsistence agriculture, evidence from various countries, including Botswana, Kenya, Lesotho, Madagascar, and Tanzania, reveals that many poor women welcome such employment opportunities and are able to perform the same tasks as men for similar wages. To expand women's participation in these projects, eligibility conditions must be extended, and job opportunities must be advertised more widely. In addition, there should be scope for advancement by women to supervisory positions. Where maintenance is contracted out, women's groups should be encouraged to bid for contracts.

Predicting the impact of infrastructure on women can be difficult and requires a close understanding of the details of their activities, opportunities, and constraints. In central Gambia, agriculture traditionally involved both women and men within a system of coexisting communal and individual cultivation. Men were responsible for organizing the communal subsistence cultivation of upland cereals, with both men and women contributing labor, while women alone were responsible for cultivating and marketing rice from individual plots. A rice irrigation project was introduced, distributing 1,500 hectares of irrigated land to farming households. An explicit intention of the project was to improve the economic status of the female cultivators by raising their incomes from higher rice yields. However, male farmers became interested in rice cultivation for commercial purposes and laid claim to the irrigated land for their communally farmed plots. While women did benefit from the project through the higher incomes accruing at the household level, their position as producers and marketers of rice was undermined.

COORDINATION OF PLANNING. Coordination of plans for competing or complementary sectors is also important. Where program and project financing involves many donor agencies, coordination preserves overall coherence of activities. In Africa efforts to improve donor coordination in transport have been embodied in recent initiatives (Box 4.7). With transport, intermodal coordination is often required. The stress on speed and reliability in modern-day freight transport is making it increasingly vital for shippers to be able to offer door-to-door service, commonly involving many modes. It is necessary to establish a legal framework that allows freight forwarders to accept liability for the entire transport chain. In addition, customs procedures in many developing country ports must be simplified to avoid delays that can significantly raise transport costs and undermine the international competitiveness of local producers.

Although governments are often tempted to intervene in price setting across modes or sectors, prices that reflect costs provide valuable information for decision making on sectoral allocations. When the local highway agency decided to expand trucking cargo capacity to the port of Santos in Brazil, shippers pointed out that rail transport was cheaper, and the railway and the railhead river port capacity were expanded instead. In China, the Henan Power Company, after evaluating the costs of expanding power generation capacity in the Yanshi Thermal Power Project, changed its initial proposal from locating the coal-fired power station near load centers and supplying it with coal by rail to siting the station near coal mines and transmitting electricity to the load centers.

PROJECT APPRAISAL. Techniques for project appraisal are well established and documented, but in practice they are not widely applied. Although formal cost-benefit analysis of projects imposes nonnegligible analytical and data demands, these techniques bring rational, objective, and, to the extent
possible, quantitative analysis to the decisionmaking process. Project appraisal is important, yet the evaluation of completed projects indicates that both high-quality project appraisal and ongoing monitor-

Box 4.7 Donor coordination in infrastructure: the African experience

The World Bank’s Africa region is encouraging donor coordination through two main routes. First, it has used regional partnerships of donors to develop policy frameworks and build consensus among those involved in the different infrastructure subsectors. These initiatives include the Sub-Saharan Africa Transport Policy Program (SSATP), which was launched as a joint undertaking by the Bank and the UN Economic Commission for Africa (UNECA). The SSATP is supported by a coalition of donors that provide seconded staff and financial support; it involves African institutions such as the Union of African Railways and the Maritime Conference for West and Central Africa. The SSATP has been particularly effective in developing a common approach among donors regarding road sector reform, railway restructuring, road safety, and improvement of the performance of urban public transport. The road components of the program—the Road Maintenance Initiative (RMI) and the Rural Travel and Transport Program—resulted in the preparation of a Donor Code of Conduct for this subsector (currently being ratified) in which participating donors agree to consult with each other before committing to major new investments.

Second, donor coordination in Africa is translating this consensus on policy reforms and investment priorities into concerted action through large umbrella projects supported by a coalition of donors. The Bank acts as lead donor for these projects; other donors participate as cofinanciers and sometimes collaborate in preparation. The two largest umbrella projects are the Integrated Roads Project in Tanzania (with sixteen participating donors in the first phase and twelve expected to support the second phase) and the Roads and Coastal Shipping Project in Mozambique (with fifteen participating donors). Both projects have focused on sustainable road financing, the provision of better qualified and higher-paid staff, and the contracting out of road work. This integrated project design has improved governments’ efficiency in managing external aid by standardizing their reporting, procurement, accounting, and budgeting systems. Such approaches are being applied to the road sectors in Burkina Faso, Cameroon, Kenya, Madagascar, Rwanda, Senegal, and Uganda.

Box 4.8 The World Bank’s experience with project evaluation

The World Bank’s own experience reveals that project appraisal alone is not sufficient to ensure the success of projects.

During the 1970s and early 1980s, integrated rural development projects represented a comprehensive effort to raise rural living standards through, among other components, a set of coordinated infrastructure investments in irrigation, roads, and social services. A review of the Bank’s experience by the Operations Evaluation Department (its internal auditing arm) found that results were often disappointing. Among the factors contributing to the relatively low success rates, the report cited overemphasis in appraisals on the details of projects, a tendency to select large and complex projects, and overly optimistic projections of project outcomes. The review emphasized that a country’s implementation capacity was a critical prerequisite for project success.

A recent review of the Bank’s overall project portfolio (the Wapenhans report) documented an increasing number of poorly performing infrastructure projects. One of the causes of this increase cited by the report was a tendency to concentrate in the appraisal process on loan approval, which can lead to an upward bias in estimating rates of return. In addition, the report showed that, relative to implementation capacities, projects were often too complex. Finally, the report argued that greater attention to uncertainty and risk was warranted in project preparation.

Both reports draw attention to components of the project planning process that cannot be addressed by refining standard appraisal techniques. The objectivity and internal consistency that such techniques offer must be complemented by careful judgments about implementation capacity and the rigorous analysis of project risks. In addition, as described in the World Bank’s official response to the Wapenhans report, ensuring that affected parties are committed to projects increases the likelihood of project success. Seeking participation by beneficiaries in project identification, design, and implementation, while ensuring intragovernmental coordination and agreement, are useful in establishing such commitment by stakeholders. Preserving some flexibility in project content and design is also desirable; this requires careful monitoring during project implementation and learning from experience as the project evolves.
Box 4.9 Incorporating environmental concerns early in planning: some recent lessons from Sri Lanka

Over the past decade, developing countries, and the World Bank itself, have begun to require comprehensive environmental assessments (EAs) as a routine component of project development. This requirement has forced a better integration of environmental concerns into project design, with appropriate attention to mitigation options. But a project-level EA is best at dealing with project-level mitigation issues. Without consideration of environmental issues at the long-term planning stage, it is doubtful that project-level EAs can steer the development of a sector along environmentally sustainable paths. For example, because the environmental impacts of hydroplants are quite different from those of thermal generation, the question of how air pollution impacts are traded off with inundation-related impacts falls well outside the domain of project EAs. Although the incremental effect of a single plant can be rationalized quite easily, what matters is the overall impact of the sequence of plants in a power sector investment program.

A recent World Bank study of the Sri Lankan power sector examined ways of bringing consideration of environmental issues into the early stages of power sector investment planning and of dealing with the basic issues of comparing very different kinds of environmental impacts associated with different technologies. Working with the Sri Lankan generation utility and a group of researchers and environmental experts, the study determined long-term development options for the sector, incorporating environmental concerns. Alternative strategies were compared, taking into account system cost, biodiversity, health effects, system reliability, and greenhouse gas emissions. The technique of multiattribute decision analysis, which permits analysis of tradeoffs between objectives, is particularly useful in such assessments when economic valuation of environmental externality proves difficult.

From the analysis, the study identified the set of "nondominated" options that was better than the others in at least one attribute (such as cost, emissions, reliability) but no worse in the other attributes. This set represents the options that decisionmakers need to consider and included, for example, not only alternative fuel combinations in power plants but also supply-side efficiency improvements in the transmission and distribution system and demand-side management options, such as the introduction of compact fluorescent lighting.

Following this study, such new methods of evaluation have begun to be institutionalized in the Sri Lankan utility's planning cycle. In 1993, for the first time, the study for planning expansion of generating capacity included a systematic examination of demand-side management and privatization options, as well as an environmental overview of conventional supply options.

Environmental and social concerns

Assessing environmental impacts. Environmental regulation and promotion of the efficient use of infrastructure help reduce adverse consequences from existing infrastructure, issues that have been explored in detail by World Development Report 1992. More options are available with new projects, although investment decisions can be consistent with environmental objectives only if environmental impacts are identified and assessed. Experience with environmental assessments demonstrates that infrastructure projects are least likely to impose stress on the environment if such assessments occur early and influence the design of individual projects—not just the selection of a particular project from a set of alternatives. In Sri Lanka a recent power planning study involved not only selecting from among various fossil fuel and other generating options, but also paying attention to the need for energy conservation (Box 4.9).

As the scale of infrastructure projects grows, environmental consequences become increasingly significant. A study of several large World Bank–funded projects in Brazil (representing total approved Bank financing of $1.15 billion) examined environmental consequences and emphasized that environmental assessments should take a broad perspective capable of recognizing regional effects and induced economic impacts, as well as the potential consequences of broad economic conditions for the project. Moreover, even though large investment programs may be broken down into subcom-
of design modifications reduced the number of households flooded from 3,300 (20,000 persons) to only 241 (1,500 persons) while maintaining an acceptable project return (Box 4.10). By contrast, many projects are delayed or abandoned as a result of inadequate resettlement planning. Construction of Colombia’s Guatape II Hydro project took three years longer at twice the planned cost because of failure to address the resettlement issue early on. Successful resettlement requires monitoring during and after project completion with flexibility for contingencies. In Indonesia, the Saguling and Cirata dams in western Java displaced more than 120,000 people in the late 1980s, and despite cash compensation many households saw their longer-run incomes decline. An enterprise based on reservoir fisheries was launched to provide employment to 7,500 displaced persons. The contribution from this employment to household incomes, and then to the wider community, has been substantial. A recent study in Cirata found that 59 percent of those who were moved because of the dam now consider themselves to be better off than before.

**Conclusion**

Improving infrastructure performance is often difficult—politically, technically, organizationally, and administratively. Without the fundamentals of good governance—accountability, a predictable and stable legal framework, openness, and transparency—even the best efforts can go astray. The institutional approaches discussed above are not universally applicable, but they do address specific concerns for specific types of infrastructure. For example, environmental concerns differ greatly across sectors. Water, sanitation, and power differ in their impacts, and even within the power sector, the environmental implications of fossil fuel generation differ from those of hydroelectric generation.

Finally, there is a need to achieve a balance between expert and user, between direct and indirect controls, and between broad goals and those narrowly defined. The provision of infrastructure often involves complex, highly engineered systems that require technical expertise but that also must be responsive to user needs to be effective. Direct controls, such as plant-specific, quantity-based emission standards, often prove cumbersome and costly, while indirect controls, such as price incentives, may not offer sufficient control. Infrastructure should contribute to broad social goals, yet it may be effective only when efforts are narrowly focused. The choice of instruments and approaches must reflect sectoral needs and the capacities of implementing agencies.