

SECTION I

DEFINING THE PROBLEM

This section defines and gives details of the relationships among water access and quality, diarrheal diseases, malnutrition, undernutrition and anemia, lack of adequate

sanitation, lack of adequate hygiene, environmental factors, and water and sanitation-related diseases.

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TACKLING THE WATER CRISIS: A CONTINUING NEED TO ADDRESS SPATIAL AND SOCIAL EQUITY

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1.1 INTRODUCTION

After decades of investment, an estimated 884 million of the world's poorest people remain with unreliable and unsafe water. Access to safe water is essential for the health, security, livelihood, and quality of life and is especially critical to women and girls, as they are more likely than men and boys to be burdened with collecting water for domestic use. Some of the trends in access to safe water globally look positive. With 87% of the world's population—nearly 5.9 billion people—using safe drinking water sources, the world is on schedule to meet the drinking water target of the Millennium Development Goals (MDGs) set for 2015 (Fig. 1.1). In China, 89% of the population of 1.3 billion has access to drinking water from improved sources, up 22% since 1990. In India, 88% of the population of 1.2 billion has access, an increase of 16% since 1990. Further, 3.8 billion people (57%) of the world's population currently get their drinking water from a piped connection that provides running water in their homes or compound. A number of spatial and social inequities, however, persist and need to be addressed. More than 8 out of 10 people without access to improved drinking water sources live in rural areas. Regionally, sub-Saharan Africa and Oceania are most behind in coverage. Just 60% of the population in sub-Saharan Africa and 50% of the population in Oceania is estimated to be using improved sources of drinking water. The poor also suffer disproportionately. A comparison of the richest and poorest population strata in sub-Saharan Africa shows that the richest 20% are two times more likely to use an improved drinking water source than the poorest 20%. Compounding the situation,

many of those counted as having access are left with water systems that will be short lived. For these systems to reach sustainability, more focused efforts must be made regarding who will maintain water systems and where the money and skills to do so will come from.

1.2 ACCESS TO IMPROVED WATER SUPPLIES

1.2.1 Background

Improvements in water supply, sanitation, and hygiene have greatly advanced the health of industrialized countries (1) in places where diarrhea, cholera, and typhoid were once the leading causes of childhood illness and death. Improved water supply and sanitation interventions provide a wide range of benefits—explicit and implicit. These include higher lifespan, reduced morbidity and mortality from various diseases, augmented agriculture and commerce, higher school attendance, lower health care costs, and less physical burden. The time-savings can allow women to engage in non-illness-related tasks, and provide more time for childcare, socialization, and education activities (2). Further, when water supplies are brought closer to homes, the savings in women's energy expenditure can result in a reduction of energy (food) intake. This savings may then be transferred to children's intake of food at no extra cost (3). The implicit benefits of an improved water supply include higher quality of life due to available supply of drinking water and increased potential for communities to engage in other improvements, once they have achieved improved access to a safe water supply.



FIGURE 1.1 Young girls collecting water (East Hararghe, Ethiopia). According to the 2005 Ethiopia DHS, only 8% of households report having water on their premises and more than half of the rural population reports taking more than 30 min for collecting drinking water. It was also noted that women and children shoulder the greatest burden for collecting water and spend a disproportionate amount of time hauling water over long distances.

Worldwide it is estimated that 884 million people lack access to an *improved water supply* (4), defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with fecal matter.¹ Under existing trends of coverage improvement, however, the target to halve the proportion of the world's population without access to an improved water supply, as set out in the Millennium Development Goals (MDG Target 10, Goal 7), is on track (see Fig. 1.2).

This lack of basic access to improved water supply results in significant impacts to health, because of water-related diseases, as well as lost productivity. Globally, annual deaths from diarrhea—linked to lack of access to water and sanitation infrastructure and poor hygiene—were estimated at 1.87 million (95% confidence interval, 1.56 million–2.19 million), reflecting an estimated 19% of total child deaths in 2004 (5). Nearly three-quarters of those deaths occurred in just 15 countries (Table 1.1), and deaths are highly regionalized (Fig. 1.3).

Improvement to water supply, in terms of quantity, reliability, and quality, is an essential part of a country's development; however, there are a number of obstacles that limit

¹ According to WHO/UNICEF, an "improved drinking water source" includes piped water into dwelling, plot, or yard; public tap/standpipe; tubewell/borehole; protected dug well; protected spring; and rainwater.

TABLE 1.1 Countries Accounting for Three-Quarters of Diarrheal Deaths, 2004 (5)

Country	Deaths Due to Diarrhea (Thousands)
India	535
Nigeria	175
Democratic Republic of the Congo	95
Ethiopia	86
Pakistan	77
China	74
Bangladesh	69
Afghanistan	65
Indonesia	39
Angola	34
Niger	33
Uganda	28
Myanmar	26
United Republic of Tanzania	25
Mali	24
Total of 15 countries	1384

successful improvement. Rapid population growth, degradation of the environment, the increase of poverty, inequality in the distribution of resources and the misappropriation of funds are some of the factors that have prevented water supply interventions from producing better results (6). Further, numerous studies have shown that resources and time are being spent in water supply interventions that do not take into account beneficiaries' needs, preferences, customs, beliefs, ways of thinking, and socioeconomic and political structures (i.e., the enabling environment).

1.2.2 Past Efforts to Improve Access to Safe Water

Development interventions began to flourish in the 1970s as disparities, in terms of quality of life and access to basic services between wealthy and poor countries, became evident. The original motivation for providing water and sanitation to the inhabitants of less developed countries was based upon the consideration that water and sanitation is a cornerstone to public health and a basic human right (7). As a human right, those services should, therefore, be financed by the government of an individual nation, but because governments of economically developing countries did not have the resources needed to provide basic services to their entire population, it was assumed that industrialized countries and international organizations should assist in the provision of these services (8). In fact, the approach taken for the design and implementation of most of these early projects did not typically consider the preferences of beneficiaries, as it was perceived that they did not have knowledge and ability to contribute. Facilities constructed soon fell into disrepair due to lack of operation and maintenance, resulting from deficiencies in organization, training, and sense of ownership by

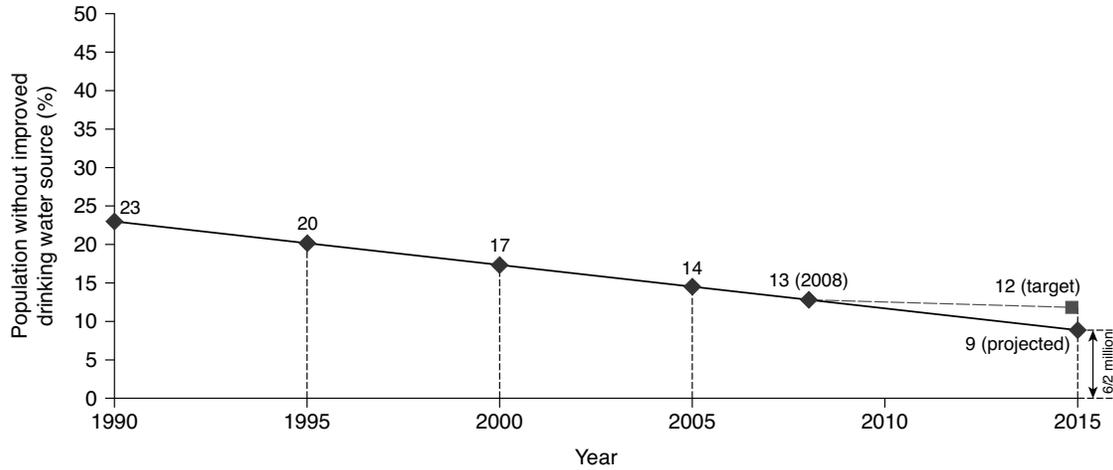


FIGURE 1.2 Based on current trends, the world is on track to meet the water target of the Millennium Development Goals.

beneficiaries. Soon after many water supply and sanitation interventions, communities often found themselves in the same conditions as they had previously known. The results were not promising, and it became evident that there was something missing in the planning.

During the International Drinking Water Supply and Sanitation Decade (1981–1990), the international community established as a common goal the provision of safe water supplies and adequate sanitation services to all the communities around the world. This meant that by 1990 every person worldwide should have his or her basic needs met. In 1981, it was estimated that 2.4 billion people would need to gain access to improved water supplies—a figure equivalent to connecting 660,000 people to a safe supply of water each day

for 10 years (9). Even though this goal was far from accomplished, an estimated 370,000 people, on average, received improved water supplies each day. Following the decade, and after two world conferences (New Delhi in 1990 and Dublin in 1992), the international community determined that water and sanitation could no longer be regarded simply as a right. After the Dublin conference there was a shift to the view of safe water as an economic good because it had an environmental and a productive value. It became clear that need was no longer a sufficient reason for the international community to provide water and sanitation to any community (7).

After the World Conference on Water and Sanitation held at The Hague, Netherlands, in March 2000, the international

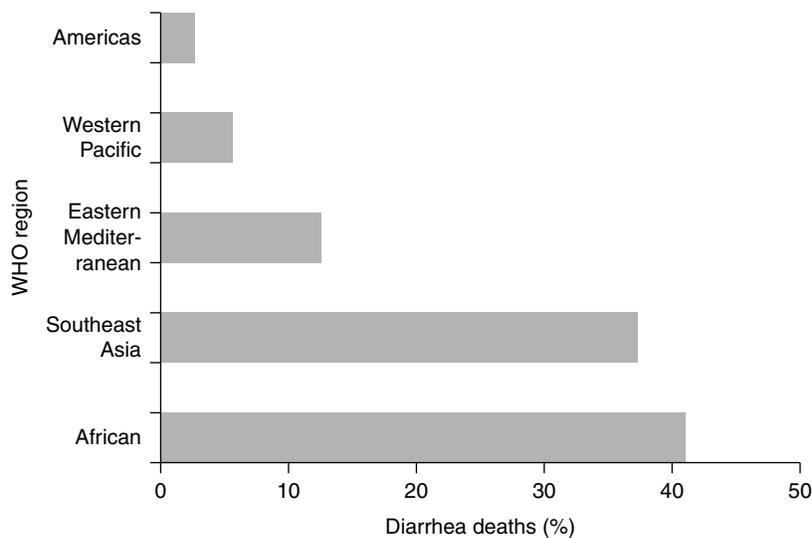


FIGURE 1.3 Distribution of deaths due to diarrhea in low- and middle-income countries in five WHO regions, 2004 (5).

community set a new common goal and published “Vision 21: Water for People.” Vision 21 proposed a world in which, by 2025, everybody would know the importance of hygiene and education and enjoy safe water and appropriate sanitation services. At the United Nations Summit in September 2000, 189 UN Member States adopted the Millennium Declaration, from which emerged the aforementioned Millennium Development Goals. Target 10 of MDG 7 is to “halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation (over 1990 estimates).” The MDGs have been a significant force of garnering donor support and government commitment to increasing water supply and sanitation. A very important aspect of Vision 21 and the MDGs, one that reflects concerns of the international community, is the recognition of the need for a new approach to water security. This new approach emphasizes “buy-in” before the implementation of a water project in any community and a stronger focus on ensuring that improvements made be sustained. Another particular aspect of Vision 21 is the ratification of water and sanitation as a basic human right. After the Water Decade, the international community indicated that water and sanitation could not be viewed as a basic right any longer, because the beneficiaries of the projects did not value the improvements made and facilities constructed when they were not required to contribute monetarily. In other words, people will not appreciate, continue to utilize, and preserve something to which they have not contributed. The World Conference, however, concluded that the lack of a sense of ownership and commitment to project improvements on the part of the beneficiaries was due to the inadequate and often neglected inclusion of beneficiaries’ preferences into project design and implementation. Further, it was noted that beneficiaries of water projects should be responsible for the costs of the operation and maintenance of the system but not for the costs of the water itself, based on the idea that every individual on earth has the right to obtain and consume enough water to guarantee his/her survival.

1.2.3 Impacts of Improved Water Supplies

There is a significant—and still growing—body of literature on the impacts associated with improved water supplies, in terms of increased quantity of water available and improved water quality. Most analyses have looked at health effects, especially the role of water supplies in preventing diarrheal disease. The quantity of water available to households is a critical component of what is meant by “improved water supply,” and it is essential for the hygiene and subsequent health of a population. When assessing health benefits due to water supply programs, it is important to understand the different interactions between water quality and water quantity. For many infectious diarrheal diseases, exposure–risk

TABLE 1.2 Numbers of People Who Received Improved Water Supplies (1981–2000)

Water Supply Category	Average Number of People Receiving Services per Day (1981–1990)	Average Number of People Receiving Services per Day (1991–2000)
Urban	100,000	130,000
Rural	270,000	90,000
Total	370,000	220,000

Source: See Ref. 9.

relationship is unclear. There remains debate regarding attributable risk and interactions of specific exposures within the fecal–oral route of disease (10). Exposure risks in children with persistent diarrhea, rather than in children with acute diarrhea, accounts for an important gap in our knowledge, because persistent diarrhea affects immune competency and increases subsequent susceptibility. Thus, it may be more important for future research to characterize exposure routes in children suffering from persistent diarrhea versus acute diarrhea (11).

Between 1980 and 2000, most studies of water quality assessed only the source of water and not the point at which users actually consumed the water (point of use). In a review of 67 studies to determine the health impact of water supplies, Esrey et al. (12) found that the median reduction in diarrheal morbidity from improvements in water availability to be 25% and the median reduction based on improvements to water quality at the source, not at the point of use, to be 16%, with a range of 0–90%. Combinations of water quality at the source and water quantity resulted in a 37% median reduction in diarrheal morbidity (see Table 1.2). In 1991, the analysis was updated, covering 144 studies and looking more carefully at their content and the rigor with which they were conducted. In the 1991 analysis, the conclusion drawn by viewing only studies deemed rigorous was that improvements in water quantity resulted in a median reduction of diarrheal morbidity of 30%, improvements to water quality at the source of 15%, and combinations of water quality at the source and water quantity resulted in a 17% median reduction in diarrheal morbidity. These reviews helped set the agenda for specific interventions that the global community would pursue. There was, however, a growing interest in assessing water quality at the point of use. In 2003, an analysis of 21 controlled field trials dealing with interventions designed to improve the microbiological water quality at the point of use showed a median reduction in endemic diarrheal disease of 42% compared to control groups (13). Nine studies used chlorine as a method of treating water, five used filtering, four used solar disinfection, and three used a combination of flocculation and disinfection. This study and subsequent studies resulted in donor investments for improving drinking

water quality at the point of use; a large number of economically developing countries now have point-of-use products that are being socially marketed.

In a more recent review of studies using experimental (randomized assignment) and quasiexperimental methods the impact of water, sanitation, and/or hygiene interventions on diarrhea morbidity among children in low- and middle-income countries was conducted (14). Sixty-five rigorous impact evaluations were identified for quantitative synthesis, covering 71 distinct interventions assessed on 130,000 children across 35 developing countries during the past three decades. These studies were evaluated for a range of factors, such as type of intervention, effect size and precision, internal validity, and external validity. The interventions were grouped into five categories: water supply improvements, water quality, sanitation, hygiene, and multiple interventions involving a combination of water and sanitation and/or hygiene. The results challenged the notion that interventions to improve water quality treatment at the point of use are necessarily the most efficacious and sustainable interventions for promoting reduction of diarrhea. The analysis suggests that while point-of-use water quality interventions appear to be highly effective, and generally more effective than water supply or improving water quality at the source, much of the evidence is from small trials conducted over short periods of time. The review indicated that point-of-use interventions conducted over longer periods of time demonstrated smaller effects as compliance rates fell. Interestingly, the study found that hygiene interventions, particularly the promotion of handwashing with soap, were effective in reducing diarrhea morbidity, even over longer periods of time.

Calculations of the cost-effectiveness of the interventions described above have shown point-of-use and hygiene interventions to be highly efficient for bringing about health improvements (15, 16). Estimates of cost-effectiveness from improved water supplies, in terms of the costs per disability-adjusted life year (DALY) averted, show that a community connection to a water source results in a cost aversion of 94 USD/DALY. This is less than half the figure for household water connection, but substantially higher than estimates for point-of-use water quality interventions, which are estimated at 53 USD/DALY averted, using chlorination (16). Estimates from improved hygiene and sanitation suggest that hygiene promotion is most cost effective, at 3 USD/DALY averted, followed by sanitation promotion, at 11 USD/DALY (15).

Water supply interventions have many benefits. For example, better water supplies enable improved hygiene practices, such as handwashing and better home hygiene, and there are likely considerable spillover effects in terms of environmental health benefits. In Lesotho, use of smaller quantities of water was related with higher rates of *Giardia lamblia* infection (17). In Taiwan, a reduction of 45% in rates of trachoma was noted when the water supply was attached to

the home, compared to a water supply that was 500 or more meters away (18). Time-savings associated with water supply interventions are also significant. In rural Nigeria, Blum et al. (19) estimated that the installation of water systems reduced collection time from 6 h to 45 min per household per day during the dry season, mainly benefiting adolescent girls and young women. In addition, Wang et al. (20) estimated a time-savings of 20 min per household per day from a village water supply improvement in China. In the Philippines, water quantity was strongly associated with nutritional status. Children in households that averaged less than 6 L per capita per day were significantly more malnourished than children in households that averaged 6–20 L or more than 20 L per capita per day (21). A study of Pakistan households showed that increased water quantity available at the household level was associated with reduced stunted growth in children (22).

It has also been observed that reducing water collection time can positively affect time spent on children's hygiene, food preparation, and feeding children (23). For households without a source of drinking water in their compound, it is usually women who go to the source to collect drinking water. In a recent analysis of more than 40 developing countries, women collected water for almost two-thirds of homes, versus a quarter of households where men collected water. In 12% of homes, children were responsible for collecting water, and girls under 15 years of age were twice as likely to collect water as boys of the same age category (24, 25).

The public health gains stemming from access to increased quantities of water typically occur in steps. The first step relates to overcoming a lack of basic access, where distance, time, and costs involved in water collection combine to result in volume use inadequate to support basic personal hygiene and that may be only marginally adequate for human consumption (Table 1.3). Significant health gains occur largely when water is available at the household level. Other benefits derived from the second step in improving access include increased time available for other purposes. Yet, availability of new or improved water supplies does not always translate directly into a significant increase in use. In East Africa, after new water supplies were placed in proximity to households, no increases in the amount of water used resulted if the original water source was less than 1 km from the home (26).

Incremental improvements can occur as one moves up the continuum of water supply service. However, providing a basic level of access is the priority for most water and health agencies. In fact, progress toward universal achievement of this level of service remains a focus of international policy initiatives as highlighted by the MDGs and the WHO/UNICEF Joint Monitoring Program. The most important health benefits are likely to be obtained when focus is placed on resources to ensure that all households have access to

TABLE 1.3 Level of Water Supply Service and Related Potential Hygiene and Health Effects

Service Level	Distance/Time for Water Collection	Quantity Collected	Hygiene-Related Issues	Health Risk
No access	>1 km or >30 min total collection time	Very low—typically less than 5 L/person/day	Hygiene not assured and consumption needs may be at risk	Very high
Basic access	Between 100 m and 1 km (5–30 min collection time)	Low—average is typically less than 20 L/person/day	Not all hygiene requirements may be met	Medium
Intermediate access	On-site (e.g., single tap in compound or in house)	Medium—average is typically 50 L/person/day	Most basic hygiene and consumption needs met	Low
Optimal access	Water is piped into the home through multiple taps	Varies significantly, but typically above 100 L/person/day	All uses can be met	Very low

Source: See Ref. 26.

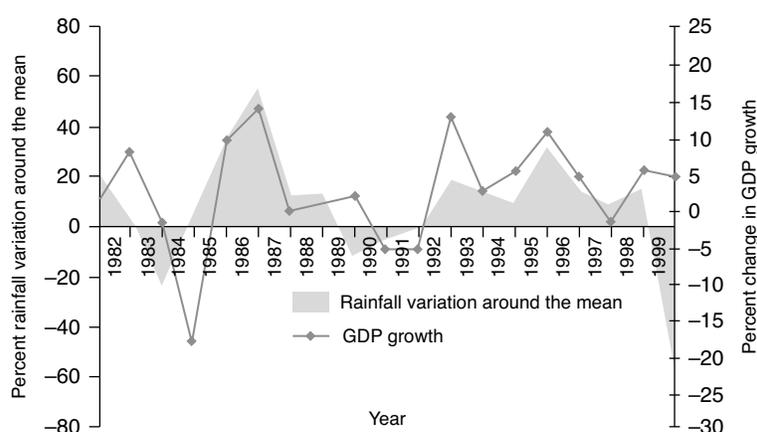


FIGURE 1.4 Rainfall variation around the mean and GDP growth in Ethiopia. Ethiopia, suffers from highly variable rainfall, both temporally and spatially, and experiences regular droughts that devastate portions of the country. It is estimated that hydrological variability currently costs the Ethiopian economy, which relies on rainfed subsistence agriculture, over one-third of its growth potential (29).

improved water sources and, in some circumstances, in directly upgrading to access at household level (27).

Water use among the poor can be an essential part of livelihood coping strategies. In practice, the use of water for domestic purposes cannot easily be distinguished from productive use, particularly among very poor communities. When communities design their own water systems, they invariably plan for multiple use water systems, and this is especially the case if the livelihoods of households depend on livestock (28). In multiple use approach interventions, it is critical that planners (i) work with the community to assess the range of water needs in collaboration with end users; (ii) examine water sources available; and (iii) match water supplies to needs based on the quantity, quality, and reliability required for various purposes. There may also be important health and social gains from ensuring adequate quality of service to support small-scale productive use, especially when this involves food production (Fig. 1.4).

Access to water used for small-scale productive activity in such areas is therefore important as part of economic growth and may deliver significant indirect health benefits as a result (27). Although water scarcity is a significant and growing problem, it should be highlighted that as a continent, Africa's water supplies are more than adequate to provide fresh drinking water for the entire population and are sufficient for their economic needs. Only 5.5% of renewable water resources are currently withdrawn, while 340 million people on the continent still lack access to safe drinking water (30). Although water resources are available, most lack the economic resources to capture and use them. In industrialized countries, 70–90% of annual renewable water resources are withdrawn, while only 3.8% of Africa's surface and groundwater is harnessed (30).

The water-related indicator used for target 10 of MDG 7 is "sustainable access to an improved water source." The technologies considered "improved," however, often do not

consistently result in high-quality water. There are certain sources of water that the public health community condemns as risky (e.g., unprotected wells) and others they deem safe (e.g., protected wells). Comparing water quality from protected and unprotected supplies across countries, however, has demonstrated that in many cases protected supplies often provide lower water quality than do protected wells in other countries. This suggests that certain practices—not certain types of water sources—may be more important in improving water quality (31). As mentioned above, it is now generally accepted that providing safe water at the source does not imply that water is safe at the point of use. A study by Gundry et al. found that about 40% of water samples from microbiologically safe sources of water were contaminated at the point of consumption. Household water treatment at the point of use for most communities is an important intervention, regardless of whether the water comes from an improved source.

The situation for urban water utilities is not much better. This is also the case for many urban communities that have access to a piped supply. It is estimated that nearly one in five water utility systems in Africa, Asia, and Latin America fail to use water disinfectants (32). Reasons for this failure include cost, operations, and maintenance of equipment and concern about disinfection by-products. Water systems in many of these regions are characterized by intermittent water flows, which can affect the quality of the water due to the negative pressure in the pipes. Thus, there is no guarantee that water is clean, even when derived from a piped system.

Of the people who report treating their water, roughly 1.1 billion people say they typically boil their water at home before drinking it—four times more than the number of people who report chlorinating or filtering their drinking water. Boiling is currently one of the most accessible means for water treatment to most populations, and has been shown effective (33). However, in the absence of safe storage, water that is boiled is immediately vulnerable to recontamination; especially when poor, the environment is unhygienic. Further, this mode of treatment can have serious side effects, such as indoor air pollution and depletion of environmental resources if biofuels (e.g., wood) are used for boiling.

1.2.4 Naturally Occurring and Anthropogenic Water Pollution

In addition to microbiological contamination of water—the emphasis of this chapter—naturally occurring and anthropogenic sources of chemical pollution can pose serious human health risks. Although no published estimates are available on the global burden of disease resulting from chemically polluted water (34), a number of countries are increasingly facing water pollution challenges due to chemicals, especially where the industrial sector is developing. In addition to anthropogenic pollutants, groundwater

commonly contains naturally occurring toxic chemicals, including arsenic and fluoride, which dissolve into the water from soil or rock layers. The most extensive problem of this category is arsenic contamination of groundwater, which has been observed in Argentina, Bangladesh, Chile, China, India, Mexico, Nepal, Taiwan, and parts of eastern Europe and the United States (35). Arsenic in Bangladesh's groundwater was first highlighted in 1993 and was a result of international agencies promoting protected wells in an effort to eliminate diarrheal diseases caused by fecally contaminated surface waters. Millions of shallow wells were drilled into the Ganges delta alluvium in Bangladesh, and estimates indicate that approximately 40 million people were put at risk of arsenic poisoning-related diseases because of high arsenic levels in the groundwater (36). Fluoride is another naturally occurring pollutant that causes health effects, and exposure to high levels in drinking water can detrimentally affect bone development and in some cases can cause crippling skeletal fluorosis. The burden of disease from chemical pollution in specific areas can be large. There are a number of events that have underscored the high levels of disease burden from chemical pollution, including methylmercury poisoning, chronic cadmium poisoning, and diseases of nitrate exposure, as well as lead exposure (34).

1.2.5 Resources Needed

The water supply component of the MDGs, while formally on track, is not a guaranteed success, especially if efforts are not sustained. Moreover, uneven progress exists between rural and urban populations, and the lower baseline water supply coverage in rural compared to urban areas is significant. There is a wide range of estimates for meeting the water supply target of the MDGs. Hutton and Bartram (37) estimated total spending, excluding project costs, required in developing countries to meet the water component of the MDG target to be 42 billion USD (Fig. 1.5). This translates to 8 USD per capita spending for water supply.

1.2.6 Spatial and Social Inequities in Access

“Equity” relates closely to the idea of fairness and that all members of a society have equal rights. Water supply interventions, for example, are considered equitable if they affect all parts of society equally. For example, perfect equity in intracountry budgets would be reflected in a situation where every citizen is allocated an equal amount of the investment, regardless of the part of the country where the citizen lives. Equal levels of access to clean and safe water would be an equitable outcome (38). Equity is concerned with comparing different parts of society, which is complicated by the many ways that society can be grouped. For example, geography, social or health status, gender, and ethnicity can be used for comparisons. Two categories of

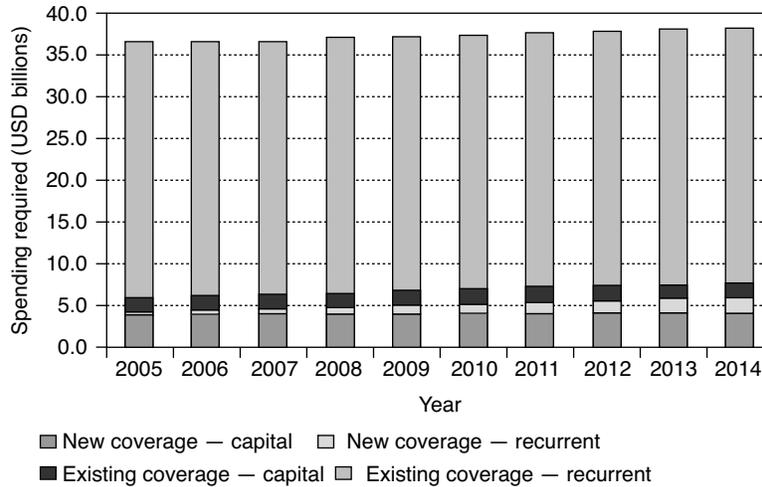


FIGURE 1.5 Spending required from 2005 until 2015 to meet water supply component of MDG target 10, excluding project costs (38).

disparities are useful for thinking about equity in water supply and sanitation (38). The first is spatial equity and includes geography, where groups are defined by where they live, such as rural versus urban, or the partitioning of a country into administrative boundaries. Social equity is concerned with groups defined by attributes linked to their identity, which traverse spatial boundaries. Particularly vulnerable groups may include women, people living with HIV/AIDS, the elderly, the disabled, orphans, and widows. The poor are also an important group that is large and critically important, but often difficult to define (38). There is obviously overlap between social and spatial inequities. For example, a large percentage of the urban population without access is also poor, and a larger proportion of the rural population who spend time collecting water are women. Additionally, equitable investments do not necessarily equate to equitable outcomes, and costs may vary according to a number of factors. For water supplies, population density, distance from places where parts are available, or the geology can affect costs (38). A number of spatial and social inequities persist and need to be addressed, and there are many challenges facing efforts to improve equitable access. Population growth is a major barrier to current efforts in the water sector to reduce the number of people living without access to safe water. In the last 40 years the population of the world has gone from 3,659 million in 1970 to roughly 6,800 million, people in 2010. In 1980, the United Nations estimated that 1,800 million people lacked access to safe water supplies; today, there are still 884 million people without access to safe water.

Spatially, more than 8 out of 10 people without access to improved drinking water sources live in rural areas (Fig. 1.6). Regionally, sub-Saharan Africa and Oceania are regions most behind in coverage (Fig. 1.7). Just 60% of the

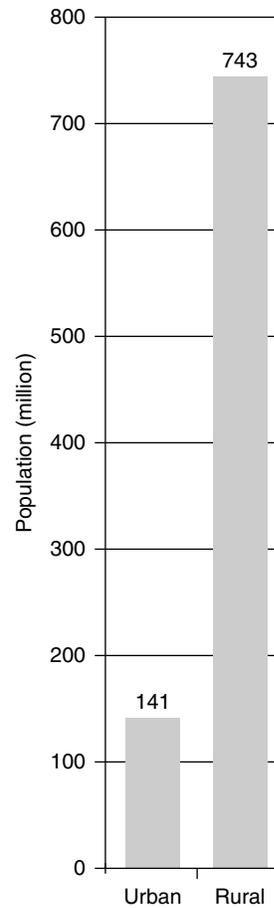


FIGURE 1.6 Number of people living in urban or rural areas without access to an improved water supply, 2008 (24).



FIGURE 1.7 Countries represented by the percentage of population using improved drinking water supplies. (See insert for color representation of this figure.)

population in sub-Saharan Africa and 50% of the population in Oceania is estimated to use improved sources of drinking water. Coverage in 19 countries in sub-Saharan Africa increased by nearly 10% between 1990 and 2006; however, absolute numbers of unserved went up by 37 million. Compounding the situation, many of those counted as having access have nonfunctioning water systems. Improved access

to rural water supply remains almost totally donor driven since most “improved options” are out of reach for users to construct at their own expense. Subsequently, improved access to rural water supply in sub-Saharan Africa has been progressing at less than 0.5% each year; the required rate to achieve the MDGs is 2.8% (31). In rural parts of Africa, for more than a quarter of the population in a variety of sub-Saharan African countries, a single trip to collect water takes longer than 30 min (Fig. 1.8) (24).

Urban areas are growing at such a pace that many municipal water facilities are unable to keep up with the increasing population (Fig. 1.9). Indeed, the provision of water to rapidly growing cities and towns continues to be an

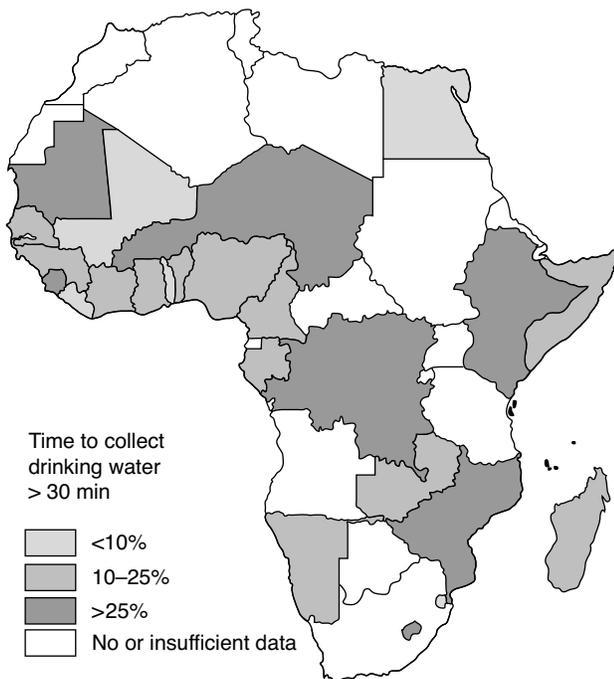


FIGURE 1.8 Percentage of population that takes more than 30 min to collect water during one trip (29).

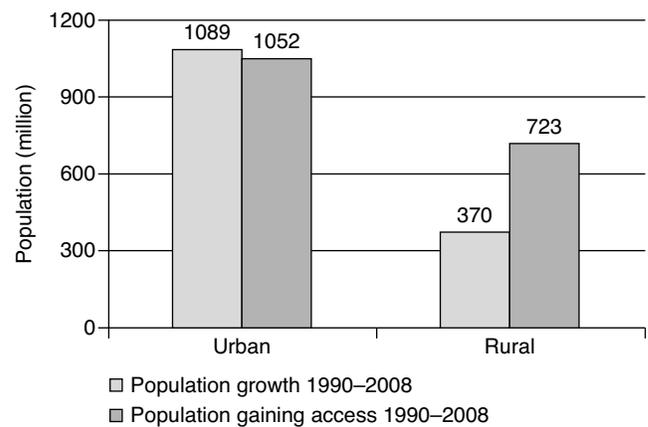


FIGURE 1.9 Increase in population growth in urban and rural sectors compared to the increase in the population achieving improved water supply coverage worldwide, between 1990 and 2008 (24).

overwhelming challenge facing municipal governments, and although urbanization can offer economies of scale for water supply systems, the growth in slum and squatter settlements makes the situation particularly difficult.

Even when a piped supply exists, typically in urban areas, it is not always reliable. Less than 10% of people in many South Asian cities receive a 24 h piped water supply. Problems arise because many municipal pipelines reach wealthiest clients first, even though they are built with aid from governments and international institutions with the goal of making water more accessible to the poor. Thus, a significant number of urban populations without utility connections must rely on alternatives, such as service from small-scale water providers (SSWPs). Currently SSWPs are most prevalent in Southeast Asia, where a quarter of households in Cebu (Philippines), Ho Chi Minh City, Jakarta, and Manila may use these services (39).

In urban areas of the developing world, governments have favored large water utilities. Unfortunately, existing tariffs and management structures have caused these systems to fail to provide piped water coverage to entire populations. Connection fees are frequently too high or total available water is insufficient to support an urban area. Many utilities choose not to equip poor neighborhoods because of the high percentage of unpaid bills, fraudulent consumption, low levels of individual consumption, and because network maintenance costs are high. Additionally, people that occupy land illegally may also be excluded from public services. In cases where water companies are allowed or mandated to serve poor households, water is not always affordable or payment schedules may not be feasible. Thus, many people are forced to illegally draw their water from “spaghetti networks” that connect to the border of a municipal grid system or to purchase expensive, and commonly contaminated, water from SSWPs.

Of further importance are the inequalities surrounding the cost of water for the urban poor. While an SSWP generally offers a more flexible payment schedule, its water is usually pricier and consumes a large portion of household expenses. It has been cited that in some cities the poor pay huge premiums to water vendors over the standard water price of those hooked up to municipal systems: 60 times more in Jakarta, Indonesia; 83 times more in Karachi, Pakistan; and 100 times more in both Port-au-Prince, Haiti and Nouakchott, Mauritania.

Additionally, because water is of unknown quality, the urban poor may pay even more in order to purify it. The United Nations Development Program estimated in 1992 that households in Jakarta, Indonesia, spent a combined total of up to 50 million USD/year to boil drinking water, an amount equivalent to 1% of the city’s gross domestic product. In Bangladesh, for example, boiling water uses nearly 11% of the family income among the lowest earning 25% of all households.

Socially, the poor suffer disproportionately. A comparison of the richest and poorest population strata in sub-Saharan Africa shows that the richest 20% are two times more likely to use an improved drinking water source than the poorest 20%.

In most developing countries, the provision of water and sanitation are women’s responsibility (24). Often, rural women must walk long distances to provide their families with water for drinking, cooking, domestic hygiene, and personal hygiene. Interventions to increase access often diminish the time that women spend gathering water and have provided participants with opportunities to learn new skills and spend more time cultivating crops in the time previously used for water collection. These classes of changes can have positive impacts on the local economy, especially when income-earning involves tasks such as laundry work and other types of activities that use water. By allowing for less time for water collection, new opportunities enable women to effectively contribute to the communities’ economic growth (40).

1.2.7 Sustainability

Sustainability of water supplies is especially difficult in rural areas because of the lack of support through monitoring systems, training, human resource back-up support, and availability of spare parts and services. Throughout rural sub-Saharan Africa, thousands of water systems are developed every year, such as boreholes equipped with motorized or hand/foot pumps. These systems often fall into disrepair shortly after installation. It is estimated that 50,000 water supply systems are not functioning across Africa—a number representing an investment of nearly 300 million USD. This problem occurs for one reason: lack of operations and maintenance; operations and maintenance, however, is a multifaceted feature of any water system.

Many of the negative results in past interventions were linked to (i) lack of community participation; (ii) utilization of inappropriate technologies; (iii) lack of a sense of ownership on the part of the beneficiaries; (iv) failure to provide the institutional support required for the project; and (v) dissatisfaction of the community with project outcomes (41). In order to design a more effective and responsive approach for the provision of water and sanitation, development organizations and donor agencies are utilizing a series of participatory methodologies and techniques that focus on getting intended users actively involved in all stages of the project cycle. Fundamentally, community participation increases the probability of success and the sustainability of the projects implemented.

Participatory approaches evolved from disciplines such as anthropology, sociology, research on farming systems, and others, and have tried to fill in the existing gap between technology (hardware) and operations and maintenance

TABLE 1.4 Seven Characteristics of the Service Delivery Approach

1. Invests on the basis of need for the entire district, as well as investing in support services and frameworks
2. Addresses financing needs for full life cycle costs from the outset to ensure asset replacement
3. Operates on a continuous time frame, not project timeline, for service delivery
4. Allows flexibility for water systems so that different management and technical approaches can be used
5. Works to achieve full coverage within established geographic/administrative boundaries
6. Seeks to coordinate all actors to work collectively under an overarching strategy, including commonly agreed-upon model(s), depending on the service provided
7. Works with most appropriate management model for service delivery

Source: See Ref. 29.

(software). These approaches were developed based upon the flaws identified and the lessons learned while implementing the supply-driven approach for the provision of safe water and sanitation services. The underlying principle was and continues to be the involvement of all stakeholders, especially the main users of the system, in all the phases of water and sanitation programs or projects, with the intention of improving their sustainability and probability of success. The primary objective was to be more responsive to the needs and preferences of users and more appropriate to given local conditions and the environment. Another important characteristic of these participatory methodologies was the significant change in the role that users of the system played during the design, implementation, construction, operation, and maintenance of the systems. Participatory methodologies were developed to facilitate the process of empowerment and capacity-building of the communities benefiting from development interventions (42).

Community participation can bring about numerous benefits to development interventions, but such benefits must be weighed against the time and costs related to their implementation. For participation and commitment on the part of the community to be effective, financial and human resources must exist at the beginning of the process; in this way, planners may ensure success (43). It is important to note that there is no one approach toward community participation that works in all situations. The approaches utilized in the water sector have to be flexible enough to incorporate site-specific information about environmental, social, and cultural factors; in addition, stakeholders' needs and priorities into the design and implementation of water and sanitation projects must be accounted for (43).

One of the most commonly used models for developing rural water interventions involves village-level coordination and the development of a system for cost recovery for operations and maintenance. Typically, a community bank account is opened and a community member is appointed to collect the fees. The selection of the technology and personnel who have the skills to operate and maintain it are also part of the operations and maintenance system in place. Other models have been developed and experimented with and include public and private sector arrangements that aim to provide support to community systems following construction.

The community management model has brought many benefits; however, it has not always resulted in sustainable water supply at scale. It is becoming clearer that communities often cannot manage the variety of tasks that arise after the construction of water systems, such as repairs, accounting, conflict resolution, legal issues, and system replacement. A new model, the service delivery approach, was developed for improving rural water services and aims to better incorporate enabling environment factors with the aim of increasing sustainability and scale. The approach considers the whole life cycle of service, from design, day-to-day operations, and maintenance to eventual replacement (Table 1.4).

For millions of rural people, the top half of Fig. 1.10 represents a standard water supply intervention. Following construction of a new system users have access to an

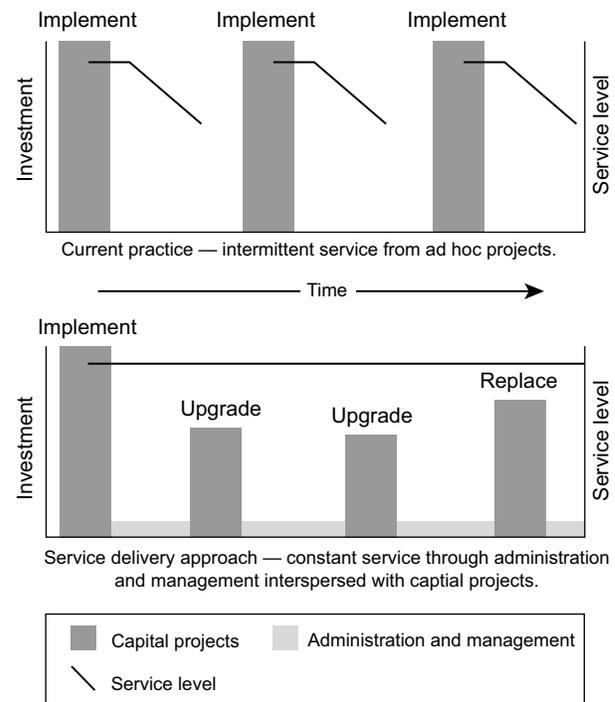


FIGURE 1.10 Current model of rural water supply interventions (top half) versus the service delivery approach (bottom half) that provides for constant service through ongoing support interspersed with capital projects (29).

improved source, but due to lack of follow-up support, the system quickly deteriorates until it is nonfunctional. In the service delivery approach, once water supply access is improved, it is maintained through a proper understanding of the full life cycle costs and institutional support needs (29).

1.2.8 Final Remarks

There is evidence that the global community is making progress toward providing all people worldwide access to a safe and reliable water supply. In 2000, for example, the number of people without a safe water supply was nearly 1.1 billion—the estimate in 2010 is 884 million. This gain is considerable given that the population of less economically developed countries went up by nearly 700 million during the decade. A number of spatial and social inequities, however, persist and certain challenges to improve equitable access are growing. Population growth—among urban areas in particular—is a major obstacle to current efforts to reduce the number of people living without access to safe water. If we are to continue moving forward, all sectors of society will need to more fully engage; these include researchers, national and local governments, NGOs, the private sector, international and bilateral agencies, and communities.

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