Water
and
Ethics

HUMAN HEALTH AND SANITATION

Monica Porto

Water

and

Ethics

HUMAN HEALTH AND SANITATION

Monica Porto

UNESCO International
Hydrological Programme

World Commission on the Ethics of
Scientific Knowledge and Technology

The authors are responsible for the choice and the presentation of the facts contained in this book and for the opinions expressed therein, which are not necessarily those of UNESCO and do not commit the Organization. The designations employed and the presentation of material throughout this publication do not imply the expression of any opinion whatsoever on the part of UNESCO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Preface

This essay is one of a series on Water and Ethics published under the International Hydrological Programme of UNESCO. A Working Group on the Use of Fresh Water Resources was established under that programme in 1998. Preliminary drafts on fourteen aspects of this topic were prepared under the guidance of this Working Group.

An extended executive summary was prepared by J. Delli Priscoli and M. R. Llamas and was presented to the first session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) held in Oslo in April 1999. At the latter meeting, COMEST established a sub-commission on the Ethics of Fresh Water under the Chairmanship of Lord Selborne. The first meeting of this sub-commission was held at Aswan in October 1999. A 50-page survey by Lord Selborne on the Ethics of Fresh Water, based on the above meetings and documents, was published by UNESCO in November 2000.

Since then, the original draft working papers have been revised under the editorship of James Dooge and published on CD ROM as an input to the Third World Water Forum held in Kyoto in March 1993. These are now being published in printed form as the first fourteen titles in a series of Water and Ethics

These essays are written from the point of view of experts on different aspects of the occurrence and use of fresh water who are interested in the ethical aspects of this important subject. They do not purport to be authorative discussions of the basic ethical principles involved. Rather, they aim at providing a context for a wide-ranging dialogue on these issues between experts in diverse disciplines from the natural sciences and the social sciences.

James Dooge
John Selborne

This particular essay in the series discusses the close links between water and health and the ethical problems arising from this connection. It explores the interaction of poverty, sanitation and health and the recent attempts at intergovernmental level to make real progress towards its solution.

Monica Porto is engaged in teaching and research in Sanitary Engineering at the Technical University of Sao Paolo in Brazil.

Contents

1. Introduction

'Water contributes much to health'   Hippocrates

The *World Health Report 1998* (WHO, 1998*b*) begins

> ... the twenty-first century offers a bright vision of better health for all. It holds the prospect not merely of longer life, but superior quality of life, with less disability and disease ....

Safe water, supplied both in enough quantity and adequate quality, is certainly one of the main requirements to achieve such optimistic view. It continues,

> ... the war against ill health ... will have to be fought simultaneously on two main fronts: infectious diseases and chronic, noncommunicable diseases....

An important segment of the infectious diseases referred to are water-related. In 1997, 33% of all deaths were due to infectious and parasitic diseases. About 1.7 million deaths a year worldwide are attributed to unsafe water, sanitation and hygiene, mainly through infectious diarrhea. Nine out of ten such deaths are in children, and virtually all of the deaths are in developing countries (WHO, 2002). By 2025 there were still be 5 million deaths among children under 5 years of age and 97% of them will occur in developing countries, most of them due to infectious diseases combined with malnutrition (WHO, 1998*b*).

Clean water is life. Contaminated water is death. Human health depends on the provision of safe, adequate, accessible and reliable drinking water supplies (McJunkin, 1983). Human populations were acquainted with the concept of relating clean water to health for a long time, even before the relationship was fully understood towards the end of the nineteenth century. Several ancient religious codes held rules of hygienic practices, which remain appropriate today. Human populations were also acquainted with the practice of using the water only once and then discarding it. If the adjacent water supplies became inappropriate to use it directly, it was always possible to collect water in another nearby clean source. The reason for construction of the first Roman Aqueduct in 313 BC was not only that the nearby springs were insufficient, but also because the ground disposal of residues for generations had polluted those springs beyond the tolerance appropriate to the aesthetics characteristics of the water (McGauhey, 1968).

With the tremendous growth of the human populations during the twentieth century, the provision of safe and clean water, as well as the maintenance of sanitation systems have become more difficult to achieve. Sanitation can reduce the incidence of infectious diseases by 20% to 80% by inhibiting disease generation and interrupting disease transmission (WHO, 1998*a*). From 1990 to 1994, approximately 800 million people gained access to safe water. Due to the population growth, however, the number of people unserved decreased only from 1,600 million to 1,100 million. During the same period the number of people without sanitation increased by 300 million. In 1994 they were 2,900 million and it is projected to increase to 3,300 million by the year 2000 (WHO, 1999). This vast unserved population lives mostly in developing countries. These were the results after a global effort promoted by the United Nations with the International Water Supply and Sanitation Decade (1981–1990), inaugurated on November 10, 1980. The goal was to achieve world-wide availability and use of readily accessible, safe, reliable and adequate community water supplies and sanitation by the year 1990. During the decade, significant improvements were made, as the population served with safe drinking water supply increased by 240% globally and in rural areas this number increased by 150%. On the other hand, the percentage of urban population with sanitation increased only from 69% to 72% (Nash, 1993). The goal was not met. Rapid population growth and difficult economic situations were insurmountable obstacles to developing countries.

The scenario is also aggravated by the fact that in 1955, 68% of the global population lived in rural areas and 32% in urban areas. In 1995 it had changed to 55% rural and 45% urban. By 2025, it will be 40% rural and 60% urban. In developing countries the rate of investments needed to provide water supply and sanitation to urban areas falls behind the urban growth. Within cities, mortality rates are higher in low-income settlements due to poor housing, high population density and lack of basic services. In rural areas there are also severe water and sanitation deficiencies, and the lack of water availability is a major cause of migration from dry, poor rural areas to the poor fringes of the big cities.

Human health is an essential component of sustainable development. Among the indicators selected at the UN Conference on Basic Social Services for All in 1997 was the percentage of population with access to safe water and sanitation. (UNDP Homepage, http://www.undp.org). Such a goal of providing access to safe drinking water in sufficient quantities and proper sanitation for all is critical for developing countries but other related issues are also of great concern for developed countries. The risk of toxic chemicals and metals in water still seem insignificant by comparison with the health hazards of viral and bacterial contamination, but the increasing magnitude of chemical pollution is leading towards an even more critical problem in the future, being one involving more complicated technical matters.

If there is consensus on the existence of an ethical principle relating water to human rights and the needs to sustain life, as cited in Young et al. (1994): '...needs are no longer measured in consumption per capita per day, but in terms of health and welfare of human populations...', then a great effort is required to fully implement it. Revision of consumption patterns, introduction of new methods to evaluate the financial efficiency of water projects, introduction of simpler and/or cleaner technologies, fostering public participation, dissemination of information and education, are all concepts to be put to work together to achieve the goal of universal access to safe water and adequate sanitation.

2.   How does water affect health?

Water intake is essential for survival. An adult male will need a daily intake of 2 to 2.5 litres on the average to guarantee the equilibrium of his physiological functions (McJunkin, 1983). Human body regulates temperature through evaporation of sweat from skin. Therefore, water intake varies with body weight, air temperature and humidity and activity. The balance between water intake and water losses must be maintained. Failing to supply water to maintain it will cause dehydration with consequences on the electrolytic equilibrium and subsequent failure of several organs like kidney and heart. Humans may feel thirst after a fluid loss of only 1% of bodily fluid and be in danger of death when fluid loss nears 10% (Gleick, 1996).

The principal pathway for the transmission of water-related diseases is through the contamination of drinking water supplies. Since the beginning of the nineteenth century there were indications of the existence of such path. The first slow sand filter was installed at Paisley in Scotland in 1804. In the United States of America, the first slow sand filter was installed in Richmond, VA, in 1832 (ASCE, 1982). However, it was only with the Broad Street episode in 1854 that the path was firmly established. The classical epidemiological study by Dr. John Snow related an outbreak of cholera in London with the use of a particular pump that supplied St. James Parish (McJunkin, 1983). The first cholera pandemic had spread from South Asia to the Americas in 1817 (Nash, 1993). A clear understanding of the water pathway would only be confirmed with studies by Pasteur in 1857 and Koch in 1870 (ASCE. 1982). Coliform bacteria as a drinking water standard was introduced in 1914 by the United States Department of Treasury (AWWA, 1990).

Safe drinking water means that it will cause no damage to human health. It means that it is free from organisms capable of causing diseases, and also from other substances that potentially can induce physiological damages. Drinking water must be aesthetically acceptable: no color, without odor and insipid. All these conditions met,

the water is considered potable and they form what is called Drinking Water Standards. The concept of safe water is becoming more and more difficult to establish. In 1925, drinking water standards in United States of America were established for physical (aesthetic) conditions, bacteriological and 4 chemical constituents (lead, copper, zinc, excessive soluble material) (Cotruvo and Vogt, 1990). In 1980, the Directive established by the European Community set 66 standards; organoleptic (4); physicochemical (15); substances undesirable in excessive amounts (24); toxic substances (13); microbiological (6); and minimum concentration for softened water (4) (Gray, 1994). In 1993, USEPA had established more than 130 drinking water standards, the major part related to maximum concentration of toxic chemical compounds. More important, even with the development of new drinking water standards, the health risks due to chemical compounds is greater today than it was in 1925. One of the pioneer alerts to the chemical contamination of drinking water supplies appeared in Rachel Carlson's classical book, *Silent Spring* (1962):

> Ever since chemists began to manufacture substances that do not occur naturally, the problems of water purification have become complex and the danger to the users of water has increased. As we have seen, the production of these synthetic chemicals in large volume began in the 1940's. It has now reached such proportions that an appalling deluge of chemical pollution is daily poured into the nation's waterways.

A study on chemical contamination of the water published by the National Academy of Sciences in the United States in 1980 alerted that only 10% in mass of the total amount of pollutants found in water are known and only some of them have safe doses and consequences completely understood (Hespanhol, 1999).

Water-related diseases can be divided in five categories: waterborne-microbiological diseases, water hygiene diseases, water contact diseases, water vector habitat diseases and waterborne-chemical diseases (McJunkin, 1983). The basis of this classification is described below. Table 2.1 shows this classification and the correspondent preventive strategy.

Waterborne – Microbiological diseases

      Diseases ransmitted through the ingestion of contaminated water in which pathogens, i.e., a disease-producing agent occur. Sources of drinking water are contaminated by human excreta from someone who is either ill or is a 'carrier'.

Water - Hygiene diseases

      Diseases related to poor hygienic habits and sanitation usually due to insufficient quantities of water for hand washing, bathing, laundering, and cleaning of kitchen utensils. Includes those of skin and eyes. It also includes most of the fecal-oral transmission diseases – with the same pathogenic agents as the

waterborne-microbiological diseases, usually transmitted by food and hand-to-mouth contact. It is very important to stress that the demand to be supplied to guarantee a healthy living not only refers to the amount needed for ingestion but also for personal and for household hygiene. Potable water is necessary to both uses.

Water-contact diseases

Skin contact with the pathogen in the water is the pathway for those diseases. The most important is schistosomiasis and it currently infects more than 200 million people in 74 developing countries (WHO, 1999). Leptospirosis is the next most important of the contact diseases and the pathogens are transmitted through skin when immersed in water contaminated with the urine of infected rats.

Water habitat vector-borne diseases

These diseases form a slightly different class because they are not transmitted directly by water but by pathogens associated with animal vectors living all or part of their lives in water. Malaria is unquestionably the most important of this class of diseases. Over 40% of the world population lives in areas with malaria risk and the incidence of the disease is in the range 300–500 million clinical cases annually. Some 1.5 to 2,7 million people die of malaria each year, and approximately one million deaths are of children under 5 years of age (WHO, 1999). Also transmitted by mosquitoes, the incidence of yellow fever is declining due to immunization but the incidence of dengue has increased due to urbanization growth.

Waterborne chemical diseases

These diseases affect both developed and developing countries. A variety of health effects are produced by chemicals in the environment (AWWA, 1990):

- toxic, causing a deleterious response in a biological system, depending on the dose and exposure;
- neurotoxic, destroying nerve tissue;
- carcinogenic, causing uncontrolled growth of aberrant cells;
- mutagenic, altering inheritable genetic characteristics;
- teratogenic, causing nonhereditary birth defects.

Nitrates in drinking water cause two adverse health effects: they induce methemoglobinemia in infants, when anoxia and death can occur, and the potential formation of carcinogenic nitrosamines. Arsenic and benzene are examples of human carcinogens. The relative high toxicity of so many of these compounds, our relative ignorance on their health effects, their possible synergistic effects and their chronic and cumulative nature, all together put the chemical pollution as a very important and rather unknown menace to human health.

Table 2.1 Water-related diseases

Category	Disease or syndrome	Preventive strategy

Waterborne-Microbiological	Diarrheas and dysenteries
	  Amoebiasis
	  Campylobacter enteritis
	  Cholera
	  E.coli diarrhea
	  Giardisis
	  Rotavirus diarrhea
	  Salmonellosis
	  Shigellosis
	Enteric fevers
	  Typhoid
	  Paratyphoid
	Poliomyelitis
	Hepatitis A
		Improve quality of drinking water
		
		Prevent casual use of unprotected
		  sources

Water hygiene diseases	Infectious skin diseases Infectious eyes diseases (conjunctivitis, trachoma)	Increase water quantity used Improve accessibility and reliability of domestic water supply Improve hygiene

Water contact diseases	Schistosomiasis
	Leptospirosis
		Reduce the need for contact
		  with infected water
		Reduce contamination
		  of surface waters

Water habitat vector-borne diseases	Malaria Yellow fever Dengue Onchocerciasis (river blindness)	Improve surface water management Destroy breeding sites of insects Reduce need to visit breeding sites

Waterborne chemical diseases	Methemoglobinemia (nitrates)
	Cancer (organic chemicals,
	  radionuclides)
	Toxicoses (metals)
	Birth defects
	  (organic chemicals)
	Mutations (organic chemicals)
		Protect drinking water sources
		Prevent casual use of unprotected
		  sources
		Improve surface water management

Source: Adapted from McJunkin, 1983 and Nash, 1993.

3. Poverty, health and sanitation

The lack of access to safe drinking water and sanitation is directly related to poverty and indirectly to the inability of governments to invest in these systems. Figure 3.1 shows the correlation between GNP and access to safe water and sanitation, using data from 98 countries with GNP varying between US$ 80 and US$ 40,000. Data were extracted from the World Bank homepage (http://www,worldbank.org).

Figure 3.1 GNP per capita (1995) and access to safe water (1989–95) in 98 countries


GNP per capita *vs.* Access to safe water
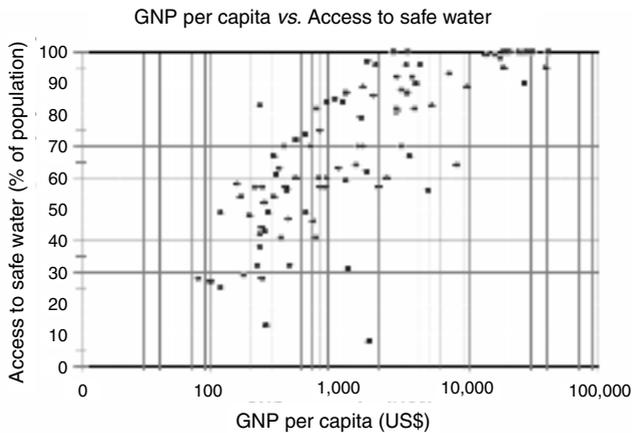
Source: World Bank, 1999.

Poor access to safe water and sanitation has a close correlation with poor health. Figure 3.2 shows the correlation between access to safe water and sanitation and mortality rates for children below five years of age. Data were extracted from UNDP homepage (http://www.undp.org). In spite of good correlation between access to safe water and infant mortality rates, one has to consider also that malnutrition, poor housing conditions and lack of access to health services are all conditions associated to poverty that will increase child mortality rates.

Inequitable service in urban areas is always an unfair situation in such areas of developing countries. Table 3.1 shows the situation of safe water access and sanitation in Brazil in 1991 for the different regions of the country. Southeast and South regions have a higher per capita income than North and Northeast regions. Table 3.2 shows in 2000 the difference between access to safe water supply and sanitation for different income levels.

**Figure 3.2 Mortality rates of children under 5 years of age (1990–95)
and access to safe water supplies (1990–95)**

Infant mortality *vs.* Safe water
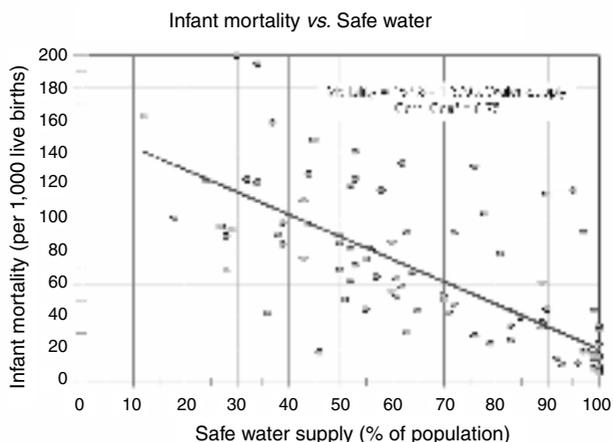
Source: UNDP, 1999.

Table 3.1   Population in Brazil served with safe water supply and sanitation

Service	*Population served (% of total population)*					
	Brazil	*North[1]*	*Northeast*	*Southeast*	*South*	*Central-West*
Water supply	74.2	59.7	56.2	86.5	77.0	65.5
Sanitation[2]	63.6	48.6	37.7	82.9	66.6	26.3

1.   Only urban areas of the Amazon Region.
2.   Includes conventional sewage systems and septic tanks.

Source: IBGE, 1991.

Table 3.2   Water supply and sanitation in Brazil for different income levels

Income level	*Population served (% of total population)*	
	Water supply	*Sanitation*
Low income	58	34
High income	93	92

Source: IBGE, 1991.

Peri-urban and rural populations living in areas without access to public water supplies will usually depend on extremely expensive water from vendors. In Northeast Brazil during the dry season, water vendors charge between US$ 1.00 to US$ 3.00 per cubic metre in the cities, and in rural villages the price can go up to US$ 0.30/ 20 per 20 litre bucket or US$ 15 per cubic metre. If these populations were supplied with safe drinking water from the water supply utility company, they would be paying around US$ 0.40 per cubic metre. Lacking any type of control, the price of the water from vendors are typically 10 to 20 times higher than those paid by high-income consumers connected to the network. In Bamako, the capital of Mali, poor people can pay as much as 45 times more per unit of water than those connect to the water pipes. Other examples are shown in Table 3.3. It is estimated that 25% of the population living in cities in developing countries buy water from vendors, typically spending 10 to 20% of the household income (WHO, 2001).

Needless to say, the people depending on water vendors will probably consume less water than the minimum daily requirements for good health. As a consequence of the unreliable quality of the water that is sold, those populations are usually severely affected by water-related diseases.

Reducing poverty through economic development would be a straightforward solution to solve water-related health problems. However, it has to be considered that such a condition is a long-term solution and also that economic development does not mean direct alleviation of poverty if it comes with an unbalanced income distribution. Instead of waiting for such a long-term solution, it has to be considered that improvement of water and sanitation is a tractable problem even in low-income settlements if locally tailored solutions are sought. Water-related health problems are closely correlated with, but not restricted to poverty (Kjellén and McGranahan, 1997). Several other measures are efficient and do not depend upon capital intensive

Table 3.3   Price of water from municipal water supplies and from water vendors

City	From municipal water supplies (US$/m³)	From water vendors (US$/m³)
Nairobi, Kenya	0,30	1.50–2.00
Port au Prince, Haiti	1.00	5.50–16.50
Jakarta, Indonesia	0.09–0.50	1.50–2.50
Lima, Peru	0.15	3.00

Source: Kalvan, 2002.

solutions: to teach hygienic practices, to put public participation as a priority in the planning and implementation of water projects, to work with subsidies in a proper manner and to search for less costly solutions in low income areas. The most critical problems, those that really demand huge capital investments, are the provision of water supply and sanitation to the poor people living in peri-urban areas. In Karachi, Pakistan, only about 12 percent of peri-urban population has access to sanitation compared to 85 percent in the city proper.

The major benefit expected to come with the implementation of the Dublin recommendations (ICWE 1991) would be 'the alleviation of poverty and disease' (WMO 1992, Young et al 1994). To seek for the implementation of the Dublin principles in the short range may not alleviate poverty but for sure it has the potential of alleviating disease.

4.   Basic ethical considerations

There are several different aspects in water supply management that have to be considered if the major objective of 'basic social services for all' is to be pursued. Basic conditions refer to the water supplied, which has to be guaranteed both in quantity and in quality. Other conditions reflect the need for making the service sustainable in the long term and they deal with institutional aspects of the water service, such as equity and public participation. Economic aspects of the water service are also important, such as the review of the subsidy policies, the cost-recovery mechanisms and the search for alternative and less expensive solutions in water supply and sanitation.

The reduction of water-related diseases depends on several measures that have to be taken together. Providing water in adequate amounts and with reliable quality is part of such measures, together with improved hygiene and sanitation conditions, as shown in Table 4.1. It should be noted the marked importance of the adequacy of the supply to improve health.

According to Gleick (1996), the basic water requirement for human needs is 50 litres per person per day divided as shown in Table 4.2. Although this value may be rather restrictive for industrialized countries, it represents a guarantee for health in most developing countries, mainly those under water scarcity conditions. In Brazil, this quantity was verified to be sufficient to provide fair living conditions to the populations in the dry Northeast.

The minimum amount required for personal and household needs depend on the climate, culture, tradition, diet technology and wealth. When the water supply source is a public standpipe farther than 1 kilometer from the house, the average consumption is less than 10 litres per person per day. When the house is connected

Table 4.1   The effect of interventions on the reduction of diarrheal diseases

Intervention	*Approximate reduction in diarrhea (%)*
Reliable drinking water quality	15
Supplying adequate quantity	20
Improved hygiene	33
Improved sanitation	35

Source: Esrey, 1996.

Table 4.2   Basic water requirements for human needs

Purpose	*Recommended minimum (litres per person per day)*
Drinking water	2
Sanitation services	20
Bathing	15
Cooking and kitchen	10
Total recommended basic water requirement	50

Source: Gleick, 1996.

directly to water pipes in high-income urban areas, the consumption can go as high as 500 litres per person per day. A typical household demand value of 100 litres per person per day may be considered adequate for a minimum acceptable quality of life.

It is generally accepted that there is a marked improvement in health as consumption increases from 10 litres per person per day to about 40 litres per day following by a lesser but still distinct improvement from 40 to 90 litres per person per day. In most communities consumption between 100 and 300 litres per person day constitutes a luxury and consumption over 300 litres a misuse of resources. These levels of consumption refer only to personal and households needs.

The consumption per person per day decreases with the increase of the distance people have to walk to collect water. If the distance from the household to the water

source is greater than 1,000 m, it can be expected that the consumption will be less than 10 litres per person per day. If the distance is less than 250 m, than the consumption can go to 15 up to 50 litres/day and it will go higher only is there is a direct connection to the household (House et al., 1997). Direct connection is therefore almost an essential condition to effectively improve health conditions.

The solution to this problem relies on the level of investment that is needed. To meet the 2015 development target of reducing by 50% the population without water supply services in Africa, Asia, Latin America and Caribbean, 1.6 billion people must be served. The challenge is immense: during the 1990s, only 816 million people gained access to improved water services (WHO/UNICEF, 2000).

Drinking water quality is especially difficult to control even in developed countries. The basic requirements for drinking water are that it should be acceptable to the consumer (no taste, color or odor)and it should be free from pathogenic organisms and toxic chemicals.

Different impacts are caused by the various pollutant sources. Microbiological contaminants, fluorides, arsenic, pesticides and other chemicals can be directly harmful to health. Color, taste, turbidity and odor can lead the consumer to search for another source, perhaps more acceptable but not necessarily safer.

To guarantee adequate quality of the water supply, two major actions are required, at least:

- to enforce drinking water standards
- to protect water sources from pollution, mainly from industrial residues.

Drinking water standards are supposed to ensure that potable, safe water is supplied to the population and it will not threaten human health. The World Health Organization has produced guideline levels to help the setting of water quality standards. In most developed countries, populations are protected by national regulations which enforce such standards. In many developing countries, however, even minimal water quality standards are not regulated by law, leading to the spread of disease and toxic contamination. In these countries WHO Guidelines may not be achievable in the short term. Setting targets that are too high can be counterproductive as they may be ignored if unattainable (House et al., 1997). Interim national standards should reflect realistic conditions, priorities and capacity to improve water supplies, especially when investment is constrained. Realistic standards are better than none.

In developed countries the situation is also difficult. Water quality standards are usually related to the concept of risk because it is very difficult to avoid all contaminants, since the goal of zero pollution is almost impossible to achieve. The risk is constantly increasing because of the estimated 100,000 chemicals placed in the environment. Water quality criteria exists for a modest number of around 200. Under such conditions, it is impossible to guarantee 'risk free' water. The only solution is to

pursue better protection of the drinking supply sources. Lack of source protection, besides increasing the risk, dramatically increases the costs of water treatment.

Several countries face severe water quality problems. Bangladesh suffers from naturally-occurring arsenical poisoning, probably affecting between 35 and 77 million people. In China, chronic fluorosis affects 30 million people. Every year 1.7 million people die from diarrhea. Quality can be improved mainly by source protection, improved sanitation, water treatment, efficient and safe distribution.

The deficit in sanitation services is even greater than in water supply services. To reduce by 50% the deficit of sanitation services by the year 2015, those served by sanitation must increase by 2.2 billion. During the 1990s only 75 million people a year gained access to improved sanitation services (WHO/UNICEF, 2000).

5. Water conservation and priorities

While it has been seen that in developing countries millions of people do not have adequate access to safe water, in developed countries the per capita consumption in the household is several times higher than the minimum necessary for basic uses. The average consumption in the household for yard irrigation and other non-essential uses is 178 litres per capita per day (Gleick, 1996), with an average of 531 litres per capita per day for the entire uses.

While developing countries are seeking a higher rate of water consumption in the household, such consumption levels of the developed countries are not to be met if a sustainable level of water use is desirable. The decision towards sustainability requires developed countries to lower such high rates of consumption to meet the paradigm. Conservation ethics promote 'reduce, reuse, recycle' as a society priority. Changing behavior is the key element in the process.

Managing water demand is one of the most efficient ways of reducing conflicts, achieving proper allocation and moving towards the equity goal. It helps the protection of the environment and it improves the reliability of water systems.

From Young et al. (1994),

The economic, social and environmental priorities to be established should take into account the availability and long-term sustainability of water resources ensuring, as a top priority, the availability of sufficient, affordable domestic supplies, in order to meet the basic needs of the community and especially the needs of the very poor, particularly during droughts.

The United Nations Committee on Economic, Social and Cultural Rights adopted the human right to water on November 26, 2002 (UN, 2002):

> The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses.

It is easier to enforce the human right to safe water if it is embedded in the local water rights system. In those countries where water is a public good, this can be done through the operation and management of a permit system or through compensation measures. In the new code of the Brazilian Water Resources Management System, water is a public good and withdrawals are controlled by a permit system. This permit system guarantees the highest priority of use to domestic needs in scarcity situations (Porto et al., 1999). The water rights system can be of great help in developing countries. With increasing demand, they will probably face in the near future severe competition between uses in order to sustain economic development and to increase the coverage of water services. The issue of priority use for drinking water is less critical in developed countries since almost all of them they have already achieved the 100% coverage target and they are under less pressure from population growth.

Water policy reforms, with better laws and adequate institutional arrangements for proper water management, including definition of water rights, are urgently required in many developing countries. Strong institutions, transparent and participative decision processes, all based in modern water management principles, such as the Dublin principles, are essential to better water governance. Several countries have already put in place their water reforms such as Brazil, Mexico and South Africa, and several others are working towards this goal such as Namibia and Nigeria (GWP, 2000).

Since access to safe water is a human right, when measuring efficiency and success of all water projects, the health improvement and the increase in well-being of the intended community should be included as a major indicator. In several different situations, small rural villages or poor sectors of urban areas are not considered for new projects due to ineffective finantial results.

6. Public participation and partnership

Community organization and people power seem to be key elements in the process of implementing better water projects and management. A World Bank study (Narayan, 1995) based on 121 rural water supply projects showed that public participation was the most significant factor in achieving successful implementation of the projects. The projects were funded by several different agencies and they were located in Asia,

Table 6.1   Cross-tabulation of overall project effectiveness with beneficiary participation by number of project

Overall project effectiveness	Overall beneficiary participation		
	Low	*Medium*	*High*
Low	21	6	0
Medium	15	34	5
High	1	18	21

Source: Extracted from Narayan, 1995.

Africa and Latin America. The proportion of water systems in good condition, with high economic benefits, percentages of target populations reached and environmental benefits, increased significantly with the degree of participation. Table 4.3 shows the differences in achieving success according to participation levels.

Besides the conclusion on the importance of beneficiary participation, other major findings were:

- public participation helped to assure equity of access to services;
- the impact of the participation throughout the project cycle was significantly greater than it was during any single stage;
- effective participation did not work when agencies were alone and strictly in control of the implementation details;
- the forms of effective participation varied tremendously;
- non-governmental organizations figured in half of the success sample although they represented only 15% of the sample.

The three elements most correlated with high participation levels were: user investment in capital costs, local ownership and control, and agency responsiveness to feedback. At the beneficiary level, the two characteristics determining participation were commitment before construction (or demands) and the degree of organization of the beneficiary. For the agencies, the two most significant characteristics were relative autonomy and degree of client orientation. The analysis also showed that the three most common impeding conditions to participation were unwillingness to give up control over implementation details, a lack of incentives for staff to support client orientation through new institutional arrangements and unwillingness to invest resources for building the community capacity to manage the physical infrastructure.

It seems that there is almost a consensus that solutions are only achieved in a local

context, in which an appropriate mix of government, users (private sector included), individual and civil society participate in the decision-making process, with clear roles and with concrete inputs to solution. A frequent claim is that the local community does not participate in technological decisions due to its lack of knowledge. On the contrary, when the community participates, it usually increases the efficiency of the decision.

For the government sector, providing adequate leadership and modernization of policies and institutions are the required roles. It can be quite a significant challenge since such modernization processes produce significant change. This is always difficult to carry out, usually due to bureaucratic management. The importance of such roles is equally valid to developed and developing countries. The magnitude and effectiveness of the European Union Framework Directive on Water will only be take effect if all member states work towards its full implementation. Water conflicts in West United States of America require an innovative approach towards management of its water rights system. Those same challenges are present in South Africa or Brazil, in the implementation of their new water management systems.

At the community level, the possibility of empowerment and participation usually brings a new way of facing their problems. It generates, for instance, a sense of ownership, which, in turn, increases commitment and willingness to pay for the services, and generally decreases conflicts or damaging acts, such vandalism. It gives a sense of independence that can gradually reduce government support to the population. Such experiences tend to be replicated in other communities and better water services can be achieved even without the reduction of poverty, frequently within a short time frame. Ensuring the participation of users is essential to provide good water management. The industrial sector, as well as the irrigation sector together with other users are vital participants. Usually it is a win-win type of situation: with their participation in the decision process, the willingness to pay for water increases and, on the other hand, they have more control over the whole situation to guarantee their supply of water. Proper participation usually improves water governance. Participation enhances the local character of the decision and involves the community in sharing the responsibility. This requires capacity development at the local level, an issue that is frequently overlooked.

After one decade, fortunately, there are several successful example of the application of the Dublin Principles, mainly those related to public participation and decentralization. Everywhere there are positive experiences. In Uganda, the construction, operation and maintenance of the third largest water supply system have been managed by the community, supplying 60,000 people in 14 villages. Elected water committees with local representatives are in charge of managing the system. Even at war risk, the water supply was not interrupted (GWP, 2000). Several water

projects in Northeast Brazil, in which explicitly there were funds to support institutional arrangement development and to foster public participation, achieved a much higher degree of success. In developed countries initiatives that involved public participation were also important and successful. Oregon's Watershed Councils initiative has been quite successful in the adoption of best practices and improvement of environmental conditions for salmon (Curtis et al., 2002). Curtis et al. (2002) also note that it is critical that those local organizations are embedded within an institutional framework to be sustainable. This calls for water governance and water reforms just as in the developing regions.

7. Equity in water supply and sanitation

All over the developing world one of the major challenges is to supply water and sanitation to poor rural and urban populations. However, development benefits tend to be more significant, in terms of well being, to those in worse conditions than to those with better living conditions. Equity constitutes a major challenge mostly due to economical reasons. The poor populations are usually willing to pay more for improved services than they are currently paying for their existing supply and sanitation conditions, but, in absolute terms, the potential revenues from the low-income levels of the society are not large enough to encourage major investments. To solve the equity problem, the subsidies to implement water supply and sanitation systems should be specially directed towards the lower income population. Unfortunately it is very common to see the opposite situation: at the end of the project, the higher income populations drew most of the benefits. Cost-sharing arrangements and beneficiary participation, if not sufficient, are essential to guarantee the correct policy regarding government subsidies.

The rapid growth of urban areas all around the world is usually due to migration of poor rural populations in search of better working and living conditions. They usually develop very poor peri-urban areas, where the lack of services involve not only water supply and sanitation, but also flood management and solid waste removal. Of the world's population, 45% live in urban areas today. In 2025, it will be 60% and most of this increase will be in developing countries. The need for heavy investments is a challenge that will probably be very difficult to meet. Integrating water into urban planning, new urban management techniques and instruments, and technological development will also be needed. 'In a great number of urban areas, however, universal coverage with piped water and sewers is just that: 'a dream' (Kjéllen and McGranahan, 1997). Alternative solutions to lower the costs of imple-

menting water supply and sanitation systems can be sought but a very realistic strategy is needed in order to effectively increase coverage.

Conventional systems of water pipes and sewers are not affordable to poor communities without massive government subsidies. To the major part of developing countries they are not affordable unless huge investments based on external loans are made. As to water supply systems, there are not many alternatives to convey treated water to households or community taps other than the traditional network of pipes. In Brazil, the cost of such systems is around US$ 150 per capita (SEPURB, 1995). In sanitation projects, the cost varies from US$ 50 per household using pit latrines to US$ 470 per household using traditional sewers (Whittington et al., 1992). The number of possibilities in sanitation systems is almost unlimited but each project has to be carefully analyzed and the choice of an adequate system will depend on technical aspects such as the size of the urban community, physical characteristics of the regions, cost and, as a really important issue, cultural practices. The population in Brazil largely accepts only traditional wet systems, whereas dry systems, like latrines, are largely accepted in several Asian countries. Traditional wet systems are more cost effective in high-density urban areas and the dry systems are economically efficient in rural or low-density urban areas.

8. References

ASCE. 1982. *Pure and Wholesome*. American Society of Civil Engineers, New York.

AWWA. 1990. *Water Quality and Treatment: A Handbook of Community Water Supplies*. McGraw-Hill, New York, Fourth ed.

CARSON, R. 1962. *Silent Spring*. Fawcett Publications, Greenwich, Connecticut.

COTRUVO, J. A. and VOGT, C.D. 1990. Rationale for Water Quality Standards and Goals. In: *Water Quality and Treatment: A Handbook of Community Water Supplies*, American Water Works Association, McGraw-Hill, New York, Fourth ed.

CURTIS, A., SHINDLER, B. and WRIGHT, A. 2002. Sustaining Local Watershed Initiatives: Lessons from Landcare and Watershed Councils. *Journal of the American Water Resources Association*, Vol. 38, No. 5, pp. 1207–15. Middleburg, VA.

ESREY, S. A. 1996. No Half Measures – Sustaining Health from Water and Sanitation Systems. *Waterlines*, Vol. 14, No. 3, pp. 24–7. IT Publications, London.

GLEICK, P. H. 1996. Basic Water Requirements for Human Activities: Meting Basic Needs. *Water International*, Vol. 21, No. 2, pp. 83–92.

GRAY, N. F. 1994. *Drinking Water Quality*. John Wiley, Chichester.

GWP. 2000. *Towards Water Security: A Framework for Action*. Framework for Action to Achieve the Vision for the Water in the Twenty-first Century. Global Water

Partnership, Stockholm, Sweden.

HESPANHOL, I. 1999. Água e saneamento básico no Brasil – Uma visão realista. In: *Águas Doces do Brasil: Capital Ecológico, Usos Múltiplos, Exploração Racional e Conservação*. Academia Brasileira de Ciências, Rio de Janeiro, Brasil.

HOUSE, S., INCE, M. and SHAW, R. 1997. Water: Quantity or Quality? *Waterlines*, Vol 15, No. 4, pp. 15–8. IT Publications, London.

IBGE. 1991. *Censo de 1991*. Instituto Brasileiro de Geografia e Estatística, Rio de Janeiro.

ICWE. 1992. *Report of the Conference*. International Conference on Water and the Environment, Dublin.

KALVAN, R. 2002. Basic Services for the Urban Poor. http://www.unhabitat.org/whd/15.pdf.

KJELLÉN, M. and MCGRANAHAM, G. 1997. Urban Water: Towards Health and Sustainability. *Comprehensive Assessment of the Freshwater Resources of the World*. United Nations Commission for Sustainable Development. Stockholm Environment Institute, Stockholm.

MCGAUHEY, P. H. 1968. *Engineering Management of Water Quality*. McGraw-Hill Book Company, New York.

MCJUNKIN, F. E. 1983. *Water and Human Health*. National Demonstration Water Project. U.S. Agency for International Development. Contract No. AID/DSAN-C-0063, Knowledge Synthesis Project, Environmental Health Information Activity, second printing.

NARAYAN, D. 1995. *The Contribution of People's Participation: Evidence from 121 Rural Water Supply Projects*. Environmentally Sustainable Development Occasional Paper Series No. 1. The World Bank, Washington, D.C.

NASH, L. 1993. Water Quality and Health. In: *Water in Crisis: A Guide to the World's Fresh Water Resources*, Gleick, P. H. (Ed.). Oxford University Press, New York.

PORTO, M. F. A., PORTO, R.L.L. and AZEVEDO, L. G. T. 1999. Participatory Approach to Watershed Management: The Brazilian System. *Journal of the American Water Resources Association*, Vol. 35.

SEPURB. 1995. Demanda, Oferta e Necessidades dos Serviços de Saneamento. *Série Modernização do Setor Saneamento, Vol. 4*. ISPN/MPO/SEPURB/IPEA, Brasilia.

UN. 2002. The Right to Water (Articles 11 and 12 of the International Covenant on Economic, Social and Cultural Rights). Substantive Issues Arising in the Implementation of the International Covenant on Economic, Social and Cultural Rights. *General Comment No. 15 (2002)*. United Nations Committee on Economic, Social and Cultural Rights, Geneva.

UNDP. 1999. Population Trends. UNDP Homepage.

UND. 1997. Basic Social Services for All Program. ACC Task Force on Basic Social

Services for All.

WHITTINGTON, D., LAURIA, D. T., WRIGHT, A. M., CHOE, K., HUGHES, J. A. and SWARNA, V. 1992. Household Demand for Improved Sanitation Services: A Case Study of Kumasi, Ghana. *Water and Sanitation Report No. 3*. UNDP/World Bank Water and Sanitation Program. World Bank, Washington, D.C.

WHO. 1998*a*. Regional Meeting in Harare for the Africa 2000 initiative on water Supply and Sanitation. *Press Release WHO/70, 13/10/98*. World Health Organization, Geneva.

WHO, 1998*b*. *World Health Report 1998*. Executive Summary. World Health Organization Homepage.

WHO. 1999. *Sustainable Development and Healthy Environments*. World Health Organization Homepage: Environmental Health Facts and Figures.

WHO. 2001. *Water for Health: Taking Charge*. WHO, Geneva.

WHO, 2002. *The World Health Report 2002*. WHO, Geneva.

WHO/UNICEF. 2000. *Global Water Supply and Sanitation Assessment 2000*. WHO/ UNICEF Joint Monitoring Programme for Water Supply and Sanitation, Geneva.

WMO, 1992. Statement on Report, International Conference on Water and the Environment (Dublin, Ireland - Development Issues for the 21st Century), 55 pp.

WORLD BANK. 1999. GNP Learning Modules. World Bank Homepage.

YOUNG, G. J., DOOGE, J. C. I. and RODDA, J. C. 1994. *Global Water Resources Issues*. Cambridge University Press, Cambridge. Reprinted in paperback 2003.