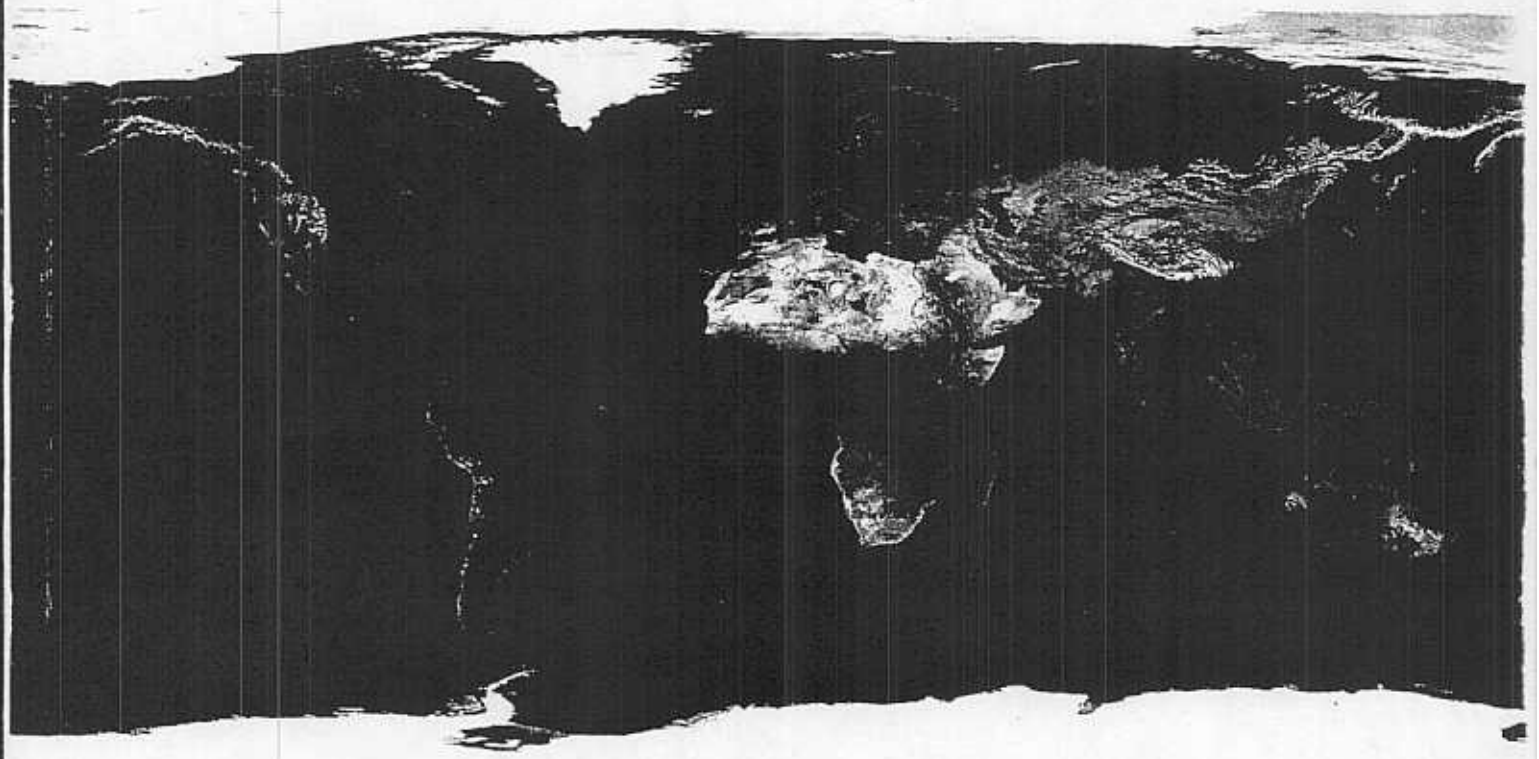
World Development Report 1992

Development and the Environment



WORLD DEVELOPMENT INDICATORS

The World Bank

Environmental Priorities for Development

and

Sanitation and Clean Water

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Environmental Priorities for Development

2 Environmental priorities for development

Setting environmental priorities inevitably involves choices. Developing countries should give priority to addressing the risks to health and economic productivity associated with dirty water, inadequate sanitation, air pollution, and land degradation, which cause illness and death on an enormous scale.

In poor countries:

- *Diarrheal diseases that result from contaminated water kill about 2 million children and cause about 900 million episodes of illness each year.*
- *Indoor air pollution from burning wood, charcoal, and dung endangers the health of 400 million to 700 million people.*
- *Dust and soot in city air cause between 300,000 and 700,000 premature deaths a year.*
- *Soil erosion can cause annual economic losses ranging from 0.5 to 1.5 percent of GNP.*
- *A quarter of all irrigated land suffers from salinization.*
- *Tropical forests—the primary source of livelihood for about 140 million people—are being lost at a rate of 0.9 percent annually.*

Concern over ozone depletion continues to grow. The consequences of loss of biodiversity and of greenhouse warming are less certain but are likely to extend far into the future and to be effectively irreversible.

Environmental degradation has three damaging effects. It harms human health, reduces economic productivity, and leads to the loss of "amenities," a term that describes the many other ways in which people benefit from the existence of an unspoiled environment. Amenities are harder to measure than costs to health and productivity but may be valued just as highly (see Box 2.1). The subject of this chapter is priorities for environmental policy: in which cases are the benefits for developing countries most likely to exceed the costs of action? Chapter 3 goes on to discuss ways to contain the costs of action by making sure that environmental policies are as cost-effective as possible, and later chapters look at such policies in greater detail.

The health of hundreds of millions of people is threatened by contaminated drinking water, particulates in city air, and smoky indoor air caused by use of such cooking fuels as dung and wood. Productivity of natural resources is being lost in many parts of the world because of the overuse and pollution of renewable resources—soils, water, forests, and the like. Amenities provided by the natural world, such as the enjoyment of an unpolluted vista or satisfaction that a species is being protected from extinction, are being lost as habitats are degraded or converted to other uses. Because the interaction of various pollutants with other human and natural factors may be hard to predict, some environmental problems may entail losses in all three areas: health, productivity, and amenity.

Policymakers need to set priorities for environmental policies. In both developing and industrial countries governments rightly give greatest urgency to environmental damage that harms human health or productive potential. The priorities that developing countries set for their own environments will not necessarily be those that people in richer countries might want them to adopt. Thus, although some cultures in poor countries may value their natural heritage strongly, most developing country governments are likely to give lower priority to amenity damage as long as basic human needs remain unmet.

National priorities will vary. In Sub-Saharan Africa, for example, contaminated drinking water and poor sanitation contribute to infectious and parasitic diseases that account for more than 62

turned to groundwater as a potential source of a cheaper and safer supply. Monitoring of groundwater for contamination has lagged behind monitoring of surface water, but that is beginning to change as in many places groundwater, too, is becoming polluted. It is often more important to prevent contamination of groundwater than of surface water. Aquifers do not have the self-cleansing capacity of rivers and, once polluted, are difficult and costly to clean.

One of the principal origins of groundwater pollution is seepage from the improper use and disposal of heavy metals, synthetic chemicals, and other hazardous wastes. In Latin America, for instance, the quantity of such compounds reaching groundwater from waste dumps appears to be doubling every fifteen years. Sometimes industrial effluents are discharged directly into groundwater. In coastal areas overpumping causes salt water to infiltrate freshwater aquifers. In some towns contamination occurs because of lack of sewerage systems or poor maintenance of septic tanks. Where intensive agriculture relies on chemical inputs combined with irrigation, the chemicals often leach into groundwater.

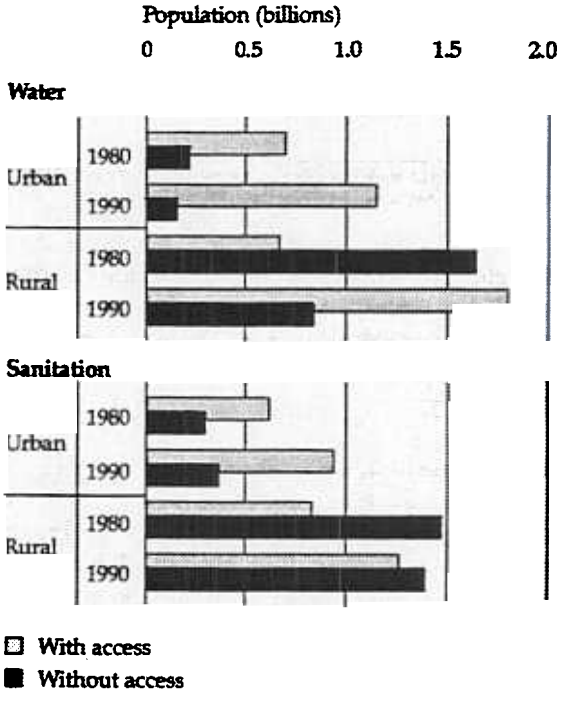
Water quality has continued to deteriorate despite substantial progress in bringing sanitation services to the world's population. Little has been done to extend the treatment of human sewage. The replacement of septic tank systems with piped sewerage systems greatly reduces the risks of groundwater pollution but leads to increased pollution of surface water unless the sewage is treated. Yet in Latin America as little as 2 percent of sewage receives any treatment. Moreover, despite the expansion of sanitation services, the absolute number of people in urban areas without access to these services is thought to have grown by more than 70 million in the 1980s, and more than 1.7 billion people worldwide are without access (Figure 2.2).

Access to uncontaminated water has barely kept pace with population growth. Official WHO figures suggest that between 1980 and 1990 more than 1.6 billion additional people were provided with access to water of reasonable quality. In fact, however, many of those who officially have access still drink polluted water. At least 170 million people in urban areas still lack a source of potable water near their homes, and in rural areas, although access has increased rapidly in the past decade, more than 855 million are still without safe water (see Figure 2.2).

It is the poor—the woman in Niamey drawing water from an open sewage channel or the Bangladeshi child washing household utensils in a pool also used as a latrine—who bear the brunt of risks from contaminated water. The differences in access to safe water by income exist both within and across countries. The gap in access between lower- and higher-income countries has narrowed only slightly, and within countries inequities continue to be striking. For example, a family in the top fifth income group in Peru, the Dominican Republic, or Ghana is, respectively, three, six, and twelve times more likely to have a house connection than a family in the bottom fifth income group in those countries. The rural poor are more likely to rely directly on rivers, lakes, and unprotected shallow wells for their water needs and are least able to bear the cost of simple preventive measures such as boiling water to make it safe for drinking. In many cities in developing countries poor households in neighborhoods unserved by the munici-

More people have safe water, but urban sanitary conditions worsen

Figure 2.2 Access to safe water and adequate sanitation in developing countries, 1980 and 1990



Source: World Health Organization data.

Table 2.1 Availability of water by region

Region[a]	Annual internal renewable water resources: Total (thousands of cubic kilometers)	Annual internal renewable water resources: Per capita (thousands of cubic meters)	Percentage of population living in countries with scarce annual per capita resources: Less than 1,000 cubic meters	Percentage of population living in countries with scarce annual per capita resources: 1,000–2,000 cubic meters
Sub-Saharan Africa	3.8	7.1	8	16
East Asia and the Pacific	9.3	5.3	<1	6
South Asia	4.9	4.2	0	0
Eastern Europe and former U.S.S.R.	4.7	11.4	3	19
Other Europe	2.0	4.6	6	15
Middle East and North Africa	0.3	1.0	53	18
Latin America and the Caribbean	10.6	23.9	<1	4
Canada and United States	5.4	19.4		
World	40.9	7.7	4	8

a. Regional groups include high-income economies. Sub-Saharan Africa includes South Africa.
Sources: World Resources Institute data; World Bank data.

pal water system buy water from private vendors, typically at prices several times greater than the charges for households with municipal hookups.

Water scarcity

Globally, fresh water is abundant. Each year an average of more than 7,000 cubic meters per capita enters rivers and aquifers. It does not always arrive where and when it is needed. Twenty-two countries already have renewable water resources of less than 1,000 cubic meters per capita—a level commonly taken to indicate that water scarcity is a severe constraint. An additional eighteen countries have less than 2,000 cubic meters per capita on average, dangerously little in years of short rainfall. Most of the countries with limited renewable water resources are in the Middle East, North Africa, and Sub-Saharan Africa, the regions where populations are growing fastest (Table 2.1). Elsewhere, water scarcity is less of a problem at the national level, but it is nevertheless severe in certain watersheds of northern China, west and south India, and Mexico.

Water scarcity is often a regional problem. More than 200 river systems, draining over half of the planet's land area, are shared by two or more countries. Overpumping of groundwater aquifers that stretch under political borders also injects international politics into the management of water scarcity.

When water is scarce, countries may sometimes have to make awkward choices between quantity and quality. As river flows decline, effluents are less diluted. In countries with inadequate effluent treatment, water quality can often be improved only if supplies from dams are used to maintain flows for dilution rather than for other economic uses. Often, the disparate agencies involved in water management cannot agree on tradeoffs between quantity and quality.

In many countries water scarcity is becoming an increasing constraint not just on household provision but on economic activity in general. Downstream cities can become so short of water as it is drawn off upstream that their industries are seasonally forced to curtail operations. That, indeed, has become routine during dry months in the Indonesian regional capital of Surabaya. As industry, irrigation, and population expand, so do the economic and environmental costs of investing in additional water supply. There is growing awareness of the need to integrate the management of water demand from the different sectors of the economy.

Health effects

The use of polluted waters for drinking and bathing is one of the principal pathways for infection by diseases that kill millions and sicken more than a billion people each year. Diseases such as typhoid and cholera are carried in infected drinking water; others are spread when people wash themselves in contaminated water. Because of their effect on human welfare and economic growth, deficient water supplies and sanitation pose the most serious environmental problems that face developing countries today. Consider first the consequences for health.

The direct impact of waterborne diseases is huge, especially for children and the poor (who are most at risk). Unsafe water is implicated in many cases of diarrheal diseases, which, as a

group, kill more than 3 million people, mostly children, and cause about 900 million episodes of illness each year. At any one time more than 900 million people are afflicted with roundworm infection and 200 million with schistosomiasis. Many of these conditions have large indirect health effects—frequent diarrhea, for instance, can leave a child vulnerable to illness and death from other causes.

A key question is what the reduction in this burden of disease and death would be if water and sanitation were improved. This is not a simple question to answer, or one on which all epidemiologists agree. Too little is known about how risks and diseases are distributed and interact with each other, and uncertainty remains over the extent to which modest changes in infrastructure account for long-run health improvements. But some impression can be gained from a recent comprehensive review by the U.S. Agency for International Development (USAID), which summarized the findings from about 100 studies of the health impact of improvements in water supplies and sanitation (Table 2.2). Most of the interventions studied were improvements in the quality or availability of water or in the disposal of excreta. The review showed that the effects of these improvements are large, with median reductions ranging

Table 2.2 Effects of improved water and sanitation on sickness

Disease	Millions of people affected by illness	Median reduction attributable to improvement (percent)
Diarrhea	900[a]	22
Roundworm	900	28
Guinea worm	4	76
Schistosomiasis	200	73

a. Refers to number of cases per year.
Source: Esrey and others 1990.

from 22 percent for diarrhea to 76 percent for guinea worm. It also showed that environmental improvements have a greater impact on mortality than on illness, with median reductions of 60 percent in deaths from diarrheal diseases. A companion WHO analysis of the largest group of health impact studies—those on the effect of water and sanitation on diarrheal diseases—suggests that the effects of making several kinds of improvements at the same time (say, in the quality and availability of water) are roughly additive (Table 2.3). Project experience shows that the gains are reinforced by educating mothers and improving hygiene.

Taking these studies as a guideline, it is possible to make a rough estimate of the effects of providing access to safe water and adequate sanitation to all who currently lack it. If the health risks of these people were reduced by the levels shown in Table 2.2, then there would be:

- 2 million fewer deaths from diarrhea each year among children under five years of age (as an indication of magnitudes, about 10 million infants die each year in developing countries from all causes)
- 200 million fewer episodes of diarrheal illness annually
- 300 million fewer people with roundworm infection
- 150 million fewer people with schistosomiasis
- 2 million fewer people infected with guinea worm.

Other effects

The costs of water pollution include the damage it does to fisheries, which provide the main source of protein in many countries, and to the livelihoods of many rural people. For instance, pollution of coastal waters in northern China is implicated, along with overfishing, in a sharp drop in prawn and shellfish harvests. Heavy silt loads aggravated by land development and logging are reducing coastal coral and the fish populations that feed and breed in it, as in Bacuit Bay in Palawan, the Philippines. Fish are often contaminated by sewage and toxic substances that make them unfit for human consumption. Sewage contamination of seafood is thought responsible for a serious outbreak of hepatitis A in Shanghai and for the recent spread of cholera in Peru.

Excessive water withdrawal contributes to other environmental problems. In addition to displacing people and flooding farmland, damming rivers for reservoirs alters the mix of fresh and salt water in

Table 2.3 Effects of water supply and sanitation improvements on morbidity from diarrhea

Type of improvement	Median reduction in morbidity (percent)
Quality of water	16
Availability of water	25
Quality and availability of water	37
Disposal of excreta	22

Source: Esrey, Feachem, and Hughes 1985.

estuaries, influences coastal stability by affecting sedimentation, and transforms fisheries by changing spawning grounds and river hydrology. When groundwater is drawn off at a rate faster than the rate of natural recharge, the water table falls. In China's northern provinces, where ten large cities rely on groundwater for their basic water supply, water tables have been dropping—by as much as a meter a year in wells serving Beijing, Xian, and Tianjin. In the southern Indian state of Tamil Nadu a decade of heavy pumping has brought about a drop of more than 25 meters in the water table. The costs are often substantial and go beyond the additional costs of pumping from greater depths and replacing shallow wells with deep tubewells. Coastal aquifers can become saline, and land subsidence can compact underground aquifers and permanently reduce their capacity to recharge themselves. Sewers and roads may also be harmed, as has happened in Mexico City and Bangkok.

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Sanitation and Clean Water

5 Sanitation and clean water

For many people in developing countries water supply, sanitation, and solid wastes are the most important of all environmental problems. More than 2 million deaths from diarrhea alone could be avoided each year if all people had reasonable water and sanitation services. And large economic and environmental costs are incurred in trying to compensate for poor-quality services.

This chapter argues that large gains—in environmental quality, health, equity, and direct economic returns—can be realized by adopting an approach that comprises four key elements:

- *Managing water resources better, taking account of economic efficiency and environmental sustainability*
- *Providing, at full cost, those "private" services that people want and are willing to pay for (including water supply and the collection of human excreta, wastewater, and solid wastes)*
- *Using scarce public funds only for those services (specifically, treatment and disposal of human excreta, wastewater, and solid wastes) that provide wider communal benefits*
- *Developing flexible and responsive institutional mechanisms for providing these services, with a larger role for community organizations and the private sector.*

Although the provision of clean water and sanitation is often omitted from the list of priority environmental challenges, in many parts of the developing world it ranks at the top. Two environmental issues are involved: the costs to human health and productivity of polluted water and inadequate sanitation and the stresses placed on water resources by rapidly growing human demands for water. This chapter argues that to address the first problem, the second must be tackled as well. This will require better management and more efficient use of water. It may mean that agriculture will have to do more with less water (as discussed in Chapter 7), and it will certainly demand a shift in how sanitation and water supply services are provided—the main theme of this chapter.

Water supply and sanitation as environmental priorities

Inadequate sanitation is a major cause of the degradation of the quality of groundwater and surface water described in Chapter 2. Economic growth leads to larger discharges of wastewater and solid wastes per capita. Inadequate investments in waste collection and disposal mean that large quantities of waste enter both groundwater and surface water. Groundwater contamination is less visible but often more serious because it can take decades for polluted aquifers to cleanse themselves and because large numbers of people drink untreated groundwater.

More environmental damage occurs when people try to compensate for inadequate provision. The lack or unreliability of piped water causes households to sink their own wells, which often leads to overpumping and depletion. In cities such as Jakarta, where almost two-thirds of the population relies on groundwater, the water table has declined dramatically since the 1970s. In coastal areas this can cause saline intrusion, sometimes rendering the water permanently unfit for consumption. In, for example, Bangkok excessive pumping has also led to subsidence, cracked pavements, broken water and sewerage pipes, intrusion of seawater, and flooding.

Inadequate water supply also prompts people to boil water, thus using energy. The practice is especially common in Asia. In Jakarta more than $50 million is spent each year by households for this

purpose—an amount equal to 1 percent of the city's GDP. Investments in water supply can therefore reduce fuelwood consumption and air pollution.

Effects on health

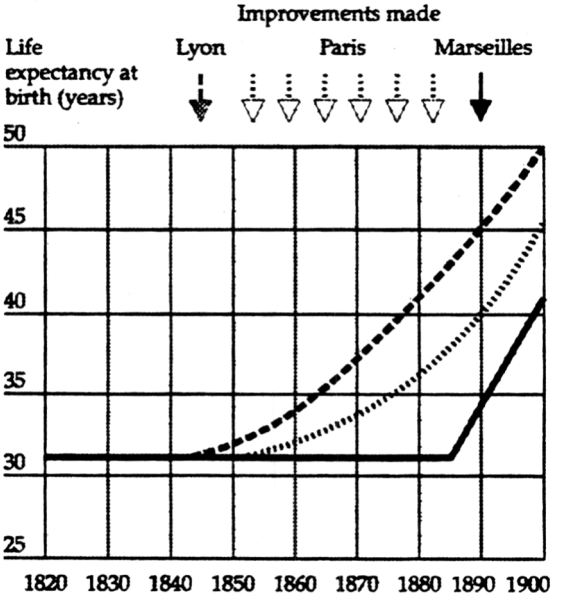
The health benefits from better water and sanitation, as noted in Chapter 2, are large. When services were improved in the industrial countries in the nineteenth and twentieth centuries, the impact on health was revolutionary. Life expectancy in French cities, for example, increased from about 32 years in 1850 to about 45 years in 1900, with the timing of changes corresponding closely to improvements in water supply and wastewater disposal (Figure 5.1). Today, adequate water and sanitation services are just as vital: diarrheal death rates are typically about 60 percent lower among children in households with adequate facilities than among those in households without such facilities. Box 5.1 describes the improvements that are critical for better health.

Effects on productivity

Improved environmental sanitation has economic benefits. Consider the case of sewage collection in Santiago, Chile. The principal justification for investments was the need to reduce the extraordi-

Health gains follow investments in water and sewerage

Figure 5.1 Life expectancy and improvements in water supply and sanitation in selected French cities, 1820-1900



Source: Briscoe 1987.

Box 5.1 Specific investments that matter for health

The potential health benefits from improved water and sanitation services are huge. What improvements must be made to secure these benefits?

- *Water quality.* Contrary to common belief, contamination of water in the home is relatively unimportant. What matters is whether the water coming out of the tap or pump is contaminated. In most developing countries the imperative is to get from "bad" quality (say, more than 1,000 fecal coliforms per 100 milliliters) to "moderate" quality (less than 10 fecal coliforms per 100 milliliters), not necessarily to meet the stringent quality standards of industrial countries.
- *Water availability.* As long as families have to go out of the yard to collect water, the quantities used will remain low (typically between 15 liters and 30 liters per capita per day). The use of water for personal hygiene usually increases only when availability rises to about 50 liters per capita per day and generally depends on getting the water delivered to the yard or house.
- *Excreta disposal.* It is necessary to distinguish among the effects on the household and on the neighborhood. For the household, the health impacts of improved sanitation facilities depend only on getting the excreta out of the house and are thus similar whether family members use an improved pit latrine, a cesspool overflowing into a street drain, or a conventional sewerage system. For the neighborhood, the key is the removal of excreta, a task done well by a wide range of technologies but badly by many commonly used systems (such as nightsoil collection and unemptied septic tanks). Because all the fecal-oral transmission routes are much more important when people live in close proximity to each other, the ill effects of poor environmental sanitation are greatest in high-density urban settlements.

narily high incidence of typhoid fever in the city. A secondary motive was to maintain access to the markets of industrial countries for Chile's increasingly important exports of fruit and vegetables. To ensure the sanitary quality of these exports, it was essential to stop using raw wastewater in their production. In the light of the current cholera epidemic in Latin America, this reasoning was prescient. In just the first ten weeks of the cholera epidemic in Peru, losses from reduced agricultural exports and tourism were estimated at $1 billion—more than three times the amount that the country had invested in water supply and sanitation services during the 1980s.

Improved access to water and sanitation also yields direct economic benefits. For many rural people, obtaining water is time-consuming and heavy work, taking up to 15 percent of women's time. Improvement projects have reduced the time substantially. In a village on the Mueda Plateau in Mozambique, for instance, the average time that women spent collecting water was reduced from 120 to 25 minutes a day. Family well-being was thus improved, as the time saved could be used to cultivate crops, tend a home garden, trade in the market, keep small livestock, care for children, or even rest. Because users clearly perceive these time savings, they are willing to pay substantial amounts (as discussed below) for easier access.

In the absence of formal services, people have to provide their own services, often at high cost. In Jakarta, for instance, about 800,000 households have installed septic tanks, each costing several hundred dollars (not counting the cost of the land). And in many cities and towns large numbers of people buy water from vendors. A review of vending in sixteen cities shows that the unit cost of vended water is always much higher than that of water from a piped city supply—from 4 to 100 times higher, with a median of about 12. The situation in Lima is typical; although a poor family uses only one-sixth as much water as a middle-class family, its monthly water bill is three times as large. Consequently, in the slums around many cities water costs the poor a large part of household income—18 percent in Onitsha, Nigeria, and 20 percent in Port-au-Prince, for example.

The economic costs of compensating for unreliable services—by building in-house storage facilities, sinking wells, or installing booster pumps (which can draw contaminated groundwater into the water distribution system)—are substantial. In Tegucigalpa, for example, the sum of such investments is so large that it would be enough to double the number of deep wells providing water to the city. And the costs of compensating for poor water quality are great, too. In Bangladesh boiling drinking water would take 11 percent of the income of a family in the lowest quartile. With the outbreak of cholera in Peru the Ministry of Health has urged all residents to boil drinking water for ten minutes. The cost of doing so would amount to 29 percent of the average household income in a squatter settlement.

What needs to be done?

Investments in sanitation and water offer high economic, social, and environmental returns. Universal provision of these services should and could become a reality in the coming generation. But the next four decades will see urban populations in developing countries rise threefold and domestic demand for water increase fivefold. Current approaches will not meet these demands, and there is a real possibility that the numbers unserved could rise substantially, even while aquifers are depleted and rivers degraded. The remainder of this chapter discusses four key policy changes that need to be made.

Managing water resources better

When there was little competition for water, it was (correctly) used in large quantities for activities in which the value of a unit of water was relatively low. In many countries irrigated agriculture became the dominant "high-volume, low-value" user. Today about 73 percent of all water withdrawals (and higher proportions of consumptive use) are for irrigation. This share is even higher in low-income countries, as shown in Table 5.1. In most countries this water is provided at heavily subsidized prices, with users seldom paying more than 10 percent of operating costs.

As demand by households, industries, and farmers increases, governments find it hard to

Table 5.1 Sectoral water withdrawals, by country income group

Income group	*Annual withdrawals per capita (cubic meters)*	*Withdrawals, by sector (percent)*		
		Domestic	*Industry*	*Agriculture*
	386	4	5	91
	453	13	18	69
	1,167	14	47	39

Source: World Resources Institute 1990.

change existing arrangements. The allocation of water in all countries is a complex issue and is governed by legal and cultural traditions. Users typically have well-established rights. Reallocation is a contentious and ponderous process that generally responds to changes in demand only with long lags. Even though agricultural use of water has the lowest value per cubic meter, there is strong political opposition to diverting water from agriculture to other sectors. The result is that in many countries, industrial and developing alike, large volumes of water are used in irrigated agriculture, adding little economic value, while cities and industries, which would gladly pay more, cannot get enough.

This mismatch is most striking in the areas around large cities. In the western United States, for example, farmers in Arizona pay less than 1 cent for a cubic meter of water, while residents of the city of Phoenix pay about 25 cents. In the industrial heartland of China around Beijing and Tianjin 65 percent of water is used relatively inefficiently for low-value irrigation, while huge expenditures are contemplated to bring water from other river basins to the cities.

Paradoxically, there is good news in these distortions. Their very size indicates that urban shortages could be met with only modest reallocation. In Arizona, for instance, the purchase of the water rights from just one farm is sufficient to provide water for tens of thousands of urban dwellers. Because of the low value of water in irrigated agriculture, the loss of this marginal water has little overall effect on farm output. To help transfers, new market-driven methods for reallocation have been developed. When a recent drought dangerously reduced available water, the state of California set up a voluntary "water bank" that purchased water from farmers and sold it to urban areas. The farmers made a profit by selling the water for more than it was worth to them, while the cities got water at a cost well below that of other sources of supply.

In developing countries, too, a start is being made in applying innovative methods for managing water resources. China's State Science and Technology Commission found that the economic rate of return to a cubic meter of water used for agriculture was less than 10 percent of the return to municipal and industrial users. Once agricultural and urban users accepted that they had to look at water as an economic commodity with a price, progress—including reallocation—was possible. And Jakarta has been reasonably successful in reducing the overpumping of its aquifers by registering groundwater users (especially commercial and industrial establishments) and by introducing a groundwater levy.

The striking features of these "market-based" reallocation methods are that they are voluntary, they yield economic benefits for both buyers and sellers, they reduce the environmental problems caused by profligate use of water in irrigation, and they lessen the need for more dams.

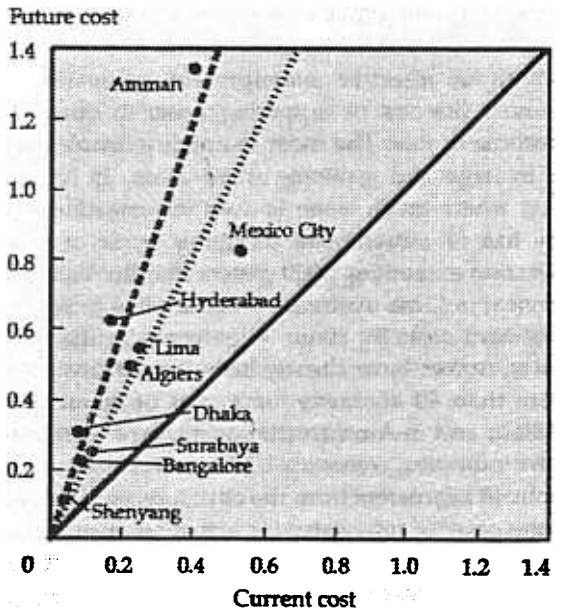
Without effective management of water resources, the cost of supplying water to cities will continue to rise. The most dramatic examples will be in large and growing urban areas. In Mexico City, where much water is used for irrigation, the city has to contemplate pumping water over an elevation exceeding 1,000 meters into the Valley of Mexico; in Lima upstream pollution has increased treatment costs by about 30 percent; in Shanghai water intakes have already been moved upstream more than 40 kilometers at a cost of about $300 million; and in Amman the most recent works involve pumping water up 1,200 meters from a site about 40 kilometers from the city. A recent analysis of the costs of raw water for urban areas in World Bank-financed projects (Figure 5.2) shows that the unit cost of water would more than double—and in some cases more than triple—under a new water development project.

Industries and households also need to be given incentives to use water efficiently. Cities, like farmers, have tended to take demand as given and to see as their task increasing supplies to meet it. As was the case with energy twenty years ago, little attention is paid to conservation and demand management in the water sector. This is both economically and environmentally unsound. Consider the case of Washington, D.C. In the 1960s the U.S. government concluded that sixteen dams and more than $400 million were required to meet the water needs of the metropolitan area. Because of resistance from environmentalists to the construction of the dams, the plan had to be reconsidered. Eventually the number of dams was reduced to one and the total cost of the scheme to $30 million. The key changes were a revised plan for managing demand during droughts and more efficient operating rules. This illustrates once again that better economics and a better environment are compatible.

Experience in industrial and developing countries alike shows the potential for using water more cost-effectively in industry. In the United States withdrawals of fresh water by manufactur-

Costs are high and are rising rapidly

Figure 5.2 Supplying water to urban areas: current cost and projected future cost
(1988 dollars per cubic meter of water)



Note: Cost excludes treatment and distribution. "Current cost" refers to cost at the time data were gathered. "Future cost" is a projection of cost under a new water development project.
Source: World Bank data.

ing industries are expected to be 62 percent less in 2000 than in 1977, primarily because of the increased costs industries have to pay for disposing of industrial wastewater. In São Paulo, Brazil, the imposition of effluent charges induced three industrial plants to reduce their water demand by between 42 and 62 percent. Figure 5.3 shows how in Beijing a variety of conservation measures in industries and households could release large quantities of water at a substantially lower unit cost than the cost under the next supply augmentation project.

A particularly important conservation alternative is reclamation of wastewater. Reclamation of water for urban, industrial, and agricultural use is attractive both for improving the environment and for reducing the costs of water supply. Reclaimed wastewater has been used for many years for flushing toilets in residential and commercial buildings in Japan and Singapore. A recent reclamation scheme in the Vallejo area of Mexico City (Box 5.2) illustrates the great potential, both economic and environmental, of wastewater reuse—and, to anticipate a theme developed below, the scope for the private sector.

At present, in most countries management of water resources is fragmented (industrial users, for example, do not have to take account of the costs that their use and pollution of water imposes

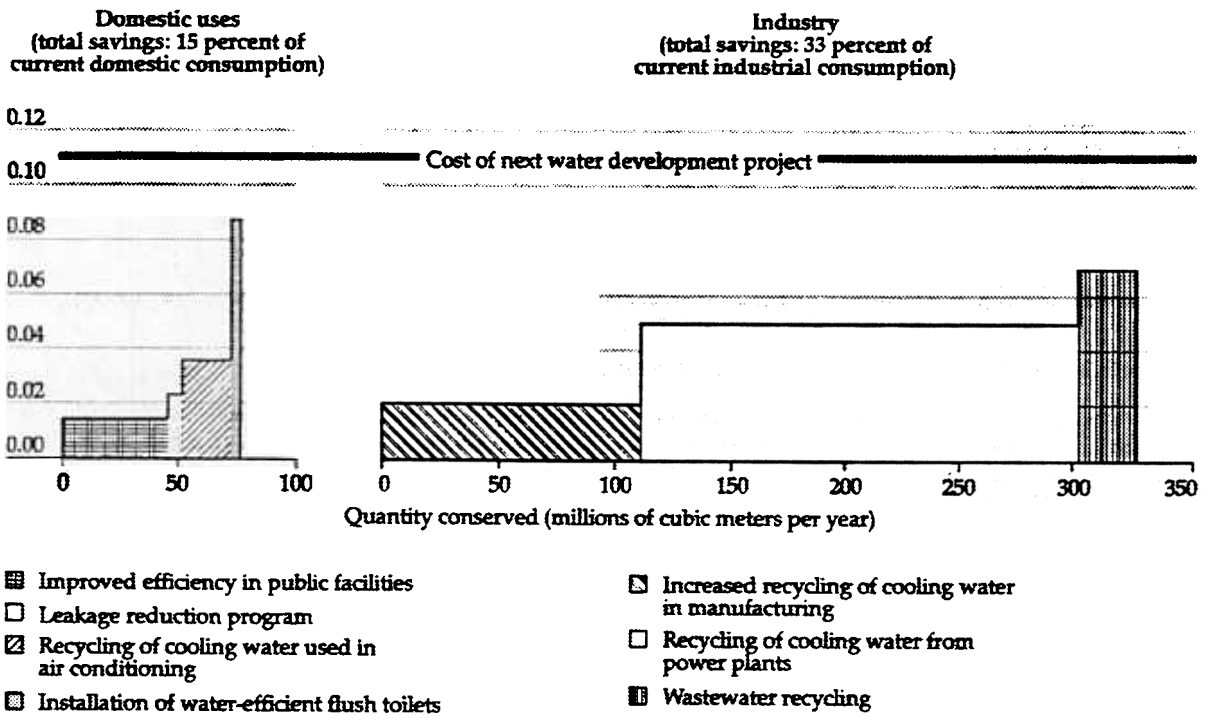
Box 5.2 Environmental improvement, management of water resources, and the private sector in Mexico

In 1989, faced with rising water prices and potential water shortages, a group of companies in the Vallejo area of Mexico City sought an alternative to water supplied by the public agency. At about the same time, the Mexican government decided to involve the private sector in water supply and wastewater treatment.

The industrialists realized that if sewage flows could be adequately treated, this could provide a cost-effective and reliable source of industrial water (and, incidentally, could improve the environment by treating wastes and reducing the need for new water supplies). Twenty-six Vallejo companies organized a new for-profit firm, Aguas Industriales de Vallejo (AIV), to rehabilitate an old municipal wastewater treatment plant. Each shareholder company contributed equity on the basis of its water requirements, with total equity amounting to $900,000.

AIV operates the plant under a ten-year concession from the government. The plant now provides 60 liters per second to shareholders and 30 liters per second to the government as payment for the concession. The concession agreement gives AIV the right to withdraw up to 200 liters per second of wastewater from the municipal trunk sewer. AIV plans to double the plant's capacity within five years at an estimated cost of $1.5 million. The firm provides treated water to shareholder companies at a price equivalent to 75 percent of the water tariff charged by the government (currently, $0.95 per cubic meter).

Figure 5.3 Conserving water as an alternative to expanding supply in Beijing
(discounted cost in dollars per cubic meter)



Source: Hufschmidt and others 1987.

on domestic users downstream) and is done by "command and control" (most allocations are set by administrative fiat). The challenge is to replace this system with one that recognizes the unitary nature of the resource and its economic value and that relies heavily on prices and other incentives to encourage efficient use of water.

Providing services that people want and are willing to pay for

During the United Nations Drinking Water and Sanitation Decade of the 1980s, coverage increased (see Chapter 2). But about 1 billion people still lack an adequate water supply, and about 1.7 billion people do not have adequate sanitation facilities. The quality of service often remains poor. In Latin America, for example, levels of leakage and pipe breakage are, respectively, four times and twenty times higher than is normal in industrial countries. In Lima 70 percent of the water distribution districts provide inadequate water pressure. In Mexico 20 percent of the water supply systems have unreliable chlorination facilities.

What has been done

Developing countries cannot afford to provide all people with in-house piped water and sewerage connections. The policy has usually been to concentrate primarily on the (subsidized) provision of water, often through house connections for the better-off and standpipes or handpumps for the poor.

Consumers in most industrial countries pay all of the recurrent costs (operations, maintenance, and debt service) of both water and sewerage services. They also pay most of the capital costs of

water supply and a large (typically over half) and rising portion of the capital costs of sewerage. In developing countries, by contrast, consumers pay far less. A recent review of World Bank-financed projects showed that the effective price charged for water is only about 35 percent of the average cost of supplying it. The proportion of total project financing generated by utilities points in the same direction: internal cash generation accounts for only 8 percent of project costs in Asia, 9 percent in Sub-Saharan Africa, 21 percent in Latin America and the Caribbean, and 35 percent in the Middle East and North Africa.

A new approach

In urban areas there is abundant evidence that most people want on-plot water supplies of reasonable reliability and are willing to pay the full cost of these services. In some areas this standard solution will have to be adjusted and special efforts made to accommodate poor people. In Latin America and, more recently, in Morocco utilities have helped poor families to install a connection and in-house plumbing by giving them the option of paying over several years. Another option is a "social tariff" whereby the better-off cross-subsi-

Box 5.3 Willingness to pay for water in rural areas

The World Bank, in conjunction with other agencies, recently completed a study of rural water demand in Brazil, Haiti, India, Nigeria, Pakistan, Tanzania, and Zimbabwe. The study suggests that where water demand is concerned, there are four broad categories of rural community.

Type I: willingness to pay for private connections is high and willingness to pay for public water points is low. Communities in this group offer exciting possibilities because people want and are willing to pay the full costs of reliable water service delivered by way of private metered connections into the house or yard. The availability of free public taps (for the poor) will not appreciably affect the demand for private connections. The appropriate strategy is to offer private connections and even encourage them (specifically, by amortizing connection costs in monthly water bills); to recover all costs through the tariff; and to deliver a reliable service. A striking finding from the World Bank study is that this category is larger than is commonly assumed; it probably includes many communities in Southeast Asia, South Asia, Latin America, and the Middle East and North Africa.

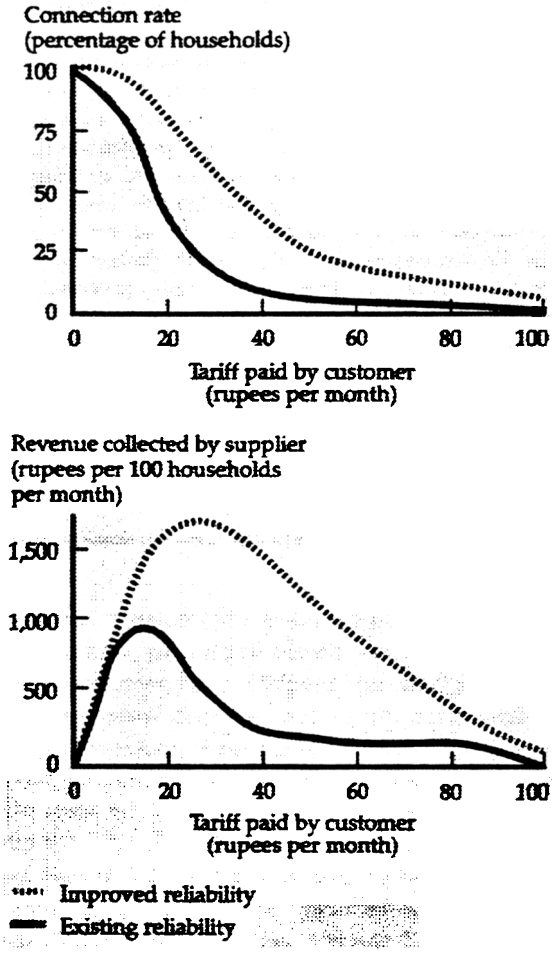
Type II: only a minority of households are willing to pay the full costs of private connections, but most households are willing to pay the full costs of public water points. Although overall willingness to pay for improved water service is considerable in Type II communities, users vary greatly in their willingness to pay for different levels of service. In these villages the provision of free public water points (such as standpipes, wells, or boreholes) would significantly reduce the demand for private connections. When there is heavy reliance on public water points, some charge must be levied on water from these sources in order to finance the system. Here the greatest challenge is to devise revenue collection systems that are sensitive to peoples' preferences about when they want to buy water and how they want to pay for it. Kiosks appear to be an attractive and flexible option for many households. Those who wish to have house connections should be able to do so but must have metered connections and must pay the full cost. Many of the better-off communities in Sub-Saharan Africa and poorer communities in Asia and Latin America probably fall into this category.

Type III: households' willingness to pay for improved service is high but not high enough to pay the full costs of an improved service. This group typically includes poor communities in arid areas in South Asia and Sub-Saharan Africa. As in Type II villages, people are willing to pay a relatively large share of their income for improved water service. The distinction is that the costs of supply are so high, as a result of a combination of aridity and low population densities, that improved systems will not be built and operated without subsidies. Given the high priority that people give to improved water supply, if transfers were available from central government or from foreign donors, households would typically choose to spend the funds on an improved water supply. The primary service offered in such communities would be public taps, wells, or boreholes, although in piped systems metered yard taps should be allowed, with tariffs set to recover full costs.

Type IV: willingness to pay for any kind of improved service is low. This group typically includes poor communities in which (a) traditional water supplies are considered more or less satisfactory by the population or (b) water supply is seen as the financial responsibility of the government. In such communities self-financed improved water supplies are not feasible. Given the low priority accorded improved water supply, available subsidies could be better used in providing other, more highly valued infrastructural services. For the time being, the appropriate rural water supply policy in such cases is simply to do nothing. For the second category, once government paternalism ceases, communities may express a willingness to pay and will become Type II communities.

Users want reliable supplies

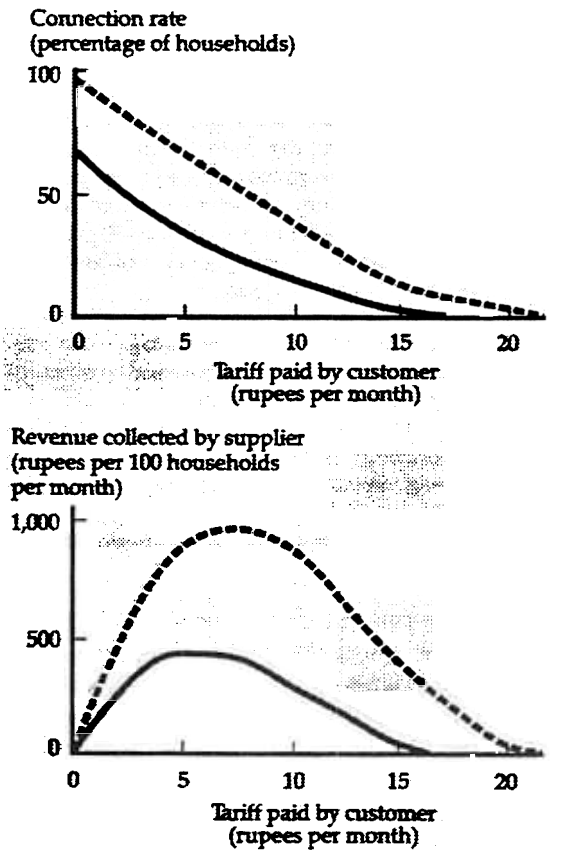
Figure 5.4 How reliability of supply affects willingness to pay for piped water: Punjab, Pakistan



Source: World Bank Water Demand Research Team forthcoming.

Credit for connections is vital

Figure 5.5 How spreading connection costs over time affects willingness to pay for piped water: Kerala, India



Source: World Bank Water Demand Research Team forthcoming.

dize the poor. Properly executed, such policies are both sensible (since the poor use relatively little water) and compassionate. But there are dangers. Social tariffs can lead to a general spread of subsidies. And the assignment of noncommercial objectives to a public enterprise generally has an insidious effect on the achievement of all its objectives, commercial and noncommercial alike.

It is widely assumed that the demand situation in rural areas is quite different, that there people have only a "basic need" which can be met with a public tap or handpump. But a recent multicountry study by the World Bank of rural water demand (Box 5.3) found that most rural people want and are willing to pay for a relatively high level of service (yard taps). As shown in Figure 5.4, they will pay substantially more if that service is reliable. And, as Figure 5.5 illustrates, more people will make use of improved water supplies if innovative financing mechanisms are employed.

Twenty years of experience with the provision of water in rural Thailand (Box 5.4) shows how it is possible to break out of a "low-level equilibrium trap" (in which a low level of services is provided

Box 5.4 Breaking out of the "low-level equilibrium trap" in northeast Thailand

A well-documented case in northeast Thailand, covering a twenty-year period, demonstrates the importance of discovering what users of rural water services want rather than making assumptions about the answers.

Since the people in the area were poor, the initial project was intended to provide protected water at the lowest possible cost. Because groundwater is abundant in the region, the technology chosen was handpumps. After five years most of the handpumps were not working, and water use habits were largely unchanged. In a follow-up phase motor pumps provided piped water at community standpipes. Again, the project failed. Five years after implementation 50 percent of the systems were not working at all, and another 25 percent operated intermittently.

As was consistent with conventional assumptions, the failures were attributed to technologies that were too complex to maintain and to the inability of the villagers to pay for improved supplies. Gradually, however, it became apparent that the main problem was not the capabilities of the villagers but the fact that the service being offered was not what they wanted. They did not want handpumps, which were not considered an improvement over the traditional rope-and-bucket system. And standpipes, being no closer than their traditional sources, offered no obvious benefits. Only piped water to yardtaps could meet people's aspirations.

In the next project yardtaps were allowed, with the users paying the full costs of connection. Five years later the verdict was in: 90 percent of the systems were functioning reliably, 80 percent of the people were served by yardtaps, meters had been installed, and locally adapted charging systems had been developed. Not only were the systems well maintained, but because the service was so popular, many systems had extended distribution lines to previously unserved areas.

In other words, in terms of the typology discussed in Box 5.3, when these (poor) people were treated as "Type IV" cases, the result was the familiar low-level equilibrium trap. When they were treated as "Type I" communities, the cycle was broken, and a high-level equilibrium was established.

willingness to pay and thus revenues are low, and the operation consequently deteriorates) to a "high-level equilibrium" in which users get a high level of service, pay for it, and maintain the desired system.

Increasing investments in sanitation

Public investment in water supply and sanitation accounts for 10 percent of total public investment in developing countries, or about 0.6 percent of GDP. Spending on sewerage and sanitation accounts for substantially less than one-fifth of lending in World Bank-financed projects. Most of this has been for sewage collection, with little spent on treatment. An indication of the huge underinvestment in treatment is that only 2 percent of sewage in Latin America is treated. Similarly, only a small proportion (typically 5 percent in developing countries, compared with 25 percent in industrial countries) of all spending on solid wastes is directed to their safe disposal.

Taking account of demand

There is abundant evidence that urban families are willing to pay substantial amounts for the removal of excreta and wastewater from their neighborhoods. People want privacy, convenience, and status; polluted water smells unpleasant and fosters mosquitos; and the installation of sewers typically increases property prices. As with water supply, so with sanitation: where public provision is absent, people pay significant amounts for privately provided services. Even in poor cities the amounts paid are considerable. In Kumasi, Ghana, for example, the use of public latrines and bucket latrines accounts for large recurrent expenditures—about 2.5 and 1 percent, respectively, of family income. In Kumasi and in Ouagadougou families are willing to pay about 2 percent of household income for an improved sanitation system. This is roughly the amount paid for water and for electricity. The examples of northeast Brazil and of Orangi, Pakistan, discussed in Boxes 5.5 and 5.6 show the willingness of households to pay for having wastewater carried out of the neighborhood (by means of a low-cost sewer).

Expanding the menu of supply options

A vital element of a demand-driven sanitation strategy is to expand the menu of services from which users can choose.

In city centers there is no alternative to costly waterborne systems. But even in relatively poor

Box 5.5 Innovative sewerage in northeast Brazil: the condominial system

The condominial system is the brainchild of José Carlos de Melo, a socially committed engineer from Recife. The name "condominial" was chosen for two reasons. First, a block of houses was treated like a horizontal apartment building—or *condominiais*, in Portuguese. Second, "Condominial" was the title of a popular Brazilian soap opera and so was associated with the best in urban life! As is evident in Box figure 5.5, the result is a layout radically different from the conventional system, with a shorter grid of smaller and shallower "feeder" sewers running through backyards and with the effects of shallower connections to the mains rippling through the system. These innovations cut construction costs to between 20 and 30 percent of those of a conventional system.

The more fundamental and radical innovation, however, is the active involvement of the population in choosing the level of service and in operating and maintaining the "feeder" infrastructure. Families can choose to continue with their current sanitation system, to connect to a conventional waterborne system (which usually means a holding tank discharging into an open street drain), or to connect to a "condominial" system.

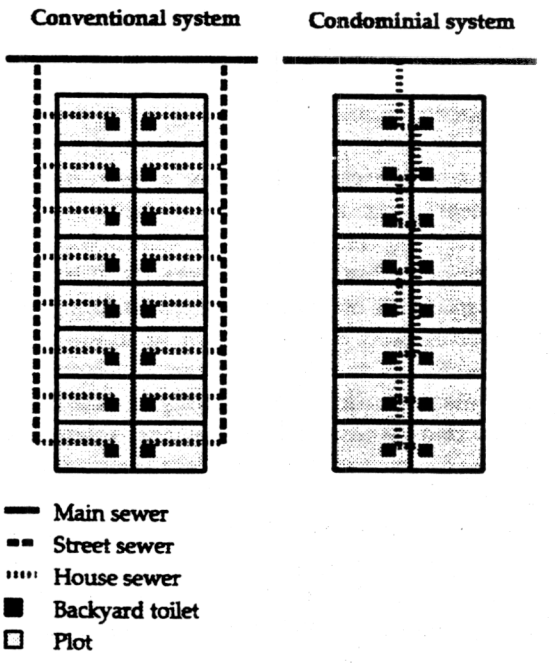
If a family chooses to connect to a condominial system, it has to pay a connection charge (financed by the water company) of, say, X cruzados, and a monthly tariff of Y cruzados. If it wants a conventional connection, it has to pay an initial cost of about 3X cruzados and a monthly tariff of 3Y cruzados, reflecting the higher capital and operating costs of the conventional system.

Families are free to continue with their current system. In most cases, however, those families that initially choose not to connect eventually change their minds. Either they succumb to heavy pressure from their neighbors, or they find the buildup of wastewater in and around their houses intolerable once the (connected) neighbors fill in the rest of the open drain.

Individual households are responsible for maintaining the feeder sewers, with the formal agency tending only to the trunk mains. This has several related positive results. First, it increases the communities' sense of responsibility for the system. Second, the misuse of any portion of the feeder system (by, say, putting solid wastes down the toilet) soon shows up as a blockage in the neighbor's portion of the sewer. The consequence is rapid, direct, and informed feedback to the misuser. This virtually eliminates the need to "educate" the users of the system about dos and don'ts and results in fewer blockages than in conventional systems. And third, because of the greatly reduced responsibility of the utility, operating costs are much lower.

The condominial system is now providing service to hundreds of thousands of urban people in northeast Brazil. The danger is that the clever engineering may be seen as "the system." Where the community and organizational aspects have been missing, the technology has worked poorly (as in Joinville, Santa Catarina) or not at all (as in the Baixada Fluminense in Rio de Janeiro).

Box figure 5.5 Conventional and condominial sewage collection systems



cities the difficulties are not insoluble. In Fortaleza, a poor city in northeast Brazil, developers of all high-rise buildings are required to, and do, install package sewage collection and treatment systems. The point here is not that this is a good technical solution but that even in a relatively poor city, developers can easily absorb such costs and pass them on to those who purchase units in the buildings.

Beyond the urban core, however, conventional sewerage systems (with average household costs anywhere from $300 to $1,000) are too expensive for most developing countries. In recent decades efforts have been made to develop technological

alternatives. Most of this work has concerned the onsite disposal of excreta. Pour-flush latrines and ventilated improved pit (VIP) latrines are often the technologies of choice—they provide good service (privacy and few odors) at reasonable cost (typically about $100 to $200 per unit), and their installation and functioning does not depend on the municipality or other organization. At even lower cost, there are yet simpler improvements, such as the latrine slab program that proved successful in Mozambique.

For a variety of reasons—high housing densities, impermeable soils, and the need to dispose of considerable quantities of domestic wastewater—onsite solutions do not function well in many urban areas. Sewage and wastewater collect in the streets and in low-lying areas, creating serious aesthetic and health problems. And in many settings people aspire to "the real thing"—waterborne sewerage.

Current sanitation choices include a Rolls-Royce (conventional sewerage), a motorcycle (an improved latrine), and a bicycle (an unimproved latrine). What is missing is the Volkswagen—something that provides much the same service as the Rolls Royce but that many more people can afford. Several such technologies are being developed:

- Effluent sewerage is a hybrid between a septic tank and a conventional sewerage system. Its distinctive feature is a tank, located between the house sewer and the street sewer, that retains the solids, thereby allowing smaller sewers to be laid at flatter gradients and with fewer manholes. Such systems have been widely used in small towns in the United States and Australia and in Argentina, Brazil, Colombia, India, Mozambique, and Zambia. The (limited) cost data suggest that solids-free sewerage costs about 20 percent less than conventional sewerage.
- Simplified sewerage, developed in São Paulo, allows smaller, shallower, flatter sewers with fewer manholes. This simplified design works as well as conventional sewerage but costs about 30 percent less. It is now routinely used in Brazil.
- The condominial system described in Box 5.5 has been developed and applied in northeast Brazil. It comprises shallow, small-diameter backyard sewers laid at flat gradients and costs about 70 percent less than a conventional system.
- The Orangi Pilot Project in Karachi (described in Box 5.6) adapted the principles of effluent sewerage and simplified sewerage to the realities of a hilly squatter settlement in Karachi. The result—not just the result of clever engineering—was a drastic reduction in the cost of sewers, from the $1,000 per household that was standard in Karachi to less than $50 per household (excluding the cost of the trunk sewers). The achievement is extraordinary—about 600,000 people in Orangi are now served with self-financed sewers.

Investing in waste disposal

There is an important difference between "private goods" (including water supply and even wastewater and solid waste collection), in which the primary benefits accrue to individual households, and waste treatment and disposal, in which the benefits accrue to the community at large. In the first case willingness to pay is an appropriate guide to the level of service to be provided, and the main source of finance should be direct charges to the users. In the case of waste disposal, however, public financing is essential. Governments that subsidize "private" water supply and wastewater collection services are left with less money to finance treatment and disposal services.

No developing country, however, will have the luxury of collecting and treating wastewater from all households. Because the costs of meeting such goals are extremely high, even in industrial countries the full population is not served by wastewater treatment facilities; coverage is only 66 percent in Canada and 52 percent in France. In making the inevitable choices, the best ratio of benefits to costs will usually be achieved by concentrating most public funds on waste treatment in large cities, especially those that lie upstream from large populations.

In recent decades some important advances have been made in innovative sewage treatment processes. At the lower end of the spectrum is the stabilization pond, a technology that has proved robust, easy to operate, and (where land is not costly) relatively inexpensive. A promising intermediate (in both cost and operational complexity) is the upflow anaerobic sludge blanket, which has performed well in Brazil and Colombia. The point is the importance of developing technical solutions that are adapted to the climatic, economic, and managerial realities of developing countries.

Rethinking institutional arrangements

A recent comprehensive review of forty years of World Bank experience in water and sanitation pinpoints "institutional failure" as the most frequent and persistent cause of poor performance by public utilities. This section deals with the key areas for institutional reform.

Box 5.6 Innovative sewerage in a Karachi squatter settlement: the Orangi Pilot Project

In the early 1980s Akhter Hameed Khan, a world-renowned community organizer, began working in the slums of Karachi. He asked what problem he could help resolve and was told that "the streets were filled with excreta and wastewater, making movement difficult and creating enormous health hazards." What did the people want, and how did they intend to get it? he asked. What they wanted was clear—"people aspired to a traditional sewerage system. . . it would be difficult to get them to finance anything else." And how they would get it, too, was clear—they would have Dr. Khan persuade the Karachi Development Authority (KDA) to provide it free, as it did (or so the poor perceived) to the richer areas of the city.

Dr. Khan spent months going with representatives of the community to petition the KDA to provide the service. When it was clear that this would never happen, Dr. Khan was ready to work with the community to find alternatives. (He would later describe this first step as the most important thing he did in Orangi—liberating, as he put it, the people from the immobilizing myths of government promises.)

With a small amount of core external funding, the Orangi Pilot Project (OPP) was started. It was clear what services the people wanted; the task was to reduce the costs to affordable levels and to develop organizations that could provide and operate the systems. On the technical side, the achievements of the OPP architects and engineers were remarkable and innovative. Thanks partly to the elimination of corruption and the provision of labor by community members, the costs (for an in-house sanitary latrine and house sewer on the plot and underground sewers in the lanes and streets) were less than $50 per household.

The related organizational achievements are equally impressive. OPP staff members have played a catalytic role: they explain the benefits of sanitation and the technical possibilities to residents, conduct research, and provide technical assistance. The OPP staff never handle the community's money. (The total costs of the OPP's operations amounted, even in the project's early years, to less than 15 percent of the amount invested by the community.) The households' responsibilities include financing their share of the costs, participating in construction, and electing a "lane manager" who typically represents about fifteen households. Lane committees, in turn, elect members of neighborhood committees (typically representing about 600 houses), which manage the secondary sewers.

The early successes achieved by the project created a "snowball" effect, in part because of the increased value of properties with sewerage systems. As the power of the OPP-related organizations increased, they were able to put pressure on the municipality to provide funds for the construction of trunk sewers.

The Orangi Pilot Project has led to the provision of sewerage services to more than 600,000 poor people in Karachi and to recent initiatives by several municipalities in Pakistan to follow the OPP method and, according to OPP leader Arif Hasan, "have government behave like an NGO." Even in Karachi the mayor now formally accepts the principle of "internal" development by the residents and "external" development (including trunk sewers and treatment) by the municipality.

Improving the performance of public utilities

A World Bank review of more than 120 sector projects over twenty-three years concludes that only in four countries—Botswana, Korea, Singapore, and Tunisia—have public water and sewerage utilities reached acceptable levels of performance. A few examples illustrate how serious the situation is:

- In Accra only 130 connections were made to a sewerage system designed to serve 2,000 connections.
- In Caracas and Mexico City an estimated 30 percent of connections are not registered.
- Unaccounted-for water, which amounts to 8 percent in Singapore, is 58 percent in Manila and about 40 percent in most Latin American cities. For Latin America as a whole, such water losses cost between $1 billion and $1.5 billion in revenue forgone every year.
- The number of employees per 1,000 water connections is between two and three in Western Europe and about four in a well-run developing country utility (Santiago) but between ten and twenty in most Latin American utilities.

Financial performance is equally poor. A recent review of Bank projects found that borrowers often broke their financial performance covenants. A corollary is that the shortfalls have to be met through large injections of public money. In Brazil, from the mid-1970s to mid-1980s about $1 billion a year of public monies was invested in the water sector. The annual federal subsidy to Mexico City for water and sewerage services amounts to more than $1 billion a year, or 0.6 percent of national GDP.

Public utilities play a dominant role in the provision of water and sanitation services throughout the world. There are many examples of such utilities working effectively in industrial countries and, as described above, a few cases in developing countries. An essential requirement for effective performance is that both the utility and the regulatory body (essential for such natural monopolies) be free from undue political interference. In the case of the utility the vital issue is managerial autonomy, particularly as regards personnel policies; in the case of the regulatory body, it is the setting of reasonable tariffs. Although this recipe is simple and has been well tested in many industrial countries, it has been extraordinarily difficult to implement in developing countries other than those with high levels of governance. Sometimes utilities and regulators are nominally autonomous, but usually key policies (on investments, personnel policies, and tariffs, for instance) are effectively made by government and heavily influenced by short-term political considerations.

Many projects financed by external agencies have addressed the problems of public water utilities through sizable action plans, technical assistance components, and conditionality. Some of these efforts, such as that undertaken recently by Sri Lanka's National Water Supply and Drainage Board, have led to significant improvements in performance. As with public enterprises in other sectors, however, most of these efforts failed because—in the words of a recent Bank review—"public enterprises . . . are key elements of patronage systems, . . . overstaffing is often rife, and appointments to senior management positions are frequently made on the basis of political connections rather than merit." And things have been getting worse rather than better. Achievement of institutional objectives in World Bank–financed water and sanitation projects fell from about two in three projects in the late 1970s to less than one in two projects ten years later.

Improving the performance of public utilities nevertheless remains an important goal, for two reasons. First, in the medium term public utilities will continue to provide services to many. Second, improvement in the performance of public utilities is often a precondition if private operators are to be induced to participate.

Separating provision and regulation

Experience in industrial countries shows that a central problem in improving environmental quality is that the public sector acts both as supplier of water and wastewater services and as environmental regulator—it is both gamekeeper and poacher. The results of this conflict of interest are similar throughout the world. In England and Wales prosecutions of those responsible for sewage treatment were rare when the river basin authorities were responsible for water resource management, environmental protection, and services. In 1989 private companies were given responsibility for the delivery of water and sewerage services (with public agencies retaining regulatory authority). Since then, fines have been increased substantially and violators have been prosecuted. The other side of the separation of powers is that service delivery agencies are, in the process, liberated from serving multiple tasks and can pursue well-defined and specific objectives.

Expanding the role of the private sector

Increased private sector involvement is warranted in two areas. One is in services to public utilities. In industrial countries the engineering of public works is dominated by private firms, which depend for their survival on their reputation for performance and which assume legal liability for the consequences of any professional negligence. These factors provide powerful incentives for supplying cost-effective, high-quality services and concurrently furnish a stringent environment for the supervised apprenticeship training that is a required part of professional certification in these countries. By contrast, in many developing countries (particularly in Asia and Africa) the engineering of public works is dominated by large public sector bureaucracies. Employment security is total, promotion is by seniority alone, good work goes unrecognized, poor work is not subject to sanctions, and an atmosphere of lethargy prevails. The direct consequence is the construction of high-cost, low-quality facilities; the indirect effects include a weak professional labor force. The obvious answers are, first, to decrease the direct involvement of the government in public works and, second, to nurture a competitive engineering consultancy sector.

More private involvement in the operation of water, sewerage, and solid waste companies is also warranted. Many industrial countries have found it difficult to reform public enterprises, except as part of a move to privatize them. Indeed, privatization is increasingly seen as a way not only to effect performance improvements but also to lock in the gains.

In developing countries there has been some ex-

perience with private sector operation of water and sanitation utilities. Côte d'Ivoire has been a pioneer—SODECI, in Abidjan, is considered one of the best-run utilities in Africa. After Macao's water utility was privatized in 1985, performance improved dramatically; the percentage of unaccounted-for water fell by 50 percent over six years. Guinea, which recently let a lease contract for supplying water to its principal cities, experienced dramatic improvements in the financial condition of the utility in just the first eighteen months as a result of raising the efficiency of bill collection from 15 to 70 percent.

Other countries have taken more incremental approaches. EMOS, the utility serving Santiago, has used private contracts for functions such as meter reading, pipe maintenance, billing, and vehicle leasing. As a result, it has a high staff productivity rate—three to six times higher than that for other companies in the region. Many other countries, faced with persistently poor performance by their public utilities, are seriously considering greater private sector involvement, following, in general, variations of the French model. For example, in Latin America, concession contracts are currently being let for the supply of water and sewerage services in Buenos Aires and Caracas.

Private involvement in the sector is not a panacea and is never simple. In the United Kingdom water privatization is generally considered the most complex of all privatizations undertaken. In developing countries there are formidable problems. For the private operator the risk involved is typically high. In addition to the obvious political and macroeconomic risks, knowledge about the condition of the assets is usually only rudimentary, and there is uncertainty about the government's compliance with the terms of the contract. Groups such as existing agencies and labor unions that stand to lose from greater private sector involvement often strongly oppose privatization.

For the government, too, there are problems. Because of economies of scale, it is virtually impossible to have direct competition among suppliers in a specific area. Countries have tried a variety of solutions: in France, there is periodic competition for markets, and in England and Wales, economic regulators reward efficiency by comparing the relative performance of different companies (a practice that is unlikely to be applicable elsewhere). In addition, in many developing countries it is often difficult to attract private sector interest. Only a handful of firms compete internationally for such contracts.

The case for private sector involvement is stronger still in the solid waste collection business. Whereas foreign control of water supply is often perceived to involve losing sovereignty over a strategic sector, no one cares if foreigners pick up the garbage. In addition, for populations of more than about 50,000 there are no economies of scale and thus no natural monopoly. Experience in many countries—including Argentina, Brazil, Canada, Chile, Colombia, Japan, Switzerland, and the United States—has shown that the private sector almost invariably collects solid wastes more efficiently than municipalities. Unit costs for public systems are 50 to 200 percent higher, with the private sector efficiency gains apparently greatest in the developing countries listed.

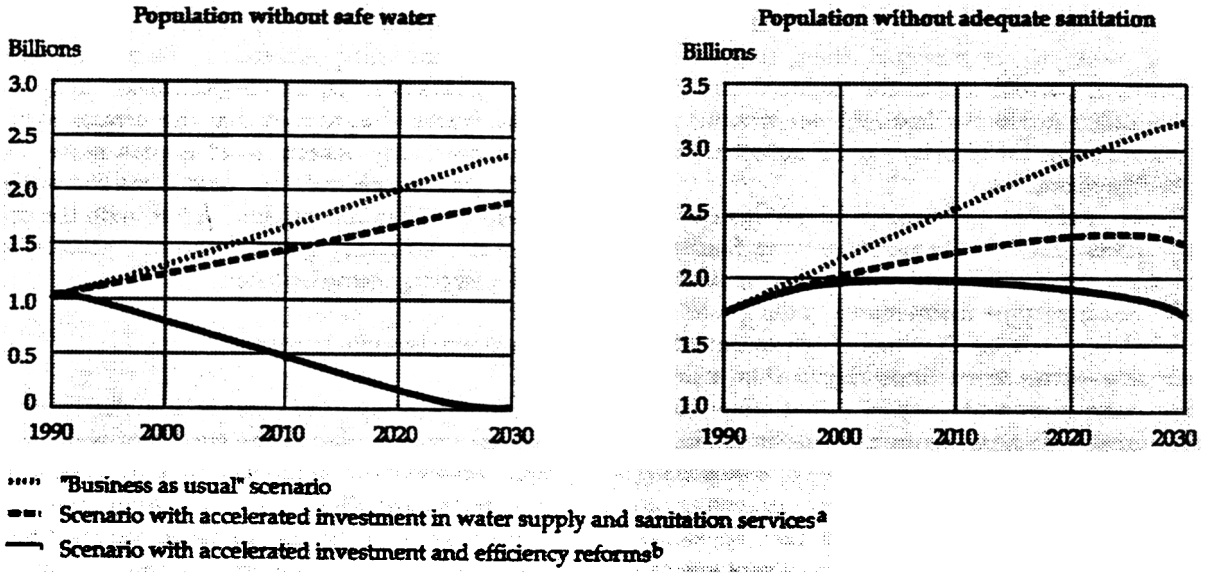
Increasing community involvement

Community groups and other NGOs also have an important role to play in the supply of water and sanitation services and the collection of wastes. As the condominial (Box 5.5) and Orangi (Box 5.6) examples show, in the urban fringe the most productive relationship between community groups and the formal sector is that of partnership, with the formal sector responsible for the "external" or "trunk" infrastructure and the community paying for, providing, and managing the "internal" or "feeder" infrastructure.

Because many water and sanitation services are monopolies, consumers cannot force suppliers to be accountable by giving their business to a competitor. To give consumers a voice in the political process, consumers' associations and ratepayers' boards are vital. Paradoxically, because there is such an obvious need for oversight of the activities of a private operator of a natural monopoly, greater private sector involvement stimulates greater consumer involvement. In the United Kingdom, for example, water users have had a much greater say in running the industry since privatization.

In recent years external agencies and governments alike have become aware that in rural areas involvement of the users is essential if water supplies are to be sustained. Generally it has been assumed that support to rural communities—in the form of information, motivation, and technical assistance—will come from the government. The difficulty is that governments, especially in rural areas, are often weak, and their officials rarely have an incentive to provide support. Here the private sector (including NGOs) may be able to help.

Figure 5.6 Safe water and adequate sanitation: three scenarios, 1990-2030



Note: Assumptions are as follows: growth of per capita income and population as in Chapter 1; per capita income elasticity, 0.3; price elasticity, -0.25; initial prices 60 percent of marginal costs, gradually rising to efficiency levels over a twenty-five-year period; initial supply costs 50 percent higher than with good practices (due to managerial inefficiencies), gradually being reduced in step with price efficiency reforms; and marginal costs rising at 3 percent per year.

a. Investment in water supply increases 30 percent, and investment in sanitation services increases 50 percent over the period.

b. To realize this scenario in low-income countries, efficiency reforms - and the resulting increase in investment shares - would need to be greater than average.

Source: World Bank estimates, based on Anderson and Cavendish, background paper.

Several promising examples of the involvement of small-scale private operators in developing countries have emerged:

- In rural Pakistan about 3 million families have wells fitted with pumps, many of which are motorized. The water supplies are paid for in full by the families, and all the equipment is provided and serviced by a vibrant local private sector industry.
- In Lesotho the government trained bricklayers to build improved pit latrines. Government banks also provided (unsubsidized) credit to finance the latrines. The program has been a singular success, thanks mainly to the aggressive role of the bricklayers in expanding their markets (and providing services as well).
- In West Africa a private handpump manufacturer has developed a "Sears Roebuck"-type scheme whereby purchase of a pump comes with five years of support, including training and the provision of spare parts. Later on, the community will be able to maintain the pump and will purchase the necessary spare parts from local traders. Because the private sector agent has clear incentives for providing services effectively, this arrangement may work better than government support to the communities.

Finally, women have a central role to play in these reforms. In most countries the collection of water has been considered "women's work" (except where the water is sold!). Only recently, however, have systematic efforts been made to involve women in project identification, development, maintenance, and upkeep. The results have generally been encouraging. In an urban slum in Zambia a women's organization improved drainage around public taps. Women have been trained as caretakers for handpumps in Bangladesh, India, Kenya, Lesotho, and Sudan. In Mozambique

women engineers and pump mechanics perform alongside, and as effectively as, their male counterparts. In Sri Lanka women's cooperatives have been set up to assemble and maintain a locally manufactured handpump. Women's cooperatives manage communal standpipes and collect money to pay for metered supplies in Honduras, Kenya, and the Philippines. Women who are trained to manage and maintain community water systems often perform better than men because they are less likely to migrate, more accustomed to voluntary work, and better trusted to administer funds honestly.

Creating an enabling environment

This chapter has argued that massive improvements can be made in health, economic efficiency, and equity through better provision of sanitation and water. The key is firmly in the hands of governments, for the single most important factor needed is political will. Where there are long-established and deeply entrenched traditions of sound governance (as in Botswana, Korea, and Singapore), it is evident that autonomous, accountable public sector agencies can provide efficient and equitable service. For many countries, however, such levels of governance are not attainable in the short run, so that greater involvement of the private sector and NGOs will be crucial to the provision of accountable and efficient services.

To allow helpful change to occur, the government must concentrate on the things that it, and only it, can do. Its job is to define and enforce an appropriate legal, regulatory, and administrative framework. This includes tasks as fundamental and diverse as rewriting legislation so that water markets can come into existence, rewriting contract laws so that the private sector can participate with confidence, building a capacity for environmental and, where appropriate, economic regulation, developing financial mandates for utilities that encourage conservation, and setting and enforcing quality standards for equipment. The government must also create conditions under which others—the private sector, NGOs, communities, and consumers—can play their parts.

What might be accomplished

More than 1 billion people are still without access to safe water and 1.7 billion people are without access to adequate sanitation facilities. Elementary calculations show that an "unchanged practices" or "business-as-usual" scenario would lead to a rise in the number of people without service in the coming decades (the top curves in Figure 5.6). This is a result of rising unit costs, as well as unprecedented increases in population. If the shares of total investment allocated to sanitation (currently 0.6 percent of gross investment) and to water supply (currently 1.7 percent) were raised by, say, 50 and 30 percent, respectively, the numbers unserved might still rise, although not as much (the middle curves in the figure). Far more important (as shown by the bottom curves) is the combination of policy reforms and accelerated investment. By attracting financial, managerial, and skilled labor into the sector and by freeing enterprises to invest more and improve maintenance, this new approach, which is already being adopted in some countries, could bring about dramatic increases in access to sanitation and clean water within the next generation.

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