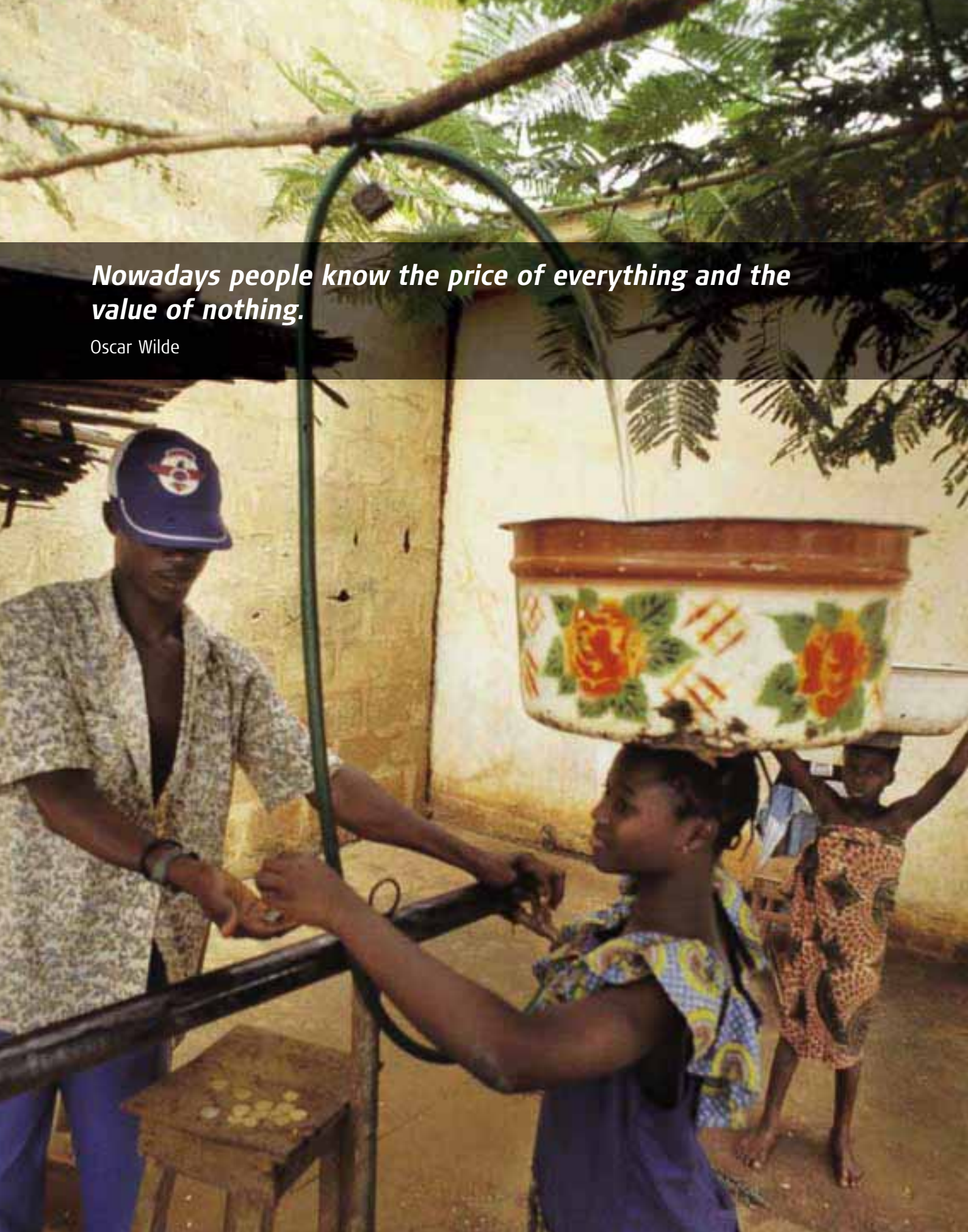

Nowadays people know the price of everything and the value of nothing.

Oscar Wilde

CHAPTER 12

Valuing and Charging for Water

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Key messages:

Because of the unique characteristics and socio-cultural importance of water, attempts to value water, or more specifically water services, in monetary terms is both difficult and, to some people, inappropriate. Nevertheless, economic valuation – the process of attaching a monetary metric to water services – is an increasingly important tool for policy-makers and planners faced with difficult decisions regarding the allocation and development of freshwater resources. With market prices unable to capture the full spectrum of costs and benefits associated with water services, economists have developed special techniques to estimate water's non-market values. Two important occasions when these tools are employed are assessments of alternative government strategies and tariff-setting. In this chapter, we examine valuation tools, explain how they are used, and explore underlying social, economic and environmental principles that condition their application. Finally we look at the emerging issues including private-sector participation, 'virtual water' trade, and payments for environmental services, which are playing an ever more prominent role in the debate on the allocation and development of scarce freshwater resources.

Top to bottom:

Men and women bathing in the Ganges, India
above: Irrigated paddies, Viet Nam

Women washing clothes at the Ralwala spring in Siaya district, Kenya. The spring serves 30 households

Public water pump in Amboseli Reserve, Kenya
below: Public water pump in Amboseli Reserve, Kenyaenya

- Given its unique, life-sustaining properties and multiple roles, water embodies a bundle of social, cultural, environmental and economic values. All of these must be taken into consideration in the selection of water-related policies or programmes if the goals of integrated water resources management (IWRM) are to be realized.

- Public policy analysis employing economic valuation provide a rational and systematic means of assessing and weighing the outcomes of different water policies options and initiatives and can assist stakeholders, planners and policy-makers to understand the trade-offs associated with different governance options.

- Charging for water services – household, commercial, industrial and agricultural – requires, firstly, consensus on the underlying principles and objectives (e.g. full cost recovery, protecting the needs of the poor and the marginalized, etc.); secondly, a thorough, systematic analysis of all costs and perceived benefits; and thirdly, a tariff structure that endeavours to maximize governance objectives within prevailing socio-economic conditions.

- Public-private partnerships, though not appropriate to all situations, can play a significant role in developing cost-efficient water service systems. Government authorities, however, must be open to a variety of initiatives, including local enterprise, public-private partnerships, community participation and water markets, and must take an active regulatory role in ensuring that societal goals are met with regard to social equity and environmental sustainability – as well as economic efficiency.

- There is a great need not only for planners and policy-makers who understand the advantages and limitations of economic valuation techniques and their potential role in informing decisions regarding water resources management, but also for technicians who can clearly express these concepts, utilize these tools, and assist stakeholders in expressing their values and preferences. In this way, economic valuation can contribute more fully to information sharing and transparency, all of which are important for good governance.

Part 1. Understanding the Multi-faceted Value of Water

Water is vital for all life on this planet, but is also essential for food production, many manufacturing processes, hydropower generation, and the service sector. The value of water varies for different users depending on the ability to pay, the use to which the water will be put, access to alternative supplies, and the variety of social, cultural and environmental values associated with the resource. Acknowledging the totality and interdependence of water-related values important to stakeholders and water users is critical to realizing Integrated Water Resources Management (IWRM). Understanding the distinction between the *value* of water – determined by its socio-cultural significance and the broad spectrum of direct and indirect benefits it provides – the *price* of water, as charged to consumers, and the *cost* of water as derived from the expense of providing water to consumers, is a critical first step to understanding the role of economic valuation in water governance and management.

The Dublin principle[1] to treat water as an economic good follows a growing consensus on the need to maximize benefits across a range of water uses. Still, the importance of ensuring equitable access and meeting the needs of the poor and disadvantaged members of society is widely recognized. How to finance this task remains a key challenge. While higher-income countries move toward systems of water tariffs based on full cost recovery and metered service, low-income countries struggle to cover basic operating costs and, for the most part, still tolerate various systems of subsidies as many users are unwilling or unable to pay for water services. According to the World Bank, pro-poor policies relying on cross-subsidization have created an inefficient and unsustainable water services sector with serious impacts on the environment in many countries. Similarly, the 'polluter pays' principle, like the 'user pays' principle, although broadly accepted, suffers from poor enforcement due to a weak governance environment. While some countries favour decentralization and management transfer as a way to relieve cost burdens, others see private sector participation as a means of achieving better services and improved cost recovery. Pricing or tariff-setting is widely supported in the financial community both to raise the needed investment capital and to curb inefficient use. None of these options are without problems.

Difficulties associated with decentralization often stem from political weakness and lack of institutional capacity at the local level. Half-hearted support by national and international organizations for community-driven development of water services has also been a problem in some areas. Private sector involvement, often touted as a key to solving financial problems in this sector, remains limited in many areas while the transfer of management models from one region to another has met with mixed results. Pricing, expected to serve a variety of objectives, including cost recovery, more prudent use of water, distributive justice and assured supplies for poor, has generally led to rising prices and a decline in water use in some countries. Many would argue that the poor would be better served by more focused tariff systems, which would be gradually introduced and underpinned by a minimal level of free service, or complimentary vouchers for water service rather than cross-subsidization.

Although economic valuation is recognized by many as an important tool in water management and substantial efforts have already been made in clarifying concepts associated with this technique, valuing water remains a controversial issue. Many stakeholders still feel that economic valuation is incapable of fully capturing the many social, cultural and environmental values of water. However, the variety of innovative initiatives attempted worldwide illustrates an increasing sensitivity to local needs and a growing understanding that the development and management of water resources must be a shared responsibility.

Although economic valuation is recognized by many as an important tool in water management... valuing water remains a controversial issue

1. See Chapter 1 for definition.

Part 2. The Socio-cultural Context

We speak of a crisis in water management because in many places the available freshwater is insufficient to meet all demands. As discussed in previous chapters, demand for water is increasing because, despite falling fertility rates in many countries, the world's population continues to increase while freshwater water supplies remain constant. Meanwhile, economic growth in many countries, especially in India and China, has increased disposable income and instigated lifestyle changes that have often meant increased water consumption. Agriculture and industry, also growing in response to these changes, require water for production, processing and transport, while electric utilities look increasingly to hydropower to meet 'clean' energy demands. Urbanization, a seemingly unstoppable trend worldwide, intensifies the pressure.

As the competition for water resources accelerates, one becomes increasingly aware of water uses in different areas. The essential value of water is universally recognized: without water there is no life. For many ecosystems, such as rivers, lakes and wetlands, freshwater is the defining element. The utility of water as a raw material, as a solvent, and as a source of kinetic energy has long been recognized. The role of water in

BOX 12.1 THE HIGH COST OF BOTTLED WATER

Over the last decade, sales of bottled water have increased dramatically to become what is estimated to be a US $100 billion industry (Gleick et al., 2004). From 1999 to 2004, global bottled water consumption grew from approximately 26 billion gallons to over 40 billion gallons (IBWA, 2005). In several cities of the developing world, demand for bottled water often stems from the fact that the municipal water supplies – if available at all – fail to meet basic criteria for drinking water quality. But companies manufacturing bottled water are also generating large revenues in developed countries. Bottled water sales in the United States in 2004 – higher than in any other country – totalled over US $9 billion for 6.8 billion gallons of water, that is, enough water to meet the annual physiological needs of a population the size of Cambodia (IBWA, 2005). Countries in the top ten list of bottled water consumers include Mexico, China, Brazil, Italy, Germany, France, Indonesia, Spain and India.

When asked why they are willing to pay so much for bottled water when they have access to tap water, consumers often list concerns about the safety of tap water as a major reason for preferring bottled water (NRDC, 1999). While most companies market this product on the basis that it is safer than tap water, various studies indicate that bottled water regulations are in fact inadequate to ensure purity or safety. The World Health Organization (WHO, 2000) warns that bottled water can actually have a greater bacterial count than municipal water. In many countries, the manufacturers themselves are responsible for product sampling and safety testing. In the United States, for example, the standards by which bottled water is graded (regulated by the Food and Drug Administration) are actually lower than those for tap water (regulated by the Environmental Protection Agency) (Gleick et al., 2004).

The explosive increase in bottled water sales raises important questions related not only to health, but also to the social and environmental implications of the phenomenon. It remains to be seen, for example, how the growth of this industry will affect the extension and upkeep of municipal water services upon which the poor depend. In fact, those most likely to need alternative, clean water sources are also those least likely to be able to afford the high cost of bottled water. In China, where roughly 70 percent of rivers and lakes are polluted, the largest demand for bottled water comes from city dwellers, for in rural areas people are too poor to pay for this alternative (Yardley, 2005).

Most water bottles are meant to be recyclable. However, only 20 percent of polyethylene terephthalate (PET), the substance used for water bottles, is actually recycled (Gleick et al., 2004). In Greece, it is estimated that 1 billion plastic drinking water bottles are thrown away each year (BBC, 2005). In addition, the PET manufacturing process releases harmful chemical emissions that compromise air quality.

Where safe tap water is temporarily unavailable, bottled water can provide an effective short-term solution for meeting a population's needs. But as noted above, the massive growth in sales of bottled water worldwide comes at a cost. A better appreciation of how people value water may help us understand how the bottled water phenomenon is impacting society's health, economic and environmental goals.

Sources: BBC, 2005; Gleick et al., 2004; IBWA, 2005; NRDC, 1999; WHO, 2000; Yardley, 2005.

BOX 12.2: VALUING WATER, VALUING WOMEN

In most, if not all, developing countries, collecting water for the family is women's work. While water for drinking and cooking must be carried home, dishes, clothes and often children may be carried to the water source for washing. Women and girls are often seen queuing with their water pots at all-too-scarce taps, then walking long distances home balancing them on their heads or hips. If the water is contaminated and a family member falls ill, it is often the woman who must care for them. Children in particular are vulnerable. In parts of the world where AIDS is rampant, individuals with weakened immune systems also easily fall prey to pathogens in the water supply.

The low status of women in many societies means that their contribution – in terms of the time and energy spent, for example, in fetching water – is considered to be of little value. In economic terms, the opportunity cost[2] of their labour is perceived as near zero. Where women have been given access to education and to money-making work, such as handicrafts production, and are permitted to sell their products and to earn income for the family, their social as well as financial position improved dramatically.

Attitudes toward water-collecting can also shift. The time women spend collecting water, especially when simple and readily available technological alternatives exist, looks very different and far more costly to the family and society as a whole, when women have income-earning opportunities. Thus, investments made to improve access to safe drinking water are both a reflection of the value placed on water for human well-being and the value accorded women. Providing regular and dependable access to safe drinking water is one way of improving the position of women as well as society as a whole.

Source: UNICEF/WHO, 2004.

human health is, of course, critical. Recently we have seen the growth in bottled water consumption, which although a necessity in some cases, is also a growing trend in places where safe and inexpensive water is readily available on tap (see **Box 12.1**).

As a physical, emotional and cultural life-giving element, water must be considered as more than just an economic resource. Sharing water is an ethical imperative as well as an expression of human identity and solidarity (see **Chapter 11**). Accordingly, the high value placed on water can be found in the cosmologies and religions and the tangible and intangible heritage of the world's various cultures. The unique place water holds in human life has ensured it an elevated social and cultural position, as witnessed by the key role water plays in the rituals of all major faiths. The proposition that water is a human right alongside the increasing competition between water users has resulted in water becoming a political issue in many regions (see **Chapter 2**). The amount of time spent in collecting water – a task mainly performed by women and children – is increasing in many areas. Water supply must, therefore, also be viewed as a social issue and, more specifically, a gender issue (see **Box 12.2**).

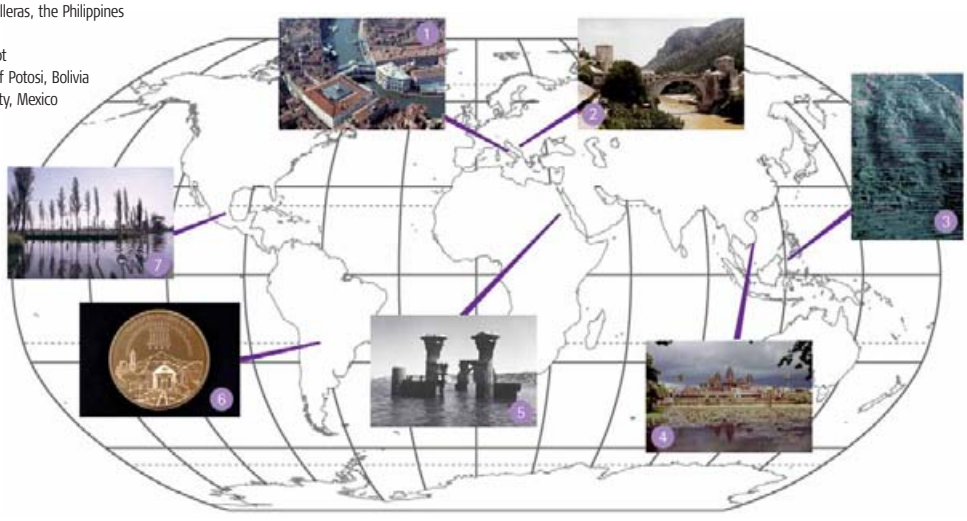
Restored interest in ethnic and cultural heritage in many societies around the world has lead to a revival of numerous traditional rituals, festivals and social customs, many of which feature water as a key element. Thus, the tradition of social bathing endures, for example, in Turkey and Japan. Water sports too play an important role; currently nearly one-third of Olympic sports use water, snow or ice. Many archaeological sites – the Roman aqueducts, the Angkor ruins, the Ifugao and Inca terraces, among others – are monuments to ancient societies' ingenuity in water engineering. Listing these historic sites on the roster of World Heritage protected cultural properties is in effect formal recognition of the high value that the international community accords these locations (see **Map 12.1**).

Water splashing at a festival in the Dai ethnic Minority Village, China

2. Opportunity cost is defined as the maximum worth of a good or input among possible alternative uses (OMB, 1992).

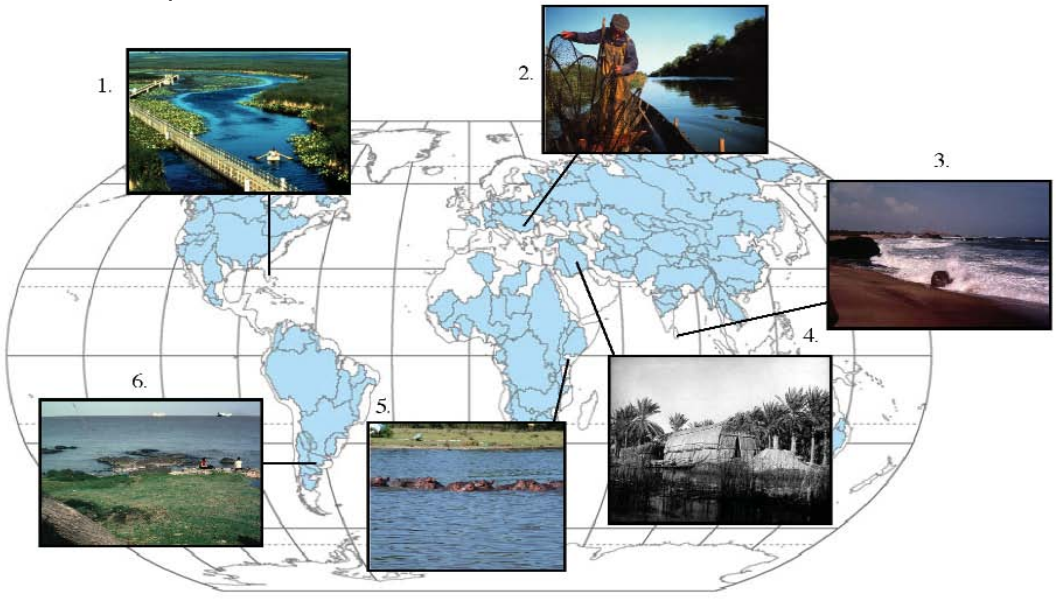
Map 12.1: World Heritage Sites with important water-related value

1. Venice and its Lagoon, Italy
2. The Old Bridge of Mostar, Bosnia and Herzegovina
3. Rice Terraces of the Cordilleras, the Philippines
4. Angkor, Cambodia
5. Nubian Monuments, Egypt
6. Heritage Medal for City of Potosi, Bolivia
7. Xochimilco and Mexico City, Mexico



Note: These are just a few of the water-related sites on the World Heritage Cultural Properties list. The list contains more than 628 cultural sites that have been cited as having 'outstanding universal value to humanity'. With the 1972 Convention concerning the Protection of the World Cultural and Natural Heritage, UNESCO seeks to encourage the identification and protection of cultural and natural heritage around the world so that it may be enjoyed by all peoples. More information on this programme and these and many other sites can be found at whc.unesco.org.

Map 12.2: Ramsar sites with important water-related value



1. Everglades National Park, US
2. Danube Delta, Romania
3. Bundala, Sri Lanka
4. Marshlands, Iraq
5. Lake Naivasha, Kenya
6. Rio del Plata, Uruguay

Note: The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty providing the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 146 Contracting Parties to the Convention, with 1,459 wetland sites, totalling 125.4 million hectares designated for inclusion in the Ramsar List of Wetlands of International Importance.

Source: www.ramsar.org/key_sitelist.htm

A growing appreciation of ecological processes is developing in many countries as society's experience of pollution and other environmental disasters increases. The wholesale destruction of the natural environment, as in the case of the Aral Sea, is no longer socially or politically acceptable. Increasingly, society has come to value healthy ecosystems and accordingly has instituted legally-binding accords to better protect the environment. The Ramsar Convention, setting aside more than 1,400 wetland sites around the world for preservation and protection (see **Map 12.2**), is a testimony to the international recognition of the environmental, social and economic importance, and correspondingly the value, accorded to these special ecosystems.

The interaction between people and their environment is embedded in their culture. The ways in which water is conceived and valued, allocated and managed, used and abused, worshipped or desecrated, are influenced by the cultural and environmental context. Cultural diversity – the result of millennia of human development – includes a treasure trove of practical approaches to water husbandry. Indigenous knowledge holders can be invaluable partners for scientists in the quest for solutions to the challenges facing planners and practitioners pursuing IWRM (see **Chapter 13**). Given their fundamental role in human life and society, water-related traditions and practices are deep-rooted and thus changing them could have significant social impact. The strong cultural and social dimensions of water management and use must be understood in all their diversity if we are to find sustainable solutions to global water problems. Valuing water, including sustaining and fostering water-related cultural diversity, heritage and knowledge, is critical to enhancing our ability to adapt in a changing world. Economic valuation of water resources must be recognized as existing within this larger and more complex context of valuing water.

Angkor, Cambodia

Cultural diversity... includes a treasure trove of practical approaches to water husbandry

Part 3. The Role of Valuation

In formal models of policy analysis, valuation is the process of assessing significance against the projected results of proposed strategies. Values, in this sense, are weights assigned to outcomes of specific policy proposals, and can vary depending on which services are being valued, on the location of the services and other circumstances. Valuation assesses situations *with* versus situations *without* governance intervention, in other words, *incremental* gains and losses.

Essentially a tool for policy-makers and planners, public policy evaluation (including benefit-cost analysis), is a process of 'reasoned' decision-making and involves several logical, sequential steps. First, identify the relevant social goals. Second, characterize the perceived problems (defined as discrepancies between goals and the current situation). The third step is to specify alternative courses of action (governance strategies) to achieve the agreed goals. Fourth, predict and evaluate the predicted outcomes, both costs and benefits. The fifth and final step is to choose and implement the strategy that seems best able to achieve society's goals (MacRae and Whittington, 1997).

Economic valuation thus refers to the application of special techniques to determine the economic value (demand or willingness to pay)[3] of water services for purposes of informing policy decisions regarding the management and allocation of water resources. In the context of selecting governance strategies, valuation is seldom applied to water itself, but rather to the consequences of proposed policy initiatives. The beneficial and adverse effects of proposed initiatives (or the benefits and costs) are identified, and values (monetary assessments) assigned to these effects. In the context of public water supply policy, charging, for instance, is a governance strategy, and the choice of how much of the cost of water supply to recover, and from whom, is an important policy issue. Non-specialists sometimes incorrectly equate the observed price, or charge to the user, with economic value. Although tariff-setting must reflect both cost and value considerations, it

3. Willingness to pay is the maximum amount an individual would be willing to pay, or give up, in order to secure a change in the provision of a good or service (OMB, 1992).

must be remembered that the upper level of charges is limited by willingness to pay, rather than being defined by it. Under-valuing, or under-pricing ecological resources not only affects resource allocation, but can bias the direction of technological development (Dasgupta and Mäler, 2004).

3a. The special case of water

A variety of physical, social, cultural, political and economic factors make water a special case with regard to economic valuation. This in turn presents special challenges in selecting appropriate governance mechanisms. Because of its variable physical nature – it flows, seeps and evaporates, but sometimes is a stationary solid – it is difficult or costly to establish and enforce property rights over water. Another critical aspect is its variability, and increasing uncertainty, in terms of space, time and quality. Because of the many environmental services provided by water and aquatic ecosystems, water is considered a 'public good' – the two defining characteristics being 'non-rivalry in consumption' and 'non-excludability' of non-paying users. However, as shown in **Table 12.2**, it also has many private uses. The general perception of water as 'different' has political as well as economic consequences, all tending to dissuade the private sector from investing in the water sector.

The importance of water for public health means that governments generally attempt to provide some minimal level of water supply and sanitation services, whether or not the full cost of these services can be recovered from users. The water sector is exceptionally capital-intensive – not only as compared to manufacturing and industry generally, but to other public utilities – with assets that are fixed, non-malleable and very long-lived (Hanemann, 2005). An industry typified by economies of scale[4], where a single supplier can provide the least-cost service, is considered a 'natural' monopoly and public ownership or regulation is customary. Such is the case for the water sector, which makes economic analysis a particular challenge. Some argue that the poor appreciation of the complexities of water as an economic commodity contributes to the current water crisis (Hanemann, 2005).

Due to the special nature of water and its particular role in human life and development, there are certain socially and politically determined principles that must be taken into consideration when assessing the value of any policy or programme. These principles reflect collective social values that set the tone for the debate and, in some cases, determine the boundary parameters and influence the consideration of various different water policies and programmes. Three of the most important of these are the principles of economic efficiency, user-pays and water security.

- **Economic Efficiency**: Efficiency speaks to the importance of maximizing returns for the money, manpower and materials invested – more 'crop per drop'. Given the growing competition for freshwater, making more efficient use of the resources available is critical. Efficiency contributes to equity to the extent that if some users are discouraged from wasteful use, more water will be available for sharing with other users. Economic efficiency is summed up in the measure 'net present value'[5] or 'present value of net benefits'. Equivalent alternative measures include the 'benefit-cost ratio'[6] and the 'internal rate of return'[7]. The formulas for all of these measures involve generating monetary estimates of the costs (including damage costs and opportunity costs[8]) and benefits of the proposed programme for each year and, with the application of a social interest rate, discounting the stream of expected annual net benefits to a single number in current value terms. The goal of economic efficiency can and should serve the parallel goals of social equity and environmental sustainability – the three pillars of IWRM.

- **User Pays**: The 'user pays' principle contends that consumers should pay an amount equivalent to the burden (i.e. the full social cost) that their consumption places on society. Full social costs include both the capital, operating and maintenance expenditures to keep the system operating, and also the opportunity costs. They would also include the costs of damage resulting from the water pollution imposed on the society – the 'polluter pays' principle.

- **Water Security**: Often perceived to conflict with the above 'user pays' principle, the notion of water security holds that resources should be distributed according to 'need'. Accordingly, all individuals have the right to an adequate, reliable and affordable supply of potable water. Because of the importance of potable water for human health and well-being, it is usually regarded as a 'merit good', meaning that in certain cases, people deserve more water than they are willing or able to pay for. Thus 'security' in the context of domestic water supply refers to governance policies designed to help the poor satisfy basic water needs. This may involve setting tariffs according to the

4. Economies of scale are the savings achieved in the cost of production by larger enterprises because the cost of initial investment can be defrayed across a large number of producing units.

5. Net present value (NPV) is the discounted or present value of an annual or periodic stream of benefits minus costs over the life of a project (OMB 1992).

6. The benefit-cost ratio (BCR) is the ratio of the present value of periodic benefits to the present value of periodic costs over the life of the project (Boardman et al., 2000).

7. Internal rate of return (IRR) is the discount rate that will render the present value of a future stream of net benefits equal to zero (OMB, 1992).

8. Opportunity cost is the maximum worth of a good or input among possible alternative uses (OMB, 1992).

criterion of ability to pay, for example, a basic charge less than a certain fraction of net consumer income. A recent OECD (2003) report suggests a 'macro-affordability indicator', or 'water charges as proportion of income or expenditure' be considered. In a given network, lower income households will generally pay a larger proportion of income for water services than the average household.

Numerous additional social and cultural considerations may influence the selection and implementation of water governance policies. The valuation of water resources needs to take into account traditional cultural values that affect how water is perceived and used. Religious and ethical teachings regarding the appropriate use of water can have an important influence on public water management activities. Experience has shown that cultural perceptions of the role of water and perceived rights associated with its use strongly affect social acceptance of government attempts to effect policy changes in this sector. As noted earlier, differential effects with regard to gender also need to be considered in assessing policy initiatives.

Environmental considerations are also receiving growing emphasis worldwide. Protests against the environmental impacts of water development projects have been known in the United States since the early twentieth century, although at that time there were few theoretical tools to aid in water policy analysis. Models for evaluating the environmental as well as the economic impacts of water projects only emerged in the post-Second World War era with the work of Arthur Maass and Maynard Hufschmidt at Harvard University. In the United States, The Omnibus Water Resources Act of 1970 mandated that water project planning consider a range of objectives including social and environmental concerns. The 1983 guidelines of the Water Resources Council strongly influence such analyses still today.

The OECD's *Management of Water Projects* (1985) takes a similar approach, advocating measurement of incremental environmental impacts. A dozen general categories of impacts are suggested for consideration in the evaluation process. Among these are: water quality (including as appropriate for the given case, specific pollutants such as dissolved oxygen, temperature, biochemical oxygen demand, pH, bacteria etc.), amenity and recreation values (e.g., clean water, turbidity; colour and, odour), natural hazard exposure, aquatic ecosystems and aesthetics (loss of valued scenery, or historical or archaeological sites). The Millennium Ecosystem Assessment (2005) report forcefully reiterates the importance of considering environmental and ecosystem values. The economic significance of anticipating and avoiding environmental damages becomes apparent when one considers the costs of remediation, not to mention the social costs. **Table 12.1** illustrates the high cost of restoring a clean water source in a selected sample of cities across the United States.

3b. Non-market economic valuation

Economic evaluation of resource allocation requires some means of estimating resource values. When markets operate appropriately, a set of market values (prices) appear which serve to allocate resources and commodities in a manner consistent with the objectives of producers and consumers. In the case of freshwater, however, markets seldom operate effectively, or, more likely, are absent. Non-market economic valuation can be defined as the study of actual and hypothetical human behaviour to derive estimates of the economic value (often called shadow prices or accounting prices) of goods and services in situations where market prices are absent or distorted. Such estimated prices are an essential component of economic assessment of public water policy choices. **Table 12.2** illustrates some of the various types of water-related goods, services and impacts that might be measured by non-market valuation techniques.[9]

Most applied methods of water valuation fall into one of two broad categories depending on mathematical procedures and types of data employed: deductive and inductive approaches. Deductive methods involve logical processes to reason from general premises to particular conclusions. Applied to water valuation, the deductive methods commence with abstract models of human behaviour that are fleshed out with data that is appropriate to projected future policy, economic or technological scenarios. Assumptions can be varied and the sensitivity of the results to varying assumptions can be determined. The advantages of deductive models are simplicity, flexibility and the ability to analyse a hypothesized future. In principle, they can incorporate alternative assumptions about prices, interest rates and technology, thus testing the projections about unknown, future conditions.

Inductive methods, on the other hand, involve a process of reasoning from the particular to the general, that is,

Fishery, India

Economic evaluation of resource allocation requires some means of estimating resource values

9. See Freeman, 2003 for a state-of-the-art review of the theory of non-market economic valuation of environmental goods and services.

Table 12.1: The high cost of coping with source water pollution in selected communities in the US

Community	Type of problem	Response	Costs (USA)
Perryton, Texas	Carbon tetrachloride[1] in groundwater	Remediation	$250,000 (estimated)
Camden-Rockland, Maine	Excess phosphorus in Lake Chickawaukie	Advanced treatment	$6 million (projected)
Moses Lake, Washington	Trichloroethylene[2] in groundwater	Blend water, public education	$1.8 million (to date)
Mililani, Hawaii	Pesticides, solvents in groundwater	Build and run treatment plant	$2.5 million + $154,000/yr
Tallahassee, Florida	Tetrachloroethylene[3] in groundwater	Enhanced treatment	$2.5 million + $110,000/yr
Pittsfield, Maine	Land-fill leachate in groundwater	Replace supply, remediation	$1.5 million (replace supply)
Rouseville, Pennsylvania	Petroleum, chlorides in groundwater	Replace supply	> $300,000 (to date)
Atlanta, Missouri	Volatile Organic Compounds (VOCs)[4] in groundwater	Replace supply	$500,000 to $600,000
Montgomery County, Maryland	Solvents, freon[5] in groundwater	Install water lines, provide free water	$3 million + $45,000/yr for 50 years
Milwaukee, Wisconsin	Cryptosporidium[6] in river water	Upgrade water system; immediate water utility; Health Department costs	$89 million to upgrade system; millions in immediate costs
Hereford, Texas	Fuel oil in groundwater	Replace supply	$180,000
Coeur d'Alene, Idaho	Trichloroethylene[2] in groundwater	Replace supply	$500,000
Orange County, California	Nitrates, salts, selenium, VOCs in groundwater	Remediation, enhanced treatment, replace supply	$54 million (capital costs only)

Note: This table features a sampling of localities of various sizes that have borne high, readily quantifiable costs due to source water pollution. It attempts to isolate community costs, excluding state, federal and private industry funding. Not included here are the costs to individuals, such as lost wages and medical costs, reduced property values, higher water bills, and, in extreme cases, death.

1. A manufactured chemical most often found in the air as a colourless gas, used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers; soluble in water.
2. A colourless or blue organic liquid with a chloroform-like odour used as a solvent to remove grease from fabricated metal parts and some textiles.
3. A manufactured chemical used for dry cleaning and metal degreasing. Exposure to very high concentrations can cause dizziness, headaches, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. See also: www.atsdr.cdc.gov/tfacts18.html
4. Volatile organic compounds; for more information see: glossary.eea.eu.int/EEAGlossary/N/non-methane_volatile_organic_compound
5. FREON (trade name) is any one of a special class of chemical compounds that are used as refrigerants, aerosol propellants and solvents.
6. A parasitic protozoa found in soil, food, water, or surfaces that have been contaminated with infected human or animal faeces.

Source: NCSC, n.d. ca. 2000.

Table 12.2: Classifying goods and services provided by water

Commodity (or Private) Goods		Non-Commodity (or Public) Goods	
Producers' Goods	**Consumers' Goods**	**Use Values**	**Non-use Values (Existence and bequest values)**
1. Agricultural Producers ■ Crop Irrigation ■ Aquaculture	1. Residential water supply	1. Enhancing beneficial effects ■ Ecosystem services ■ Recreation ■ Aesthetics ■ Wildlife habitat ■ Fish habitat	1. Protection of aquatic environment
2. Off-stream industries ■ Manufacturing ■ Commercial services	2. Residential sanitation	2. Reducing adverse effects ■ Pollution abatement ■ Flood risk reduction	2. Protection of wild lands
3. In-stream industries ■ Hydropower ■ Transportation ■ Fisheries			3. Protection of biodiversity and endangered species

Source: Young, 2005.

from real-world data to general relationships. Observations on water-user behaviour are tabulated and subjected to formal statistical analysis to control for external factors influencing willingness to pay. Use may also be made of surveys of expressed preferences for recreation or environmental improvements, observations of prices on various elements from water rights to land transactions, responses to survey questionnaires, and secondary data from government reports. Because inductive techniques are based on observations of actual behaviour and real-life situations, they are preferred by many analysts. With data from published sources or surveys, these can be readily used to analyse the outcome of previous policies. One limitation in the evaluation of future or hypothesized policies is that analysis may involve assumptions outside the range of available historical observations. The accuracy of inductive techniques depends on several factors, including the representativeness and validity of the observed data used in the inference, the set of variables and the functional form used in fitting the data, and the appropriateness of the assumed statistical distribution. For readers interested in detailed discussion of these methods and the specific contexts in which they may be useful, there are numerous texts available for consultation.[10]

Examples of the application of different methods are provided in **Boxes 12.3** to **12.5**. In **Box 12.3** we see how contingent valuation was used to evaluate the willingness to pay for a proposed improved wastewater disposal program in Cairo, Egypt. **Box 12.4** summarizes several statistical (inductive) studies using historical government data to develop estimates of investment returns to irrigation in Asia. **Box 12.5** provides an example of a major benefit-cost analysis of global improvements of water supply and sanitation services, using an alternative cost (deductive) approach.

Economic valuation has been criticized for its lack of transparency and difficulty of use. Certainly, competence with survey research and other data collecting methods and complex mathematical and statistical skills, plus significant time and resources are necessary to perform valid economic valuations. A related problem is the dependence of techniques, based on consumer surveys and choice experiments, on public knowledge of the subject in question (Powe et al., 2004). One major criticism is that many stakeholders feel that economic valuation fails to capture all relevant value, especially social, cultural and environmental aspects, of typical water and environmental policy issues. Finally, non-specialists may find it difficult to understand and interpret study results.

Over the last several decades, the theory and practice of non-market economic valuation of water and environmental resource policies have been greatly improved, and those with the skills, time and resources can effectively derive conceptually consistent and empirically valid measures for the value of water and the benefits of water governance strategies. The primary

10. See, for example, Young, 2005.

BOX 12.3: WILLINGNESS TO PAY FOR IMPROVED WATER AND WASTEWATER SERVICES: CAIRO, EGYPT

A review of the status of wastewater disposal in Cairo, Egypt – one of the world's largest and fastest growing urban areas – showed inadequate water supply and wastewater conveyance, treatment and disposal capacities. Contingent valuation methods employing a referendum-type questionnaire to collect information on consumer preferences were used to develop estimates of the willingness to pay and economic net benefits for each of four potential investment programmes: (a) opportunity to connect to the water supply network; (b) improved reliability: provision of all-day water service; (c) wastewater maintenance to eliminate sewer overflows; and (d) an in-home connection to the wastewater disposal network. A separate sample of about 1,000 households was interviewed for each of the four programmes. Statistical analysis of responses showed willingness to pay for a water connection was US $7.70 per household per month compared to an estimated cost of US $2.50 per household per month for a net economic benefit of US $5.40 per household per month (evaluated with a 10 percent discount rate in 1995 US dollars). Respondents also showed a positive net willingness to pay for reliability of US $0.50 per household per month. For the wastewater programmes, an estimate of willingness to pay of US $2.20 per household per month was derived for the programme to eliminate sewer flooding which compared to a cost of US $0.20 per household per month, while a connection to the wastewater network was valued at US $7.60 versus a cost of US $6.30 for a net benefit of US $1.30 per household per month. However, if the wastewater investment programme was designed so as to require the household to pay for treatment in addition to disposal, willingness to pay was insufficient to justify that form of investment programme. And, although the mean net willingness to pay was positive for most of these plans, the distribution of responses showed that some lower income households would be unwilling to participate if charges were set at full costs.

Source: Hoehn and Krieger, 2000.

advantage of applying these techniques is that they generate information on different beneficial and adverse effects in a common denominator – money. This, in turn, enables policy-makers and stakeholders to better understand the trade-offs to be made and be better prepared to make the necessary decisions regarding the most appropriate water development strategies.

3c. Application of valuation techniques in evaluating alternative governance strategies

Public policies addressing water resources allocation and management must serve societal goals, such as equity and environmental sustainability, as well as financial feasibility, administrative practicality and economic efficiency. Thus, choosing the best governance strategy is a challenging process. In the context of water governance, the application of non-market valuation methods to estimate benefits (reflecting demand or willingness to pay) for water services have been used to assess and compare alternative proposed policies and programmes for the management and allocation of water resources.

Governance strategies should be selected to optimize the achievement of societal goals. In this context, valuation can be viewed as a fairly neutral and objective process by which social goals and trade-offs can be identified and debated and the optimal governance strategies chosen. In benefit-cost analysis (BCA) (e.g. Boardman et al., 2000), policy outcomes are assumed to be quantifiable and values are assigned to them in the single monetary metric. Although many impacts, positive and negative, are not properly or fully measured, if at all, by market prices, non-market economic valuation techniques can be used to assign monetary values to these impacts.

In BCA, monetary values must be assigned to each physical unit of input and product. The primary sources of these values are the observable market prices. However, in the case of water, as discussed above, market prices do not adequately reflect all the goods and services associated with water resources nor the true social value, for example, when agricultural commodity prices are controlled by government regulation or when minimum wage rates are set above market clearing prices. In such cases, prices must be adjusted to reflect the full costs and benefits. In many cases where market prices do not exist at all, it is necessary to construct surrogate prices. Whatever the source, the prices used in BCA are interpreted as expressions of willingness to pay (WTP) for, or willingness to accept compensation (WTA) for going without, a particular good or service by individual consumers, producers or units of government. For market prices, this presumption is straightforward, since the market price represents the willingness to pay at the margin for the potential buyers of the good or service. For non-market economic goods, WTP is also the theoretical basis on which surrogate (or shadow) prices are calculated. The assertion that willingness to pay is an

BOX 12.4: ECONOMIC VALUATION OF RETURNS TO IRRIGATION WATER INVESTMENTS IN ASIA

Several recent studies to assess the relative contribution of policies designed to enhance rural economic growth and reduce poverty in Asia have been reported by the International Food Policy Research Institute (IFPRI). Each study used inductive methods to analyse state or provincial time series data on public expenditures and economic output measures. Evenson et al. (1999), having analysed data from nearly all districts of thirteen states in India from 1956 to 1987, found that the marginal internal rate of return (IRR) to investments in irrigation was only about 5 percent. In contrast, public expenditures on agricultural research and extension were reported to yield marginal IRR of 58 percent and 45 percent, respectively. Also for India, Fan et al. (1999), using 1970–93 state data in a cross-sectional, time-series econometric study, found that irrigation development distantly trailed road building, agricultural research and development, and education in its impact on poverty reduction, although irrigation showed a somewhat more favourable impact on productivity. Fan et al. (2002) also compared returns to irrigation investments in China with other rural development programmes from provincial data for 1970–97. For the nation as a whole and for each of three economic zones, the authors reported high returns to investment in education, agricultural research and development, and rural infrastructure, but '[i]nvestments in irrigation had only modest impact on agricultural production, and even less impact on poverty reduction, even after trickle-down benefits were allowed.' Similarly, for Thailand, Fan et al. (2004) report that for 1970–2000, estimated economic benefits of irrigation investment failed to exceed costs, while agricultural research and development, electricity and education yielded quite generous rates of return. Overall then, one can infer that rates of economic return to investments in irrigated agriculture have been low in recent decades, particularly when compared to the opportunity cost of capital or to the return on alternative programmes aimed at improving the livelihoods of the rural poor. These conclusions suggest that the deductive methods typically used to evaluate proposed investments in irrigation may have been overly favourable to such programmes.

Source: Young, 2005.

appropriate measure of value or cost follows from the postulate that public policy should be based on the aggregation of individual consumer preferences.

Not all agree with this approach, however. Major opponents challenge the view that the economic efficiency impacts measured by benefit-cost analysis fully reflect society's goals. Sagoff (2004), the well-known and outspoken advocate of the widely held position that benefit-cost analysis has little role to play in environmental planning, argues that political resolution of value conflicts is the most appropriate approach. The basic argument is that other important goals relevant to decisions on appropriate water governance strategies cannot be reduced to the common denominator of money. When values conflict, as they often do, a dilemma arises. Some solution must be found which reconciles the disparate, competing perspectives. A widely used method of reconciliation is called the 'approved process approach' (Morgan and Henrion, 1990). This approach, roughly speaking, requires all relevant parties to apply the concept of 'due process', or to observe a specified set of procedures, to estimate a proposed policy's impacts on all relevant indicators of value. According to this method, any decision reached after a mutually acceptable mediator balances the competing values according to the specified procedures is deemed acceptable.

One variant of the approved process approach often applied in water resources analyses is called 'multi-objective planning'. Multi-objective assessment of water projects and policies has been promoted for some time in both the US and Europe with two well-known manuals by the Water Resources Council (1983) and by OECD (1985). Both emphasize a similar framework of analysis with three goals in common: economic efficiency, environmental quality and social well-being. Each provides advice on developing indicators to reflect the degree of goal attainment by particular strategies focusing on indicators both for beneficial as well as adverse effects for the *with* versus the *without* policy situation. Both approaches call for environmental impacts to be balanced against economic and social welfare considerations. In each case, the manuals emphasize the point that the task of technical analysts is not to come to a final decision on governance strategy, but to illustrate the expected impacts in the appropriate metrics. With many values or goals considered incommensurate (i.e. not reducible to a common denominator), it is assumed that the ultimate resolution or weighting of conflicting values will be referred to the political arena.

Watering ramp in a field, Senegal

BOX 12.5 BENEFITS VERSUS COSTS OF IMPROVED WATER AND SANITATION SERVICES

Adoption of the Millennium Development Goals (MDGs) that deal with extending the availability of water and sanitation services has prompted interest in assessing the net economic benefits of such programmes. Hutton and Haller (2004) evaluated five different scenarios with different levels of intervention for seventeen World Health Organization (WHO) sub-regions. The five levels of intervention were:

1. Water improvements required to meet the MDG for water supply (halving by 2015 the proportion of those without safe drinking water).
2. Water improvements to meet the water MGD for water supply *plus* the MDG for sanitation (halving by 2015 the proportion of those without access to adequate sanitation).
3. Increasing access to improved water and sanitation for everyone.
4. Providing disinfectant at point-of-use over and above increasing access to improved water supply and sanitation.
5. Providing regulated piped water supply in house and sewerage connection with partial sewerage connection for everyone.

Costs were determined to be the annualized equivalent of the full capital cost of the intervention. Benefits were measured in terms of several variables: the time saving associated with estimated benefit-cost ratios for selected regions. Economic benefits were found to greatly exceed the costs for all interventions, particularly level (4), a result that was robust for all regions and under alternative intervention scenarios.

Source: Hutton and Haller, 2004. www.who.int/water_sanitation_health/wsh0404.pdf

WHO Sub-Region	Population (million)	Benefit-cost ratio by intervention level				
		1	2	3	4	5
Sub-Saharan Africa (E)	481	11.50	12.54	11.71	15.02	4.84
Americas (D)	93	10.01	10.21	10.59	13.77	3.88
Europe (C)	223	6.03	3.40	6.55	5.82	1.27
South East Asia (D)	1689	7.81	3.16	7.88	9.41	2.90
Western Pacific (B)	1488	5.24	3.36	6.63	7.89	1.93

Note: The parenthetical letters identify WHO sub-regions as classified by epidemiological (health risk) indicators. See source for definitions.

Part 4. Charging for Water Services

An increasingly important aspect of water governance is the regulation of water quality

For both municipal and irrigation water services in developing countries, performance, efficiency and conditions of water delivery systems tend to fall far short of normal standards. Many people, but mostly the poor, lack access to safe water supplies and/or sanitation facilities, and for many others, the only access may be via water vendors or public latrines. Often over one-third of water transmission is lost to leakages or to unregulated access. The World Water Council's report 'Financing Water for All' (commonly known as the Camdessus Report), addressed the issue of mustering financial resources to meet internationally agreed water supply and sanitation goals, concluding that currently available sources will be insufficient to maintain and expand coverage (Winpenny, 2003). As the financing of water services is becoming ever more urgent, recovering costs is seen to be central to improving the conditions of water services. In this context, charging for water services is increasingly being promoted as an appropriate response.

Criteria applied to tariff-setting

Multiple criteria influence policy decisions on how to finance water services and how much revenue to collect from beneficiaries (cf. Herrington, 1987, 1999; Hanemann, 1997). In addition to the goals of safe and affordable water for all and maximum net social benefits, two key criteria are:

- **financial sustainability**, requiring the collection of sufficient revenue to meet present and future financial obligations, that is, operating costs as well as the capital costs of facilities and infrastructure, and the
- **user pays principle**, which holds that consumers should pay an amount equivalent to the burden of their consumption on society. This implies that charges should attempt to recover full costs, including not only operation, maintenance and capital replacement, but taking into account foregone benefits (opportunity costs), as well as any externalities (damages to third parties) (see **Figure 12.1**).

Other characteristics important in the successful implementation of any charging plan are:

- **simplicity**, which means that the selected tariff plan should be open, understandable and straightforward with users able to see how usage patterns affect the amount payable
- **transparency**, enabling consumers to understand how their own tariffs and those of other user classes are set, and
- **predictability**, permitting customers to reasonably anticipate and plan for their water-related expenses.

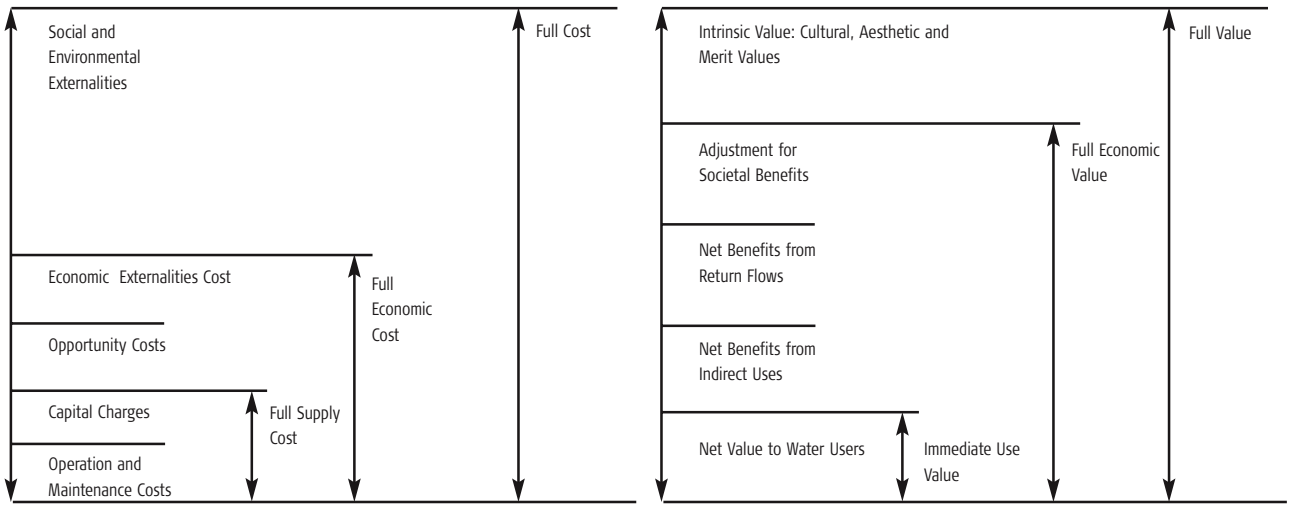
These criteria often come into conflict. For example, assuring that the less fortunate members of society are charged an affordable rate is likely to clash with both the user pays principle (recovering full costs) and maximizing net social benefits (pricing at marginal social cost). As shown in **Figure 12.1**, tariff-setting must balance both cost and value considerations as the upper level of charges is limited by user willingness to pay. Resolving the conflicts of rate-setting is inherently a political process. Any assessment of the various charging options must consider carefully the incidence of all costs and benefits, if charging is to be equitable as well as efficient.

Structuring user charges

For most marketed goods and services, units are obvious and the price per unit is easily understood. The case of water tends to be more complex. Water users may pay only a charge for access to the delivery network, but not for water itself. Charges may include a fixed periodic (e.g. monthly) access fee as well as a variable charge based on volume used. Many utilities require an initial connection fee. Hence, there is no single 'price'. In general the tariff structure for water services can be described in two dimensions: form and level.

The form refers to if and how the charge relates to the quantity used, while the level refers to the proportion of the cost of service to be recovered from users. Flat rates are more or less independent of the quantity used or may be linked to the projected level of use, according to, say, the number of family members or size of pipe connection. Conversely, charges may vary directly with the quantity of water used. Rate structures are changing because of the falling costs of metering, the increasing tendency to define water as a commodity (rather than a

Figure 12.1: Comparing the cost and value of water



a. Components for cost of water supply

b. Components of water use value

Source: Derived from Rogers et al., 1998, Savenije, H. H. G. and van der Zaag, P. 2001, and Matthews et al., 2001.

public good), and the perceived need to use charging to restrain water use as well as to recover costs.

The level of charges refers to the proportion of costs to be recovered from users and how these costs are divided among user groups. Although previously, water was widely regarded as a public good to be made available to all without charge and financed by from general public revenues, increasingly, policy is changing to one of full cost recovery, except where poverty is an issue. Charging each customer according to the cost each imposes on the system is seen to be consistent with both the criterion of the sustainability and the principle of fairness. Because of the importance of water for health and well-being, less well-off customers may be charged according to ability to pay, rather than full cost. In the residential sector, affordability is often measured by the fraction of household income spent on water. Although the determination of this fraction may be subjective and policies vary by country, commonly the aim is for household expenditures on water to be below 3 percent of annual income (OECD, 2003). Where the balance of costs must be raised elsewhere, one common solution has been cross-subsidization, that is, revenues from better-off residential or industrial users or from city, state or national government coffers covering the cost of less affluent users.

One major problem stemming from the politicized nature of rate setting is that subsidized rates are inadvertently made available to too large a proportion of the service base. As a result, revenues are insufficient to operate the utility efficiently and to extend service to potential new users. Over time infrastructure deteriorates or other sources of financing must be sought.

4a. Charging for municipal water services

Two conceptual positions vie for the main charging formula: the average historical cost method and the incremental future cost (or long-run marginal cost) method. Critics of the first model point out that only a small portion of the charge to consumers varies with the amount used. However, they contend that with a low marginal charge, customers have insufficient incentive to restrain water use and to invest in water-saving appliances, xeric landscaping and other conservation measures. Sceptics also observe that the historic costs model with its annual depreciation of historic capital costs ignores price inflation and current value or the replacement cost of assets. More generally, critics hold that with low marginal charges, historical cost models in practice encourage profligate water use, and stimulate construction of increasingly expensive supply systems ahead of need, which leads to calls for rate hikes only to support excess capacity. Finally, in practice, the historical cost method ignores social costs, such as the opportunity costs and detrimental environmental impacts.

Advocating an alternative approach, public utility economics literature (e.g. Hall, 1996, 2000) proposes that the relevant costs for determining municipal water charges is long-run incremental social cost. The purpose of charging at long-run incremental social cost is to produce price signals that induce water-use levels that maximize net benefits of the water utility's services. This concept, it is argued, reflects the true scarcity of the resources required to deliver water. A rate structure based on incremental cost, in theory, provides incentives for users to reduce water use, the value of which to them is less than the cost of provision. It would also, it is argued, encourage water users to make investments in plumbing fixtures and appliances for which the cost savings in water is less than the supplier's incremental cost of provision. In contrast to the historical cost method, social costs would include not only the costs of inputs and services acquired on the market, but non-market opportunity costs of the potential value of the water in alternative uses, and the unintended side effects on third parties. One difficulty of adopting the incremental future cost approach is the relative complexity of determining future as opposed to past costs, particularly opportunity and social costs. Another is the large rate hikes that could result unless tariff increases were phased in.[11]

4b. Charging for irrigation water

Around the world, it is rare that water users are charged the full cost of water services. Subsidized irrigation water is justified not only on users' limited ability to pay but on the (disputed) economic grounds of secondary economic benefits, for example, the boost in agricultural production due to increased availability of irrigation water. For public irrigation systems, the aim is to recover only operating and maintenance costs from users, with initial capital costs covered by the general public budget or donor agency contributions. Even in self-supplied pumping systems, typically no account is made for the opportunity cost of water or for the cost of damages to third parties. With cost recovery difficult in practice, inadequate revenues generally force some higher level of government to cover shortfalls or lead to a deterioration of the system.[12]

Of the several potential methods of charging for irrigation water, the most common is area-based charging, set according to the area irrigated, but also possibly according to the season, irrigation method or crop grown (Tsur et al., 2004). Area-based charges are criticized, however, for lacking any incentive to conserve water, for instance by reducing the number of irrigations, by limiting the amount of water applied per irrigation or by shifting to less water-intensive crops. The main alternative to an area-based charge is volumetric charging, which requires some agreed-upon method of measuring volume, such as length of time of water delivery based on a stable and known rate of flow. In fact, many different types of tariffs exist. Typically, the organization and configuration of irrigation water supply influence the feasibility of alternative methods of charging for irrigation water.

A review of policy reforms to increase farmers' cost shares and apply volumetrically based charges reveals several problems. One is that within the irrigation sector, non-economic goals tend to be more influential than economic efficiency, so in practice, full cost recovery and incremental cost pricing are less important. Moreover, with irrigation charges designed both to signal scarcity and reduce the taxpayer burden, adversely affecting farmers' incomes, governments find such polices neither in the public interest nor in their own political interest. Complicating the issue is the fact that governments often undertake irrigation projects to foster economic development in disadvantaged regions. Moreover, there is the perceived issue of national food security and the belief that production from irrigated land is more stable.[13]

Both cost and benefit considerations suggest that volumetric pricing of irrigation water may not be as desirable as it might first appear. The extra costs of assessing volumetric-based charges are often judged not worth the cost of implementation, thus volumetric-based charges are even less common in agriculture than in municipal and industrial water systems. From the perspective of benefits, the issue of volumetric pricing to encourage water saving is further confounded by the distinction between water withdrawn and water consumed. Water leaked from permeable canals, ditches and fields returns to the hydrologic system (surface or groundwater) hence becoming available from streams or wells. Only when leaked water is permanently degraded and/or lost to future use is it true that water saving at the farm or the district level is important. Thus, the evaluation of the technical efficiency of water use in the agricultural sector must be addressed on a case-by-case basis.

Some observers (e.g. Young, 2005) contend that governments and donor agencies tend to overestimate potential economic returns to irrigation and, as a result, farmers' actual ability to pay for water (see **Box 12.4**). As a result, projects have experienced lower than

A farmers' son uses a motorized pump to irrigate a greenhouse in Mborucuya, Argentina. This small farm has received credit from a support project for small scale producers to finance both the greenhouse and the irrigation pump

11. Recent texts with in-depth discussion of this topic include Shaw, 2005 and Griffin, 2006.

12. Further detailed discussion can be found in Tsur et al., 2004 and Cornish et al., 2004.

13. A more cynical view holds that these below-cost charging policies are merely the result of successful political efforts to obtain government subsidies on behalf of political supporters.

BOX 12.6: IRRIGATION MANAGEMENT TRANSFER (IMT) AS A COST RECOVERY TOOL

Many developing countries (aided by international donors) have in the past several decades invested large sums in irrigation systems with the expectation of increasing agricultural productivity and improving incomes for poor farmers. It was assumed that most such schemes would be economically and financially self-sufficient under reasonable management. However, most developing countries have not implemented charging programmes to recover actual operating and maintenance costs, let alone to pay for the capital costs of the investments. As governments have been unable or unwilling to adopt cost-recovery policies that keep pace with inflation or the need for periodic system rehabilitation, they have found that budgetary demands of the irrigation sector increasingly compete with other public needs. Policy reforms to transfer more of the irrigation costs to water users have come as part of a package called 'Irrigation Management Transfer' (IMT). These programmes assume that farmer management of public irrigation systems would make the system more responsive to members, and thereby encourage water users to be more receptive to paying costs. Expectations were that local control would not only improve the cost-effectiveness but by transferring costs to users reduce costs to the public exchequer. Results of such reforms have been, at best, mixed. While IMT programmes have been somewhat successful in more developed countries (US, New Zealand and Mexico), elsewhere the results are less promising. In many cases, charges to farmers did increase, but farmer-managed systems have tended to under-invest, thus necessitating public rescue. Little evidence of an overall increase in agricultural productivity or farm incomes has been observed. In large systems with many smallholders, costs of administration and revenue collection are necessarily high, and the users have ended up with lower productivity and income. In some cases, the systems have collapsed. The conclusion seems to be that IMT can work in cases where irrigation is essential to high-performing agriculture, and farmers are not too numerous, better educated and behave as businessmen. Furthermore, the cost of operating and administering the irrigation system must represent a modest proportion of the increment in farmers' income expected from irrigation. Where the system serves numerous, small farms producing low-value staple crops (such as in the rice-producing regions of Asia), in terms of cost recovery, system efficiency and productivity, IMT has not produced the expected results.

Source: Shah et al., 2002.

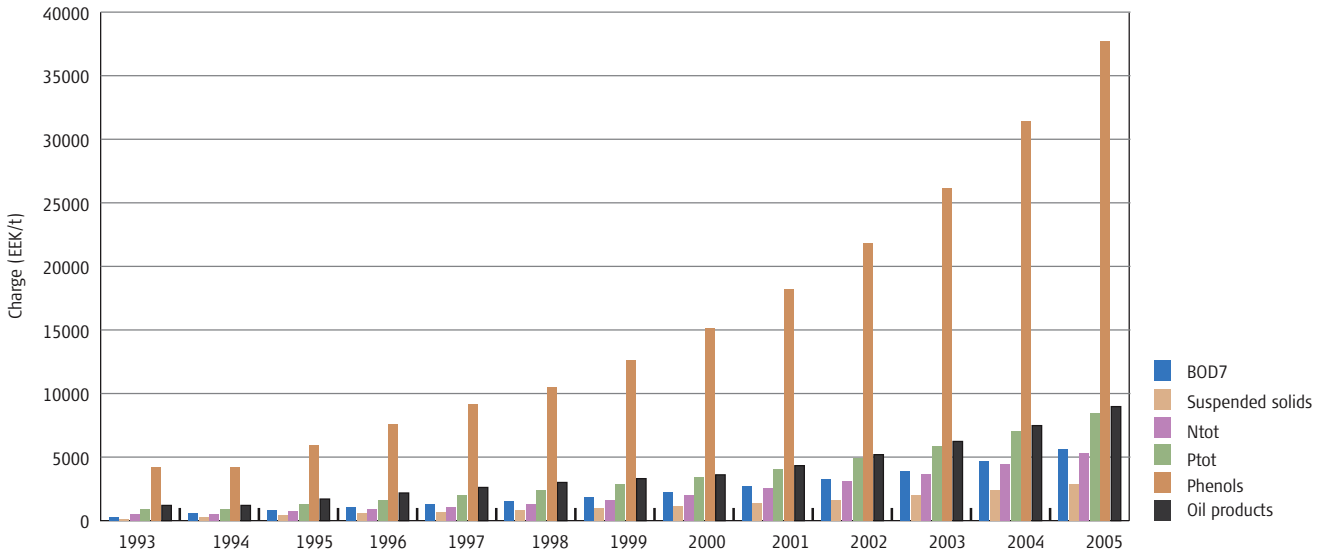
expected net returns to water. With subsidies to irrigation capitalized into higher land prices, governments find that levying higher user charges may not only depress farm income, but risk imposing significant capital losses on landowners. Nevertheless, many countries are moving toward collecting a larger proportion of irrigation costs from farmers. As part of a larger reform and decentralization effort, this trend aims not only to reduce public subsidies, but also to increase efficiency and the responsiveness of irrigation delivery. Such policies, often called irrigation management transfer (IMT), seek to shift the administration of all or part of irrigation water delivery to associations of water users, thus sharing the responsibility of water management. **Box 12.6** reviews the experience in various developing countries for transferring responsibility for irrigation water delivery to user groups.

4c. Charging for discharge of industrial effluent

An increasingly important aspect of water governance is the regulation of water quality. Water's solvent properties and widespread availability provide both producers and consumers with an inexpensive means of waste disposal. With public expectations of near zero effluent discharge, policy-makers face a paradoxical situation with regard to water use and quality. In many countries minimum waste disposal would be enormously expensive, even impossible, unless some important industries were closed altogether. Assessing the costs and benefits in such cases demands careful consideration of the relative effectiveness and desirability of the alternatives, not only from an economic perspective, but also in terms of the distribution of costs and benefits, the ease of monitoring and enforcement, and industry flexibility, among other factors. Although direct regulation has been the main tool of water quality management in the past, water pollution is increasingly being addressed by decentralized systems of incentives and disincentives, such as effluent charges (see **Chapter 8**).

The effluent charge, also called an emissions or pollution tax and essentially a fee levied on each unit of contaminant discharged, is based on the principle of 'polluter pays'. Initially this principle was intended to 'suggest' to governments that they should refrain from subsidizing investments required to comply with pollution-control regulations. A more recent interpretation holds that emission charges should be set so that the costs, or the economic value, of the damages inflicted by polluters on third parties are borne by the polluters themselves, in effect 'internalizing' the previously externalized costs of production. With the unit charge set to rise with

Figure 12.2: Actual and planned water pollution charges in the River Narva and Lake Peipsi Catchment, 1993–2005



Note: EEK/t is Estonian Kroon per ton. 1 Estonian Kroon (EEK) = 0.06390 Euro (2005).

Source: Environmental Information Center, Tallinn, Estonia.

increased levels of discharge, polluters may respond as they choose, that is, reduce effluent or pay the charges. Firms facing low pollution reduction costs relative to the charges imposed would presumably move to reduce discharges. Others might find it cheaper to pay the tax than to make the necessary pollution control expenditures. Such charges should provide incentives for pollution discharge to be reduced by the least cost methods available. All firms would find it in their interest to seek changes in processes, technologies and/or in discharge treatments that reduce the cost of coping with the problem of residuals disposal.

Criticisms have come from all sides but most prominently from polluters, who complain of potential impacts on profits and hence, over the longer term, on net worth and share value. Public officials, on the other hand, are concerned producers may be forced into reducing output and employment with corresponding negative effects on tax revenues. From the viewpoint of regulatory agencies, effluent charges present challenges of monitoring and enforcement. Environmental groups object to effluent charges on the grounds that they convert the environment into a commodity. Surveys of pollution control strategies in OECD nations show that environmental charges for the most part were not applied to induce less polluting behaviour nor to compensate damaged parties, but to fund specific environmental expenditures. Despite all criticism, effluent charges for water pollution management are seeing increasing application (see **Figure 12.2**).

Chemical outflow, Germany

Part 5. Responding to the Challenge of Valuing Water

In this section, we introduce some of the issues at the forefront of the debate on valuing water. The subjects addressed include public-private partnerships, virtual water and payments for environmental services. Private sector participation in water resources development can assist not only in meeting financial and management needs of this sector but in tailoring water services to better address local concerns and values. The concept of 'virtual water' – recognizing the value of water embedded, directly or indirectly, in various products and services – has come to influence both production and trade policy in an attempt to maximize returns to water as a scarce factor of production. Payment for environmental services, that is, paying upland farmers for land husbandry that preserves the output of clean and regular water supplies, directly acknowledges the value of the water to downstream users.

5a. A shared management approach: Public-private partnerships

Public-private partnerships (PPPs) are essentially a management tool designed to bring the strengths of both public and private sectors to water utilities. They combine the social responsibility, environmental awareness and public accountability of government with the technology and management skills and finance of the private sector (UNDP, 2004). Depending on the extent of private sector participation (PSP), public-private partnerships are also characterized by the state's changing role, that is, from one of sole service provider to monopoly regulator in charge of controlling tariffs and service quality (World Bank, 1994; Estache et al., 2005).

Sharing skills and resources

Despite the wide acknowledgement that the public sector in many regions lacks not only the economic resources, but also the technical and management skills required to meet water services demand in an efficient and environmentally sustainable manner, private participation in water services remains controversial because of water's essentiality for life (Cosgrove and Rijsberman, 2000; Gresham, 2001). In countries where the political and institutional climate make it difficult for governments to involve the private sector, contracting-out services, operation and management of the water supply, allows the public sector to take advantage of private sector technology and skills, while maintaining ownership of

BOX 12.7: WATER AND SEWERAGE SERVICES IN YEREVAN, ARMENIA

The World Bank made two loans worth US $80 million to Yerevan for improving water and sewerage services, in particular in poorer areas. In 2000, ACEA (Italy), C. Lotti & Associati and WRc (UK) undertook an operations and management contract for Yerevan. At that time just 21 percent of billed accounts were paid. Billing collection was revived through the introduction of metering from 2002. With an increase in the number of registered customers from 275,500 in 2002 to 311,056 by April 2004, 245,000 of these were metered and 28,000 filed as non-active accounts (empty apartments, etc).

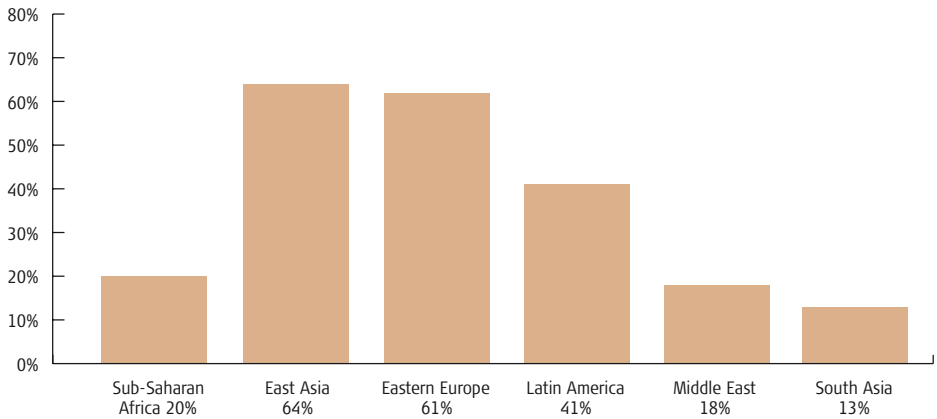
Service indicators	1999	2003	2004
Water provision (hours/day)	6	13	16
Percentage of metered apartments	56	–	95
Percentage of revenue collected	21	87	100

Instead of charging domestic customers a nominal per capita consumption of 250 litres/day, customers are now being billed for actual usage, on average about 100–120 litres/capita/day.

Some 30 percent of Yerevan's population lives below the poverty line. The introduction of metering has improved service affordability for these people. In 2002, the bottom quintile spent 8.1 percent of their income on water services. This fell to 5.0 percent in 2003 and is expected to reach about 4 percent in 2005, despite a 50 percent overall tariff increase in April 2004.

Sources: OECD, 2005; World Bank, 2005.

Figure 12.3: Share of private sector participation in water supply and sanitation by region



Source: Estache et al., 2005.

key assets (see for example **Box 12. 7**) (World Bank, 1997; Gresham, 2001; Estache et al., 2005). Private corporations are now involved in some dimension of large-scale water supply in almost half the countries of the world, particularly in the developed world, but also increasingly in the developing world as shown in **Figure 12.3**. The private sector's proportion of the water and sewerage sectors in developing countries comprises, on average, only 35 percent, whereas in developed countries it constitutes 80 percent of the market – in particular because of already high coverage rates and an institutional climate conducive to private investment (Estache and Goicoechea, 2004).

Reconciling cost recovery and affordability

Population growth and burgeoning water demand have convinced most policy-makers that the cost of water system development will increasingly have to be met by users, especially if the Millennium Development Goals are to be achieved. Meeting the financial challenge of water supply means the involvement of all stakeholders, with funds from governments, financial markets, international aid and users. However, with private sector participation – ranging from small water vendors to large private utilities – projected to increase in the next decades, the issue of pricing is critical, not only to improve access and quality of service and discourage theft and wasteful use, but to ensure affordability and fairness to all customers (Whittington, et al. 2002).

Recent problematic PSP experiments in some developing countries, such as Bolivia (see **Box 12.8**) and Ghana, highlight the need to ensure the availability of affordable water supply and sanitation for poor households (Finnegan, 2002). PSP arrangements – particularly those transferring the responsibility for capital investment to the private sector – can increase tariffs to levels often unaffordable for the poor. Accordingly, there is an urgent need to better understand consumers' conditions and to improve subsidy mechanisms in PSP schemes. Research has revealed that these benefits have been captured by middle-income and rich consumers rather than the poor and that the poor in many cases are willing to pay for improved water supplies. In sprawling cities of the developing world, poorer populations typically lack access to formal water systems and may pay more than ten times per cubic metre of water than people with household connections (Raghupati and Foster, 2002).

An inclusive approach

Technological change and more cost-effective, smaller-scale systems continue to alter market structures in water delivery, actively engaging civil society both through community-level initiatives as well as through large-scale water supply schemes (Estache et al., 2005). Public-private community partnerships incorporate innovative grassroots mechanisms to enable service to poor populations in small regions at more affordable levels. The 'private' side of these partnerships refers to a range of different actors, from households to community organizations, NGOs and small businesses. The 'public' side of the partnerships involves not only the public utility and the independent regulator, but local governments committed to facilitating grassroots initiatives (Franceys and Weitz, 2003). As in traditional public-private partnerships, each of these options may

Population growth and burgeoning water demand have convinced most policy-makers that the cost of water system development will increasingly have to be met by users

BOX 12.8: THE 'WATER WAR' IN COCHABAMBA, BOLIVIA

The city of Cochabamba, Bolivia, the third-largest city in Bolivia, has a chronic water shortage. A sprawling city of 800,000 people, whose population has exploded during the last decades with immigrant workers from the countryside, it has many poor neighbourhoods lacking connection to municipal water supplies. In recent years, residents in peri-urban areas pushed for workable community initiatives with the help of foreign aid. Small-scale water companies built electric pumps to access well water and distribute it throughout these neighbourhoods, at a total cost of US $2 to US $5 per month. In 1997, conditions on the World Bank US $600 million loan for debt relief included the privatization of the water supply in Cochabamba, and in 1999, a private operator was granted a 40-year concession contract to rehabilitate and operate the municipal water supply system, as well as the smaller ones. The contract provided for exclusive rights to all the water in the city, including the aquifers used by the water cooperatives. Billing and metering was implemented, with the cost of these services, as well as of connections, being reflected in the tariffs.

Within weeks of taking control of the city's water supply, prices were raised to unaffordable levels, effectively leaving the poor in marginal areas without access to any water as they were no longer permitted to draw water from their community wells. Workers living on the local minimum wage of US $60 per month suddenly had to pay US $15 for the water bill. In 2000, a coalition of workers, farmers and environmental groups, 'Coalition for Defence of Water and Life', organized a general strike and massive protests in opposition of the rate hikes. Bolivians blocked highways, and the city was shut down. Police forces and the military were sent to take control of the city, and martial law was declared. As protests grew stronger despite being suppressed, the private operator withdrew from the city and the government rescinded the concession contract. This experience led the government to reconsider private sector participation, and to enact a law granting legal recognition to traditional communal practices, under which small independent water systems shall be protected.

Source: Finnegan, 2002.

allocate ownership rights and responsibilities for investments and management differently. In larger-scale initiatives private corporations can also partner with local governments and NGOs. NGOs can provide local governments with information on the specific needs of poor areas, which then can be better addressed in negotiating concession contracts, for example, by defining specific connection targets or obligations for expansion into peri-urban areas. NGOs and communities can also participate in tariff collection on behalf of the private utility in exchange for deferred payment of connection fees. Likewise, municipal governments can facilitate connections by, for example, waiving the land title requirements for slum dwellers. To reduce connection costs, NGOs can help by providing transportation and materials, while the community contributes labour, for instance carrying pipes, digging trenches and laying lines (Franceys and Weitz, 2003). As described in **Box 12.9**, researchers have discovered such innovative approaches in Manila in the Philippines.

The value of public-private partnerships

Both the value and economic valuation of water are important in assessing water supply and sanitation alternatives. While privatization may not be suitable in all cases, neither are underfinanced public utilities a sustainable solution given burgeoning water demand. Likewise, the global replication of community-driven arrangements is not viable on a large-scale. Experience with both public and private delivery of water services over the past decade has taught us that ownership of water infrastructure, whether public or private, has no significant effect on efficiency nor on the selection of the public versus private sector as service provider (Estache and Rossi, 2002; Wallsten and Kosec, 2005). Indeed, ownership has proved less significant than governance, and thus a good institutional climate is important, not only for private sector investment, but for the transfer of relevant technical knowledge and management skills (Estache and Kouassi, 2002; Bitrán and Valenzuela, 2003). Similarly, institutional mechanisms that enable various degrees of engagement by consumers must be put in place in order for efficiency-oriented water supply schemes to be successful. Ultimately, the decision as to whether to involve the private sector, civil society and government is political and influences the kinds of governance mechanisms needed to ensure efficient and equitable service.

Provided that mechanisms to ensure affordable access by those without ability to pay are put into place, the potential economic and social benefits of improved access to water services are great. In addition to the considerable health benefits gained from connection to the official

BOX 12.9: TARGETING THE POOR THROUGH GRASSROOTS MECHANISMS IN MANILA, THE PHILIPPINES

In 1997, a twenty-five-year concession contract for water supply and sewerage in the city of Metro Manila, Philippines, was granted to two companies: Manila Water Company to supply the east side, and Maynilad Water Services to provide the west side of the city, with an aim at having spare capacity in case of failures. In order to increase access to the poor, the concession agreement provided for public standpipes for every 475 customers in 'depressed' areas. Instead of implementing this conventional solution, both companies have devised innovative approaches to extend service to poor areas.

Manila Water has a programme which relaxes some application requirements in order to enable water connections for poor customers. Group taps are designed for every two to five households where users get together to apply for a single connection. The group is given a 'mother meter' and thus, share the cost of their usage. Each group chooses a representative, who is in charge of collecting and paying the bill to Manila Water. Besides group taps, Manila Water has a programme of community-managed water connections whereby a metered master connection is provided, and a community association acts as water distributor through individual or shared connections, which allows local residents to manage water according to their needs.

Maynilad Water Services favours individual to shared connections. Under its 'Water for the Community' programme, the land title requirement for connections is waived and payment of connection fees is deferred over a period of six to twelve months, and in some cases twenty-four months. NGOs were crucial in providing information to the private utilities, as well as in information campaigns aimed at community mobilization. They helped with the provision of materials while the community contributed labour for carrying pipes into the city, which helped decrease connection costs. The number of connections has increased dramatically, and poor consumers, who now pay less for water than under their previous informal supply arrangements, are able to enjoy the same kind of services provided to other sectors of society.

In specific focus group discussions, several residents stated that connecting to the urban water supply had greatly decreased their water bills. In the Liwang Area of Manila, one resident related that, after being hooked up to the network, her monthly bills came to on average between 25 and 50 pesos per month, in contrast with 40 pesos per day spent on informal water vendors. Another resident, who used to pay a flat fee of 300 pesos per month to a neighbour with access to the system, now pays 60 pesos per month for a larger amount of water.

Source: Franceys and Weitz, 2003.

network, poor people freed from the burden of water collection can expect to have more time to engage in productive poverty-alleviating pursuits. Similarly, the public sector can expect to benefit from a reduction in unaccounted-for water losses, enabling them to price water more efficiently and potentially reduce subsidy mechanisms. Finally, participation of all kinds, from information-sharing, to consultation in PSP arrangements, to having a voice in decision-making and management in public-private community partnerships, is crucial for the long-term success of improved water supply and sanitation.

The choice of public-private partnership depends on the political, institutional, social and cultural features of the area where the service is to be provided. An assessment of the capability of governments to provide service in the target areas plus an analysis of the costs and benefits of different options and associated tariffs – including their potential impact on different sectors of society – will enable policymakers to make more informed choices as to which management tool can provide water services that best meet the societal goals of equity, efficiency and environmental sustainability.

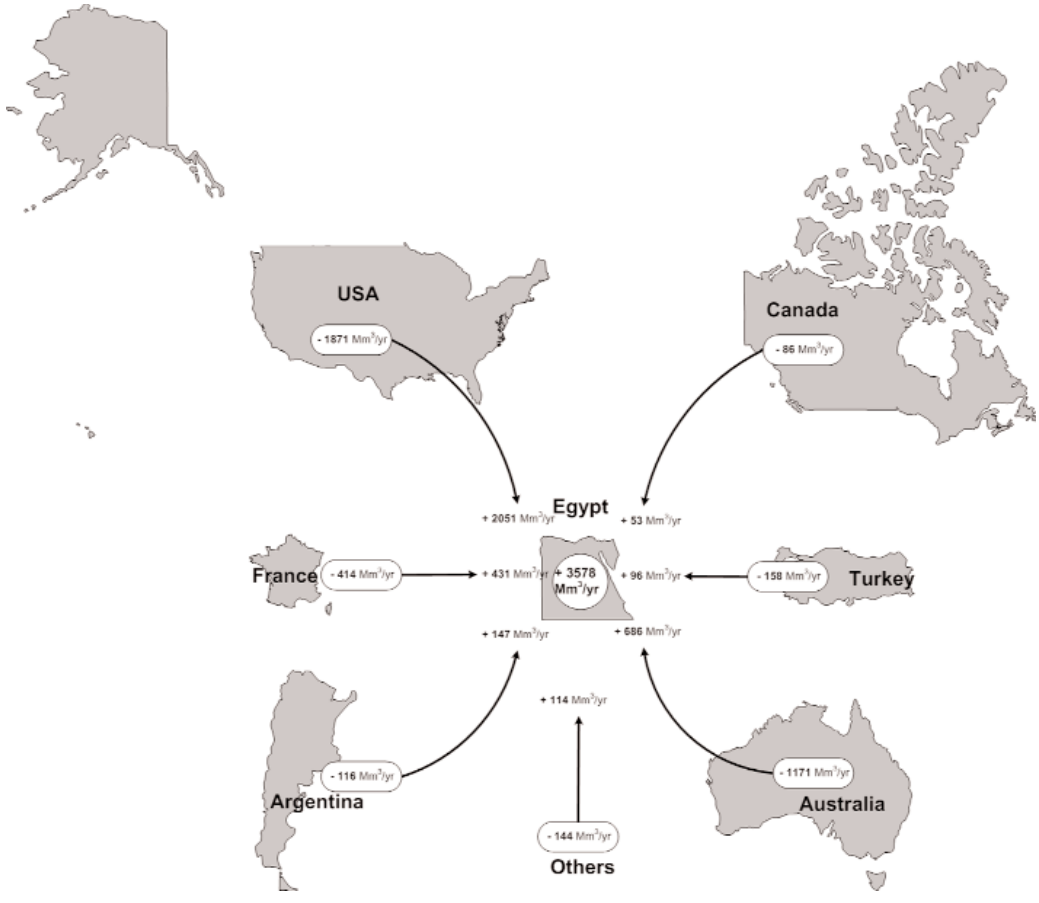
5b. Virtual water trade

Virtual water, a concept that emerged more than a decade ago, is defined as the volume of water required to produce a given commodity or service. Allan proposed the term 'virtual water' to describe a phenomenon he observed in countries of the Middle East. They were using imports in the form of water-intensive products, such as food, to create a 'virtual' inflow of water as a means of relieving pressure on scarce domestic water resources (Allan, 1997). Several Middle Eastern nations, most notably Jordan and Israel, have altered their trade and development policies to promote the import of water-intensive products, generally agricultural crops, and the export of crops of high water productivity, that is, high income per unit of water consumed in production (Hofwegen, 2003). The adoption of such policies, in effect, recognizes the value of water.

As Allan (1997) noted, 'It requires about 1000 cubic metres of water to produce a ton of grain. If the ton of grain is conveyed to ... [an] economy short of freshwater and/or soil water, then that economy is spared the economic, and more importantly the political stress of

Wetlands in Amboseli Reserve, Kenya. These wetlands are fed by the Kilimanjaro mountain glaciers

Figure 12.4: Estimated annual water savings attributed to trade in wheat, Egypt, 1997–2001



Note: Negative figures indicate the amount of water consumed in the production of the quantity of wheat exported, whereas positive figures indicate the amount of water savings by the importing country. Conversion formulas vary by country depending on various factors, including seed stock, type of technology used, and water management efficiency in the different countries.

Source: Chapagain and Hoekstra, 2005.

mobilizing about 1000 cubic meters of water.' These 'water savings' can be used to produce alternative, higher-value agricultural crops, to support environmental services, or to serve growing domestic needs. As seen in **Figure 12.4**, the imported goods may require more water during production in the alternative source country, but presumably this would be a country suffering from less water stress so that, overall, the efficiency of water use is promoted. Thus, 'virtual water' embedded in products is increasingly perceived as an alternative source of water for some water-stressed nations (see **Chapter 11**).

Recent research has revealed that the flow of such virtual water between nations is substantial (Hoekstra and Hung, 2002; Chapagain and Hoekstra, 2004; Chapagain et al., 2005). As observed by Allan (1997) 'more water flows into the Middle East each year as virtual water than flows down the Nile into Egypt for agriculture'. Worldwide, the virtual water in international trade totals 1,625 Gm^3 annually. This amounts to about one-fifth of total world trade with approximately 80 percent of virtual water flows as trade in agricultural products, and the remainder as industrial products (Chapagain and Hoekstra, 2004) (see **Chapters 7 and 8**).

Increased trade in 'virtual water' has been proposed as a means to increase 'global water use efficiency', improve 'water security' for water stressed regions, and alleviate environmental impacts due to growing water demand (Turton, 2000). Emerging from the apartheid era, South Africa realized the potential benefits of adopting policy supporting virtual water imports as opposed to an

ambitious programme of inter-basin water transfers (Allan, 2003). However, the concept of virtual water has not been accepted worldwide. Attempting to link agricultural imports directly to water dependency is difficult as numerous factors besides water availability affect farmers' planting decisions and production methods. Special trade arrangements, access to foreign exchange credits, market advantage – all affect the market and thus, decisions in the agricultural sector. Changing patterns of trade based on water conservation concerns need to be examined in the context of larger, national issues, including food security, food sovereignty[14], employment, foreign exchange requirements and perceived vulnerability to external political pressure. Additional research needs to be conducted on the social, economic, political as well as environmental 'implications of using virtual water trade as a strategic instrument in water policy' (Hofwegen, 2003). In the current period of political, economic and environmental uncertainty and instability, it is unlikely that societies will soon abandon the goal of food security. The new concept of food sovereignty introduced in recent years reflects the concerns of the small-scale agriculturalists. Llamas (2003) has argued that adopting 'virtual water trade' as a policy would require that the World Trade Organization or another international institution guarantee a prohibition on food embargos.

It should be noted that the concept of virtual water is still in developmental stages and several computational difficulties remain to be overcome. Figures on virtual water trade must be viewed cautiously as considerable uncertainty is associated with some of the underlying assumptions. Given the significant spatial and temporal variability in crop productivity and irrigation efficiency, extrapolations across geographic area and cultures could be problematic. Distinction should also be made with regard to the origin of the 'virtual water' in question (Llamas, 2003). Groundwater and surface water (see **Chapter 4**) have many alternative uses whereas options for soil moisture are more limited. One key question raised is: does adopting the concept of virtual water in designing trade policy contribute to an improvement in water availability?

Virtual water is an interesting concept, especially where water is in critically and chronically short supply and it will undoubtedly play an important role in influencing production and trade strategy for some nations. However, water is not the only factor of production and other factors, such as energy costs, may come to play an increasingly important role in determining water resources allocation and use. It has been suggested that the concept of 'virtual water' trade is most applicable to the developed or high-income countries and that policies that might work for the relatively rich Middle East countries, however, may not work for the poorer economies of sub-Saharan Africa. This raises the question as to whether this approach will serve to alleviate or accentuate the differences between the rich and the poor countries.

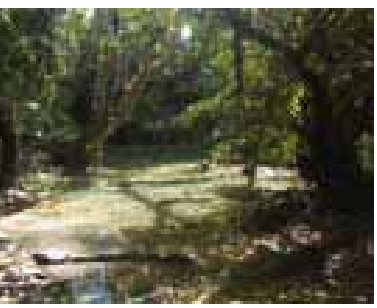
The concept of virtual water could be valuable in promoting the production and trade in goods most suited to local environmental conditions and the development and adoption of water efficient technology. Adopting this approach, however, requires a thorough understanding of the impacts of such policies on socio-cultural, economic and environmental conditions, from local to national and regional levels. As the rigour of the analytical tools improves, undoubtedly so too will the usefulness of the concept of virtual water in terms of integrating the concerns of different sectors. However, as Allan (2003) observed, it may be that 'the virtual water remedy to local water scarcity will be shown to depend more on political processes rather than the scientific authority of the idea or precision with which it is defined'. In effect then, the success of the concept of virtual water may well turn on the achievements of global trade negotiations.

5c. Payments for environmental services

'Valuing' water is increasingly being extended to include an appreciation of human activities in upper catchment areas that contribute to maintaining the regular flow of clean water for downstream users (Pagiola and Platais, 2002; FAO, 2004). As increasingly recognized, land use and land cover management in the uplands affects water cycling through the Earth's natural systems. Healthy, intact ecosystems and their geologic substrate facilitate the hydrological cycle, filtering percolating water, distributing nutrients, providing a nurturing habitat for a wide diversity of wild animal and plant populations (biodiversity), and storing carbon. These and other functions, known as 'environmental services', endure only if fragile areas are protected, over exploitation of resources is avoided, pollution limited, and human intervention mediated by natural buffers. With the increasing recognition of the value of environmental services over the past decade, a variety of schemes have emerged that propose 'paying' for ecosystem services, or rewarding human actions contributing to preserving these

Local community installing water pipes for their village in Kinhare, Tanzania. This project will bring safe drinking water to the region for the first time. Previously people had to collect often unsafe drinking water from distant streams and carry it in buckets

14. Food sovereignty has been defined as the right of peoples, communities and countries to define their own agricultural, labour, fishing, food and land policies so that they are ecologically, socially, economically and culturally appropriate to their unique circumstances. It includes the right to food and to produce food, which means that all people have the right to safe, nutritious and culturally appropriate food and to food-producing resources and the ability to sustain themselves and societies. (*Source*: 'Food Sovereignty: A Right for All', a political statement of the NGO/CSO Forum for Food Sovereignty. Issued on 13 June 2002, in Rome). www.foodfirst.org/progs/global/food/finaldeclaration.html



functions. In effect, these schemes attempt to link the 'benefits' enjoyed by downstream users to the 'costs' incurred by the *de facto* catchment managers.

In one sense, paying for environmental services is an extension of the concept of 'cost recovery' discussed above. Payments for environmental services would fall into the category of indirect operating costs (see **Figure 12.1**). Acknowledging and compensating those individuals who actually manage the environment by those who benefit from these services attempts not only to reward good land husbandry, but in formalizing the relationship between the two groups of users, also enhances the long-term security of these ecosystem functions and the downstream benefit flows. Formal legislative support for payments for environmental services is recognized as one means of developing a sustainable source of environmental funding perhaps less vulnerable to political vagaries.

Payment for environmental services (PES)[15] has been commonly considered in the context of watershed management, biodiversity conservation, and more recently, carbon sequestration. Watershed-based PESs have a longer history and thus seem more straightforward. They avoid many of the constraints inherent in some of the newer schemes focusing on biodiversity conservation and carbon sequestration. As Scherr et al. (2004) observed, [m]arkets for watershed services are site and use specific and currently are limited to situations where the downstream beneficiaries – such as hydroelectricity power generation, irrigators, municipal water supply systems and industry – are directly and significantly impacted by upstream land-use'. Most payment schemes are in their infancy with analysts still learning from pilot projects both in developed and developing countries. The wide diversity of approaches reflects the variety of services supplied, participants' concerns, and physical and cultural environments. Ongoing programmes show promising results, however, with good prospects for scaling up to the basin, regional or national level (Scherr et al., 2004; Gouyon, 2003).

Typically, we find that watershed-based payment schemes fall into one of three categories: public payment programmes, self-organized private arrangements and open trading. Latin America and several of the developed countries have most experience with such schemes (FAO, 2004). The types of payment mechanisms associated with catchment protection include: best-management practices contracts, protection contracts, water quality credits, stream flow reduction licences and reforestation contracts. Compensation generally comes in a variety of formats but mainly occurs as: direct financial remuneration; payment in kind, for example, infrastructure and equipment; and/or privileged access to resources or markets, for example, land-use rights. Case studies show that compensation programmes can have significant positive impacts on local livelihoods (InfoResources, 2004). In Costa Rica, landholders in watersheds designated critical are paid between US $30 and US $50 per hectare per year for good land management practices (Scherr et al., 2004). In Mindanao in the Philippines, regular payments to residents in the catchment area of the Mount Apo geothermal facility have been ongoing for many years (Warner et al., 2004), while in Europe a new PES project is being planned for the lower Danube River Basin (see **Chapter 14**).

Whereas typically, development programmes channel funds to or through local governments, it is proposed that new programmes could more efficiently and effectively target funds directly to the environmental stewards themselves. Transparent processes and multi-stakeholder involvement with emphasis on locally determined priorities and participatory planning, implementation and monitoring are needed to bridge the gap between proposed and existing programmes. Given the close links between poverty and resource dependency, designing PES programmes that reward the poor for good natural resources stewardship is key to effective conservation. While the vulnerability of hydroelectric facilities to poor land management in catchments is of growing concern, for many countries the not unrelated issue of poverty alleviation, particularly in rural areas, has become a national priority, as has the decentralization of government services. The potential of PES schemes to address these several issues is increasingly recognized. Indeed, paying for environmental services, in particular as related to hydroelectric production, responds to the demands for clean energy – hydroelectricity being a well-known example (see **Chapter 9**) – for better catchment area management, for greater local responsibility, and for poverty reduction. Lessons have already been learned, as indicated in **Box 12.10**. In building on royalty programmes traditionally associated with resource extraction, PES seems to have the potential to serve as a new paradigm for sustainable watershed management, integrating the concerns of users throughout the basin.

15. Another related term is 'green water credits', which are payments proposed as a mechanism for the transfer of cash to rural people in return for better management of 'green water' (see **Chapter 4**) resources (Dent, 2005).

BOX 12.10: LESSONS LEARNED IN PAYING FOR ENVIRONMENTAL SERVICES

A review of programmes in which payments for environmental services have been made concluded that these schemes are most successful when:

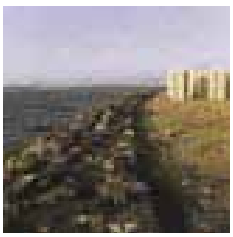
- financial sustainability is promoted by independence from long-term external financial support
- locally defined best management practices are taken into consideration
- transaction costs are minimized
- rights and responsibilities of all parties including intermediaries are clearly defined
- payment is linked to performance monitored regularly
- resource rights and tenure are secured
- legal and institutional frameworks create an enabling environment
- mechanisms for fees assessment, collection and disbursement are locally determined, clearly defined, and transparent
- poverty reduction is explicitly addressed, especially providing women and disadvantaged groups with opportunities to participate in planning, implementation and monitoring, for example, targeting small-holders as service providers.

Source: Warner et al., 2004.

According to many analysts[16], '[m]arkets for forest ecosystem services are expected to grow in both developed and developing countries over the next two decades' (Scherr et al., 2004). Currently nearly one-third of the world's largest cities depend on forested watersheds for their water supplies (see **Chapter 3**). Water demand, projected to double if not triple in the coming half century, will grow fastest in the developing world. It is increasingly apparent to water providers and water users that investments in watershed protection can be far more economical than investments in costly engineered solutions, such as water treatment plants or long-distance canals. For governments – principal purchasers of many ecosystem services but also catalysts for many private-sector payment schemes – incorporating PES schemes in basin-wide integrated water resources management programmes has the potential to deliver rural poverty alleviation as well as environmental conservation and enhanced water security. Thus, recognizing the value of environmental services in the very real sense of financial compensation may be an attractive alternative to governments facing growing rural-to-urban migration and increasing pressure on already overstretched urban water supply systems.

The assessment of strictly anthropogenic impacts is tricky, especially as the timing and scale of the impacts of different land-use and vegetation management practices on hydrological function and resources vary according to local environmental conditions – which are sometimes confounded by natural phenomena. Experience has shown that although the effects of human actions are more directly observed in smaller catchments, they are also visible on larger scales. More extensive monitoring and evaluation is needed in order to better understand land-use and water linkages so as to refine the diverse mechanisms emerging for compensation for environmental services (Fauré, 2004).

16. Founded in 2000, the Katoomba Group is a collection of government officials, private sector professionals, academic researchers and NGO representatives devoted to sharing information and experience on development of financial markets for ecosystem services. www.katoombagroup.com/



Part 6. Indicators under Development

Economic valuation has been defined as the task of assigning a money metric to the benefits and costs associated with different policies so that different governance options can be compared and ranked. To enable the comparison of actual achievements against targets or projected outcomes, we must look to selected variables for quantitative measures that we could employ as 'indicators'. The indicators noted below are those that could be used to monitor progress towards society valuing water in a manner likely to realize societal objectives, including efficiency, equity and environmental sustainability. The indicators noted are still in developmental stages and clearly more research and experience is needed to assess their ease of use, robustness, and reliability with regard to understanding their utility for cross-country comparisons.

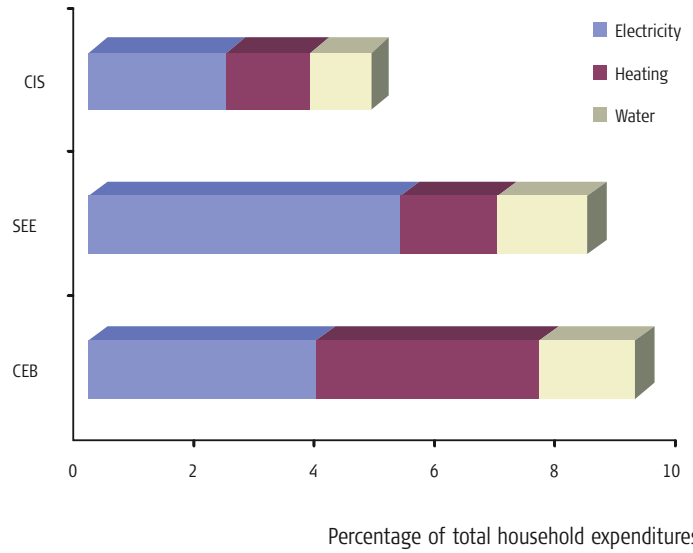
Water Sector Share in Public Spending: In highlighting public-sector spending in the water sector, this indicator illustrates the level of political commitment to meeting the Millennium Development Goals (MDGs) on water. Expressed as a percentage, this indicator shows the proportion of the total public budget allocated to water systems development. Data on annual investments by sector are generally available from national statistical yearbooks, country-wide economic reviews, and the government office responsible for water sector development. Widely applicable, this indicator could be used at any level where statistics are available.

Ratio of Actual to Desired Level of Investment: This indicator illustrates the extent to which investments required to meet water-related MDGs are on track. Computed as AL/DL, where AL is the actual level and DL refers to the desired level of investment, this ratio indicates the degree to which planned investment is realized. Although not an indicator of actual hook-ups, the allocation of funds for the installation of the necessary infrastructure is a crucial first step. The data required for this calculation should be available from the national budget documents. Data on desired level of investment could be obtained from the project documents and feasibility studies of relevant infrastructure development projects, or perhaps government offices in charge of water resources planning and infrastructure development.

Rate of Cost Recovery: This indicator measures the total amount of fees actually collected as a proportion of total revenues scheduled to be collected. It reflects as well the effectiveness of fiscal administration and institutional governance in the water sector. Data required to prepare this indicator include: total water charges to be collected and those actually collected. These are usually available from the published annual reports of water utilities and national budget documents. The rate of cost recovery could also be viewed as an indicator of the population's willingness to pay for water services. The effectiveness of the fee collection system will have a direct influence on private sector willingness to invest in this sector and the ability of public water systems, which depend on cost recovery through charging, to meet projected expansion plans as well as maintenance obligations.

Water Charges as a Percentage of Household Income/Expenditure: Water charges are seen as an important instrument for improving cost recovery in the water utilities sector. Expressed as a proportion of household income or household expenditure, water charges illustrate the pressure of this expense on household finances (see **Figure 12.5**). Indirectly, this figure may also serve as an indicator of household willingness to conserve and use water efficiently. A very low rate would indicate little incentive to conserve or use water efficiently. The potential for introducing effective demand management measures would depend on this figure. Data required to estimate this indicator are generally collected through household income and expenditure surveys conducted by governments at regular intervals.

Figure 12.5: Affordability of utility services in Eastern Europe and Central Asia, 2003–04



Key: CIS = Commonwealth of Independent States: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.
SEE = South Eastern Europe: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR Macedonia, Romania and Serbia and Montenegro.
CEB = Central Eastern Europe and Baltic States: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia.
Note: Affordability estimates are unweighted averages. Data on district heating were not available for Albania and Georgia, where heat networks are not functioning.

Source: Fankhauser and Tepic, 2005.

Part 7. Conclusions and Recommendations

The supply and affordability of water is of growing political and economic concern as it is increasingly recognized that safe water is not only essential for health, but also for social and economic development. As the world's population grows in numbers and wealth, the demand for more and better water supply and sanitation services increases, as does the competition between sectors serving other societal needs, such as food, manufactured goods and environmental services. Understanding the value of water is essential if this ever more scarce resource is to be more effectively and efficiently applied to meeting societal goals.

Valuation is the process of assessing the impact of various policies and initiatives then assigning weights to various policy outcomes based on the importance of various policy objectives or criteria. Value, in this sense, is not assigned specifically to water but to consequences of a change in governance or policy initiatives. Values vary depending on the services in question, the location, the policy context and other circumstances. Economic valuation assesses outcomes based on willingness to pay and willingness to accept compensation. Other considerations include social values, such as rights to clean water and adequate sanitation irrespective of ability to pay, gender equity, and respect for religious and cultural beliefs and environmental concerns, including concern for biodiversity preservation and wetland protection.

Economic valuation can be useful for assessing the potential net benefits of proposed public policy initiatives as well as the realized benefit of previous policies. For example, research indicates that the economic returns to public investments in irrigation in Asia over the past three decades have been quite modest as compared to returns from alternative investments (e.g. research, rural roads and education) or even the cost of capital. High benefit-

cost ratios for investments in water supply and sanitation in areas where such facilities are lacking suggest that a reallocation of resources toward domestic water services would improve social welfare.

Though considerable effort has gone into expanding and refining the analytical methods for measuring water-related values, results are only as reliable as the assumptions and data upon which the analyses are based. More work needs to be done on refining these tools and improving data collection. Economic valuation is rarely seen as a wholly acceptable solution. Although helpful in elucidating the trade-offs between different objectives in alternative scenarios, it is often necessary to enter the political realm or formalized negotiations in order to resolve the dissonance inherent in situations containing multiple conflicting objectives. Greater attention needs to be focused on understanding more clearly '*who benefits*' and '*who bears the costs*' in any water resources policy or development initiative. Seeming inconsistencies in governments' stated objectives and activities can often be understood by analysing the distributional aspects of government investments.

Charging, as a governance policy, aims to balance multiple competing objectives. Most water professionals now feel that the reform of charging policies is critical to improving the performance of the water services sector. Revised charging structures need to be more widely implemented to improve cost recovery, to facilitate adequate maintenance and expansion of water supply systems, and to provide incentives for conservation, while making water services affordable and available to all. The political unpopularity of increased charges will need to be overcome with phased tariffs in some areas but also programmes to help consumers understand the true costs and value of regular, reliable water and sanitation services. Given that willingness to pay, the limit to charging, is a function of information, better informed, and better served, customers should facilitate cost recovery and thus the development of water services. For the moment, however, many poor find full-cost charging, unaffordable, so subsidies will probably need to be maintained in many areas if MDGs on water supply and sanitation are to be met in the near term.

Several factors, but especially the shortfall of funds for infrastructure development, have led many national and local governments to look to the private sector for assistance in water systems management and development. The experience of private sector involvement in the water sector, however, has been decidedly mixed. Indeed, dissatisfaction with water services after private sector involvement brought consumers onto the streets in Bolivia. Given the nature and role of the resource, the nature of associated infrastructure investment and the social sensitivity regarding water supply, it is almost impossible to depoliticize water. However, an increasing number of examples of successful public-private partnerships should serve to enlighten future developments. Governments, for their part, need to take more seriously their regulatory responsibilities to ensure quality service and socially equitable access.

Virtual water, that is, the water embedded in various goods, has become a topic of increasing interest as water-stressed countries reassess their production priorities. Many nations have realized that they can in effect import 'virtual water' in the form of goods requiring significant water for their production, for example, food. Thus, countries experiencing severe and persistent water stress may opt for trade policies focused on importing water-intensive goods while exporting more high-value water-efficient products. Similarly, the growing interest in payment for environmental services reflects societies' and governments' heightened appreciation of the value – including cost savings – of ecosystem functions especially as related to water supply. These include filtering water, regularizing water flows, and buffering against flood and tidal surges.

Throughout this chapter the concept of measurement has dominated the discussion. Although we acknowledge that some values of water are difficult if not impossible to measure, informed decision relies upon such information developed largely through regular monitoring and data collection. Indicators which focus on critical aspects of water resources management and allocation have an important role to play in developing efficient and effective systems of water governance. Continued work is needed to further refine the art and science of developing indicators, particularly with regard to the social and environmental dimensions of value, and at the local and national level. Both theoretical and real-world studies are needed.

As freshwater becomes ever scarcer and increasingly contested, the importance of understanding the diverse values of water increases. Recognizing the distinction between 'valuing' and 'valuation' is critical. Valuing water

is not solely a matter of applying sophisticated economic techniques and calibrating various water-related goods and services in terms of a money metric. Rather, it means involving all stakeholders in a process of determining priorities and making informed decisions on specific courses of action that will enable society to better meet its water-related goals. Economic valuation is a tool that can assist in this process and charging is but one strategy among many possibilities. It is important not only that more individuals involved in policy making and planning are made aware of the strengths and weaknesses of the various economic techniques that can be applied in assessing governance strategies, but that stakeholders become better capable of understanding and articulating the wide spectrum of values that water holds for them.

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World Water Council on virtual water: www.worldwatercouncil.org/index.php?id=866

For definitions:
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