

Water is an economic good: How to use prices to promote equity, efficiency, and sustainability

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1. Introduction

In 1992 the Dublin Water Principles claimed “water as an economic good” for the first time in a UN setting. But water has been recognized as an economic good for many centuries before 1992. Throughout Europe and the early United States private water supply companies thrived in a wide variety of settings. The “sanitary revolution” of the 19th century saw the demand for public ownership and management of most of these companies in the name of public health. This, of course, did not obviate the need for water to be treated as an economic good, but a heavy emphasis on the public-good nature of water and its disposal led to the development of heavily subsidized public systems. With the exception of France, this was the path followed in most countries around the world. In the late 1980s, however, the World Bank and other multilateral and bilateral institutions discovered the virtues of “privatization” in the provision of public services and with privatization all of the attendant problems of setting tariffs and prices.

There are many different ways to promote equity, efficiency and sustainability in the water sector and water pricing is probably the simplest conceptually, but maybe the most difficult to implement politically. For example, the typical *command and control* approach taken in most countries with respect to water management leads to large government involvement because of its needs for detailed hands-on monitoring and measurement. Using price policies, however, still requires significant government intervention to ensure that equity and public goods issues are adequately covered. This paper focuses on the role of prices in the water sector and how they can be used to promote equity, efficiency, and sustainability.

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1.1. *Effects of price policies*

Economic theory has long ago explained how correct pricing of private and public goods can lead to gains in economic efficiency. From this literature, however, it is assumed that, given the typical price and income elasticities for water and the typical income distributions encountered, raising prices is regressive and therefore reduces equity. We argue in this paper that the conventional wisdom is incorrect—increasing prices can improve equity. Higher water rates allow utilities to extend services to those currently not served and those currently forced to purchase water from vendors at very high prices. More surprisingly we argue that price policy can help maintain the sustainability of the resource itself. When the price of water reflects its true cost, the resource will be put to its most valuable uses. In Table 1 we list the three generally accepted effects of price policy; demand reduction, efficient reallocation of the resource, and increasing the supply, together with three effects which are not generally associated with price policy, namely; improved equity, improved managerial efficiency, and improved sustainability of the resource. Here “water resources” encompasses surface water, groundwater and wastewater. We show that if water resources are managed in an integrated fashion where the economics, legal and environmental aspects complement each other, increased prices do improve equity, efficiency and sustainability of the resource.

Table 1
Three well-known and three lesser known effects of price policy

(a) <i>Increased price reduces demand</i>
(i) Substitutes become cheaper
(ii) Conservation becomes affordable
(iii) Change consumption preferences
(b) <i>Increased prices increase supply</i>
(i) Marginal projects become affordable
(ii) Provides economic incentives to reduce water losses
(c) <i>Increased price facilitates re-allocation between sectors</i>
(i) From irrigation to domestic and industrial
(ii) From off-stream to in-stream uses
(d) <i>Increased prices improve managerial efficiency due to increased revenues by</i>
(i) Improving maintenance
(ii) Improving staff training and education
(iii) Making modern monitoring techniques affordable
(iv) Making modern management techniques affordable
(e) <i>Increased prices leads to sustainability</i>
(i) Reduces demands on resource base
(ii) Reduces pollution loads due to recycling of industrial water
(f) <i>Increased prices reduce the per unit cost of water to poor people</i>
(i) Increases coverage of poor urban and peri-urban populations because additional water is available for extending the system
(ii) Reduces reliance by the poor on water vendors

1.2. Full cost pricing of water

The problem faced by the water sector is that prices and tariffs are almost universally below the full-cost of supply. This means that almost everywhere there are large inefficiencies in the water sector and that water prices need to be raised. The recent World Water Commission strongly endorsed the need for full-cost pricing of water services:

Commission members agreed that the single most immediate and important measure that we can recommend is the systematic adoption of full-cost pricing of water services (World Water Commission, 2000, p. 33).

Unfortunately, there is some ambiguity on the exact definition of full-cost pricing. Here we use the definitions given by Rogers, Bhatia, and Huber (1998) for full-cost pricing of water services. That paper shows the relationships between full-supply cost, full-economic cost, and full-cost. They also provided definitions of the value-in-use of water services showing the relationship between economic value and full-value. In addition to cost and value, the third parameter needed for implementation of water price policy is the tariff, or price, to be charged for the water service. Unfortunately, the literature on water pricing often confuses costs, value, and price. For a clear policy analysis it is important to keep these three concepts distinct. Table 2 and Fig. 1 show these

Table 2
Three important concepts from water economics

COST	O&M costs, capital costs, opportunity costs, costs of economics and environmental externalities
VALUE	Benefits to users, benefits from returned flows, indirect benefits, and intrinsic values
PRICE	Amount set by the political and social system to ensure cost recovery, equity and sustainability. The price may or may not include subsidies. Prices for water are not determined solely by cost

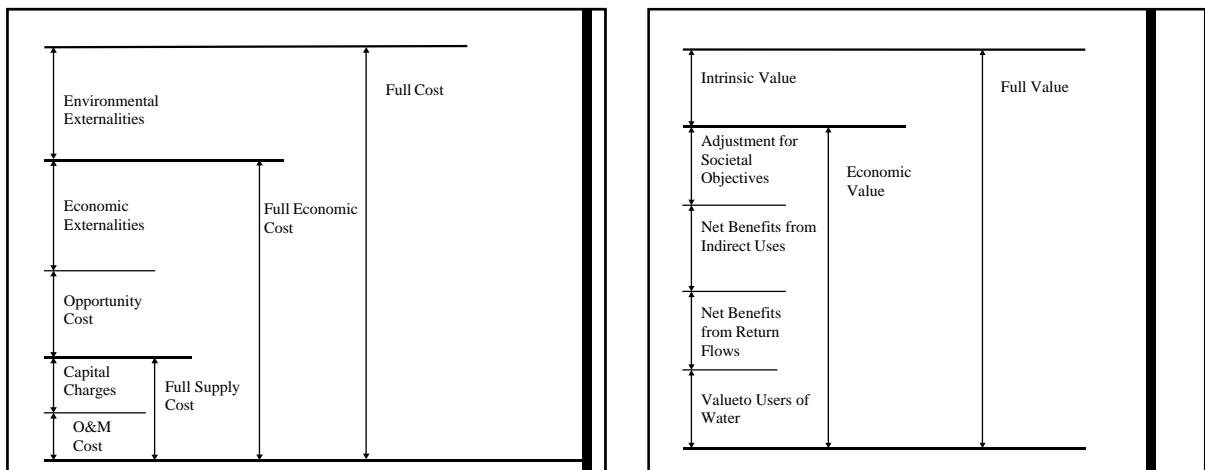


Fig. 1. General principles for cost and value of water.

concepts and how they relate to each other. Rogers et al. (1998) give detailed definitions of each of these components.

1.3. Pricing policies in OECD countries

Jones (1998) and OECD (1987, 1999a–d) summarize the recent developments in water pricing in the OECD countries. The Polluter Pays Principle (PPP) and the User Pays Principle (UPP) are now widely accepted in the OECD countries. The UPP was recommended as a measure to “at least cover the opportunity costs of capital, operation, maintenance, and environmental impacts.” OECD (1989). This mirrors the recommendations of Rogers et al. (1998) and the Commission on Water for the 21st Century’s Report (2000).

There has been increasing participation by the private sector with the government moving away from the role of “provider” to “regulator” of water services. Most countries have, however, chosen the “concession” rather than the “full privatization” model for development. The precise form of private sector participation still varies considerably. “Full” privatization (asset ownership and management) are found in England and Wales, and the Czech Republic; investor-owned in the US; and concessions (delegation of authority to fully private concerns) in France, Spain, Portugal, Hungary, Poland. Traditional direct/delegated public management is still found in Belgium, Denmark, Canada, Greece, Korea, and Sweden, and some areas in Austria and Italy (OECD, 1999c).

1.4. Pricing policies in Asian development bank member countries

The Asian Development Bank (1993, 1997) has carried out two surveys of water utilities in 38 large Asian cities at two intervals five years apart. Over the period water production rose 14%, per capita consumption dropped from 182 to 159 liters per capita per day (l/c/d), the average tariff rose 88%, unaccounted-for-water remained unchanged at 35% of production and the coverage of the population rose from 75% to 79%.

There were large variations in the per capita water consumption in different cities. Dhaka, Bangladesh, had the lowest of 43 l/c/d, and Apia, Western Samoa, the highest with 475 l/c/d. As a point of comparison Singapore had 168 l/c/d and Brussels 108 l/c/d. One assumes that Asian countries cannot afford the luxury of more than 200 l/c/d of water for domestic consumption, yet Taipei has 282 l/c/d, Delhi 257 l/c/d, Bangkok 217 l/c/d (Asian Development Bank, 1997). These large per capita consumption values may demonstrate the lack of metering and low tariffs in these cities.

Of the 50 utilities surveyed in 1997, only half had 100% metering of production and consumption; about a dozen have very little or no metering. Overall, 82% of the house connections, 97% of industrial connections, 80% of commercial connections, and 88% of institutional connections were metered. While these figures seem impressive, it is important to note that utilities do not provide 100% coverage. Fifteen utilities provided 100% coverage, but utilities like Cebu, Philippines, provided as little as 23%.

In the domestic sector, 32 of the 50 utilities used meters to determine payment; 7 utilities used flat rates, and 10 used a combination of the two forms. In the industrial sector, 35 utilities used a metered method, 2 used flat rates, and 12 used a combination. While total water production

increased between 1993 and 1997, the groundwater component in production volume decreased from 12% to 10.8%. Yet this was a net increase in volume.

The ownership and management of utilities take many different forms in these countries as well. Sixteen of the 38 utilities surveyed in 1993 were government departments, 18 were government enterprises, and 4 were more autonomous enterprises. Seoul, Bangkok, Singapore and Taipei had no grant financing of capital investments; at the other end of the spectrum Hong Kong, Manila and Shanghai required significant grant financing (Asian Development Bank, 1993). Private sector participation (PSP) has been on the rise in Asian utilities. PSP take many different forms and degrees in different cities and utilities. Among these: contracts for services; management contracts; leasing contracts; operating concessions; build, operate, and transfer; and full privatization. Twenty-seven of the 50 utilities had no PSP; 11 had some production contracts; 8 had distribution and leak repair contracts; 14 had bill collection and meter reading contracts; and 4 had management contracts.

2. Water prices

In the past most cities and utilities in the world have provided water to their customers almost free of charge because water is considered a basic necessity, and because water was a relatively cheap and abundant resource. But now with much larger communities requiring service, the only way to ensure that everyone has access to this basic need is to ration it in some way. And perhaps the best way to utilize water to the best and most-valued uses is to put a price on water, and construct appropriate tariff structures to meet different social, political and economic goals in different situations.

2.1. Objectives to be fulfilled when setting water tariffs

A tariff can take many different forms. Each form or design will address a specific objective. The “best” tariff design for a particular community and situation is one which strikes the most desirable balance among the objectives that are important to that community (Boland, 1997).

Consumers and suppliers of water have different expectations of water tariffs. Consumers like high quality water at an affordable and stable price. Suppliers like to cover all costs and have a stable revenue base. The level and structure of fees for water and wastewater services have consequences far beyond these expectations. Water-related fees can be expected to generate revenue, improve efficiency of the supply and supplier, manage demand, facilitate economic development and improve public welfare and equity (Potter, 1994). The following is a list of objectives that different tariffs can fulfill. No one tariff design can meet all objectives. But the key is for the utility or community to identify the objectives most relevant to its situation. The reader is referred to Boland (1997), OECD (1987, 1999a,c), Potter (1994), Howe (1997), and Wong (1999) for a more complete discussion of these objectives.

- The tariff must maximize efficient allocation of the resource.
- Water users should perceive the tariff as fair.
- Rates must be equitable across customer classes.

- They must bring sufficient revenue.
- Provide net revenue stability.
- The public must understand the rate-setting process.
- Promote resource conservation.
- Tariff-setting process should avoid rate shocks.
- Be easily implemented.
- Water must be affordable.
- Rates must be forward looking.
- The rate structure must attempt to reduce administrative costs.
- Include environmental costs.
- Not conflict with other government policies.
- Water prices must also reflect supply characteristics like water quality, supply reliability, frequency of supply.
- Tariff structure must vary depending on consumption measurability.
- More sophisticated rate structures may also account for daily peaks and seasonal variations in water demand.

2.2. *Tariff elements*

In order to achieve the goals listed above for tariffs, most OECD countries use some combination of the following elements in their tariff structures (OECD, 1999c). The exact combination of these elements depends on the specific situation and characteristics of the city, utility and behavior of customers.

- Connection charge.
- Fixed charge.
- Volumetric charge.
- Block charge.
- Minimum charge.

The two-part tariff system and increasing block tariff structure are two such popular combinations.

2.3. *Two-part tariff system*

Several OECD countries, for example Australia, Austria, Denmark, Finland and the United Kingdom, with successful water pricing schemes use a two-part tariff structure. This has fixed and variable elements. In these countries the fixed element varies according to some characteristic of the user, and the variable element often uses average cost pricing (OECD, 1999a). This method can be improved upon by using an increasing block tariff system (IBT) for the variable part. One of the main advantages of the two-part tariff system is the stabilized revenue base it affords the supplier. The fixed element protects the supplier from demand fluctuations and reduces financial risks. The variable element charges the consumer according to his consumption level and therefore encourages conservation.

2.4. Increasing block tariff structure

This is a more refined form of the two-part tariff system. IBT provides different prices for two or more pre-specified blocks of water. The price rises with each successive block. The utility must decide on the number of blocks, volume of water use associated with each block, and price to be charged for each block when designing an IBT structure (Boland & Whittington, 1998). While the first of these is more a management decision the second and third are political and social decisions.

IBT is a progressive tariff. This allows the utility to provide lifeline to the poor at below-cost rate, and charge higher prices for use beyond this minimum volume. This subsidy allows the poor access to water and sanitation and promotes public health. Thus IBTs are acclaimed for improving equity. Under this system poorer households get access to low-rate water since they possess fewer water consuming appliances (Whittington, 1997), and allow for rich-to-poor subsidies and industrial-to-household subsidies as well (Boland & Whittington, 1998).

3. The need for full-cost pricing

Basic economics require that the price of a service be at least as high as the cost of providing that service. Rogers et al. (1998) argued that sustainable and efficient use of water require the tariff to match not only costs of supply (i.e. O&M and capital costs), but also opportunity costs, economic externality costs, and environmental externality costs. Very often the tariffs do not even meet the full supply costs, and sometimes the value of water is lower than the cost of supply! The evidence presented below is from the Subernarekha Basin in India.

Fig. 2 compares costs and values associated with agricultural water use in the Subernarekha River Basin. The total economic value, calculated as the sum of net value of crop output, value of return flow, value of water in non-irrigated uses, and value of other societal objectives, is 9.7 cents/m³. The total economic cost, calculated as the sum of O&M costs, capital costs, pumping costs and opportunity cost, is 65 cents/m³. Shortage of information and data prevented Rogers et al. (1998) from estimating the intrinsic value of water and the environmental costs of providing irrigation water. Nevertheless, the disparity between value-in-use and cost is very large. Even if the intrinsic value were large it probably would not be large enough to meet this 55.3 cents/m³ gap plus environmental costs.

Fig. 3 compares costs and values associated with urban and industrial water use in the Subernarekha River Basin. Assuming that both sectors use the same source, we use the same cost structure for both. Rogers et al. (1998) calculated the full cost of water to be 46.7 cents/m³. The value in industrial use was \$2.60/m³; the value in urban use was 25 cents/m³.

Why is there such a gap in the value of water in the two sectors? Fig. 4 shows that the industrial tariff is more than double the urban tariff. So the urbanites over-consume and value the resource less. In this case there is an industrial-to-domestic-to-agriculture subsidy and each of the tariffs is much smaller than cost of supply.

In the above figures, “cost” includes supply costs and opportunity costs, but not environmental and economic externalities costs. Yet the tariff falls well below this cost. In the agricultural sector,

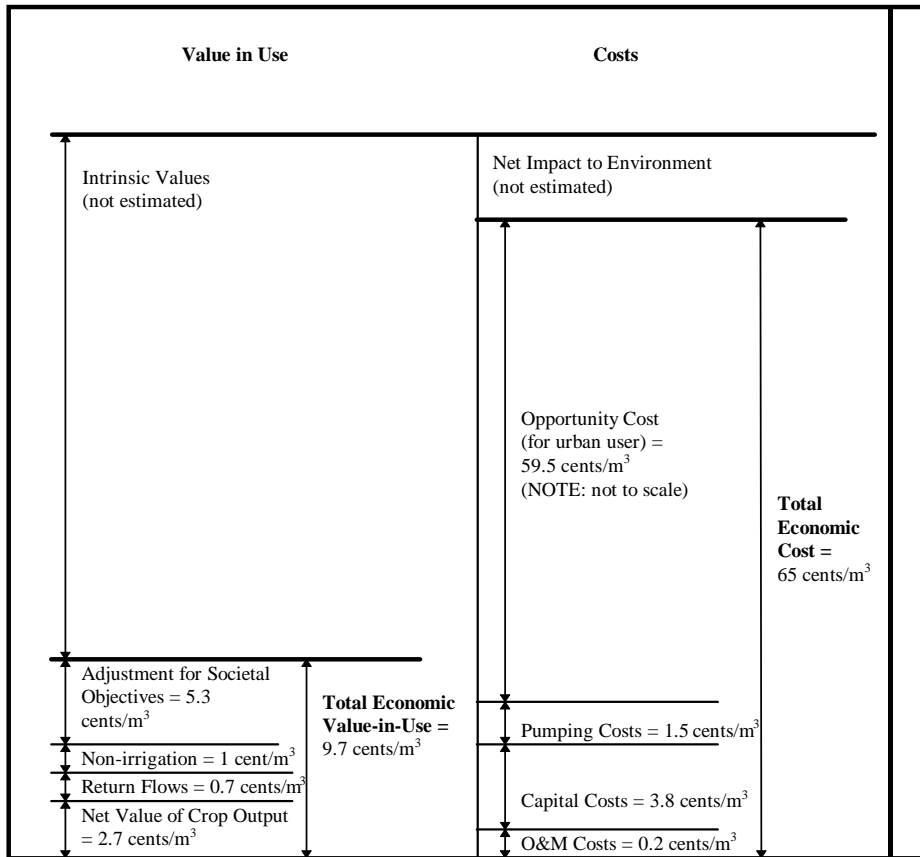


Fig. 2. Estimation of value-in-use for irrigated agriculture and costs of water in Subernarekha River Basin, India. Source: Rogers et al. (1998).

costs exceed value of the crop as well. Such low-priced water will only encourage wasteful use. Water suppliers must progressively increase tariffs to cover full cost of water.

Opportunity cost is the largest cost component in the irrigation costs given above. When the agricultural tariff increases and more water becomes available to the other two sectors, the opportunity cost of agricultural water will decrease. And because of reduced availability in this sector, the value of water in irrigation will increase. The story will be different in the other two sectors. As more water becomes available, the reduced capital and pumping costs will decrease the cost of industrial and urban water. And because of the more abundant resource, its value will also decrease. So values and costs can be expected to converge across sectors.

Although the above examples were taken from developing countries, water price differentials in different sectors are not unique to those countries. Such examples are rampant in industrialized countries as well. The Northern Colorado Water Conservancy District in the US, for instance, charges irrigators about \$3.50/acre-ft (about 0.3 cents/m³), and about \$7/acre-ft (about 0.6 cents/m³) for cities and industries. The capital costs not covered by direct water-related revenues are paid for from real-estate taxes levied against all urban and rural real estates in

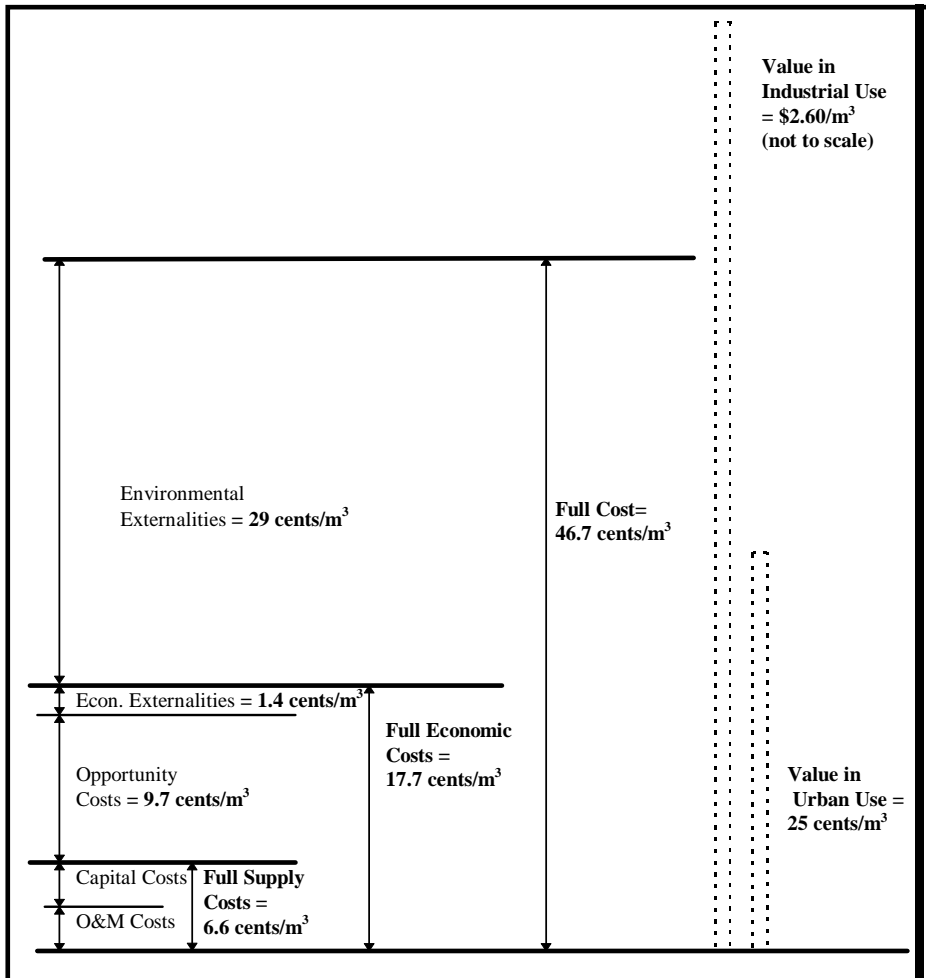


Fig. 3. Estimation of costs and values for the urban and industrial sectors in Subernarekha River Basin, India. Source: Rogers et al. (1998).

the District (Howe, 1997). In effect, industries and households subsidize water for the agricultural sector.

The large variations in values, costs and prices will allow for trading between sectors. Currently agriculture is the largest water user in most countries. On average, 69% of world's water is used in agriculture, and 23% in industry. In OECD countries, however, 65% is used in industry, while only 30% is used in agriculture (OECD, 1999b). Trading does not require that all agricultural water be transferred to the urban and industrial sectors. A small transfer of agricultural water can meet all the demands in urban and industrial sectors. On the other hand, since the required transfer is small, the required price increment is also small. At least on the first pass, a small increment in irrigation water prices (where the tariff can still be less than urban or industrial tariff) can help meet the highly valued needs in the other two sectors.

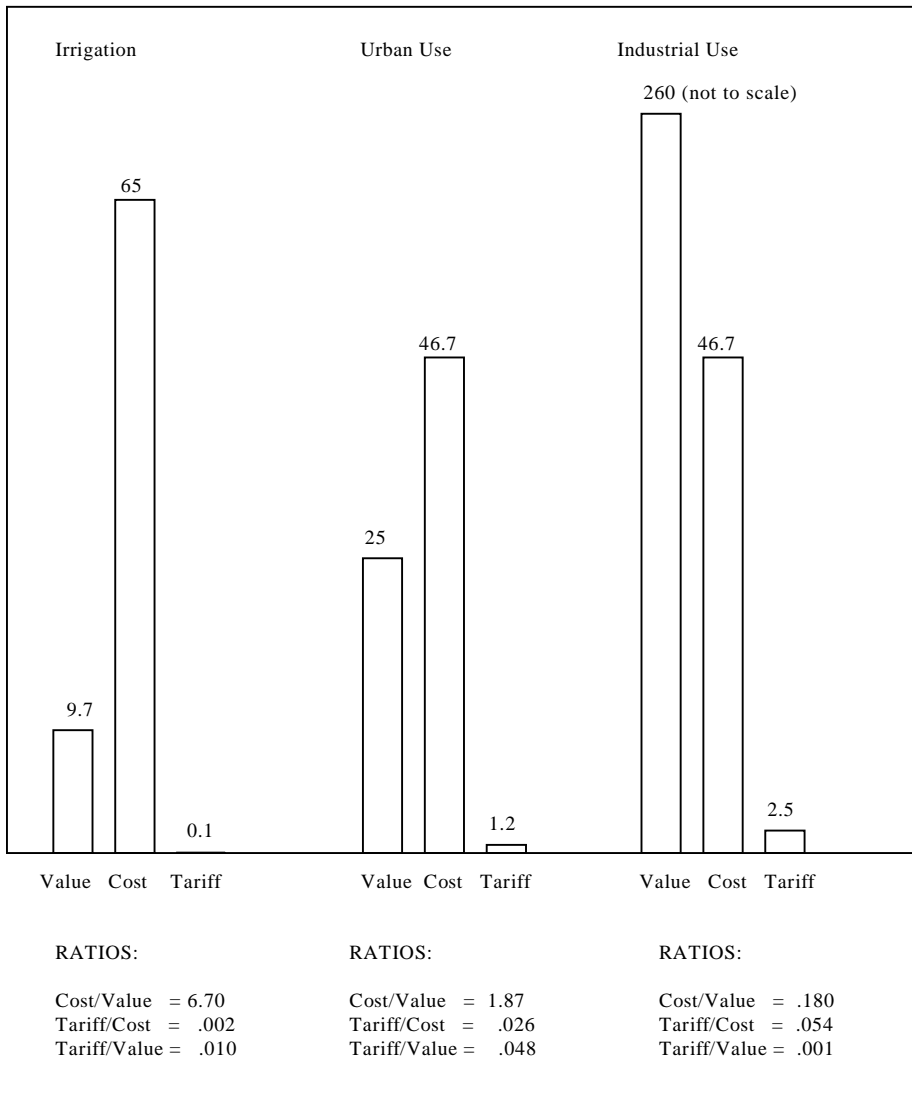


Fig. 4. Comparison of value-in-use, costs and tariffs for three sectors in Subernarekha River Basin, India (figures in cents/m³). Tariffs are as follows: Agriculture 0.1 cents/m³, urban households 1.2 cents/m³, and industry 2.5 cents/m³. Source: Rogers et al. (1998).

3.1. Backstop technology for water

While the previous subsection requires that water rates be increased, utilities’ capacity to increase water rates is limited by the availability of alternate freshwater sources. The ultimate alternate source—the backstop source—of freshwater is seawater or brackish water.

A recent bid to design, build, own and operate a 25 million gallons-a-day sea water desalting plant made by Stone and Webster to the Tampa Bay Water’s Board of Directors has

revolutionized the pricing capabilities of water utilities. Stone and Webster plans to use reverse osmosis for desalting sea water, and plans to provide water at a cost between \$1.71 and \$1.86/1000 gal (\$0.45 and \$0.49/m³) in the first year of operation (Leitner, 1999). With desalting technologies being able to produce such low-cost water, water providers to urban and industrial areas will be hard-pressed to match and improve on this price.

Leitner (1999) notes that this particular cost is quite unique to Florida and its environs. Low sea water salinity at the proposed locations; low power costs in the US; no-cost cooling water; use of large-scale reverse osmosis trains; economies of scale; amortization over the 30-year contract period, and tax-exemptions all contribute to this low cost.

The net present value of Stone and Webster's plant is \$222.60 million of which 48.6% is attributed to fixed costs, 29% to power costs, 4.7% to chemical costs, and 17.7% to other costs. So even if these proposed costs were modified to represent conditions at other locations, they would still prove to be substantially lower than previously known desalting costs. If this project were to be successful, industries and large cities in coastal areas may be increasingly motivated to switch to desalted water for future supply increments.

3.2. Subsidies

Many support measures and subsidies are used to promote growth, employment and increase incomes in particular sectors. There is also a growing awareness in OECD countries that subsidizing water use is not necessarily the best way to achieve sectoral economic or social objectives. In fact, some economic and social goals are harmed over the long-run by using a subsidy-based approach. This is especially true when these support measures are used to prop-up ailing industries that invariably contribute to significant environmental damage (Potier, 1996). General reduction in water prices shields all consumers from important economic and environmental signals. Any support measure that lowers the user costs of resource consumption, rather than encourages reduced or more efficient use of the resource, will contribute to potentially higher volumes of inputs, throughputs and pollution (OECD, 1998). Subsidy removal therefore is a step towards full-cost pricing of environmentally harmful activities. Subsidy removal is not a substitute for, but a complement to, policies which internalize social and environmental costs of these harmful activities (OECD, 1998).

Cross subsidies from industrial users to farmers and households have long been characteristic of OECD water pricing policies. These cross-subsidies are increasingly being recognized and are gradually being reduced (OECD, 1999b). But many cities in Asian and Pacific Region still allow for industrial water consumers to subsidize domestic consumers. The ADB uses the ratio between industrial tariff and domestic tariff as a measure of the subsidy. ADB (1993) showed that 85% of these subsidies are in the range of 1.4–3.9. Subsidies in larger cities ranged from 1.8 to 2.2, while in smaller cities they ranged from 2 to 3. A few cities—Cebu, ChiangMai, Kathmandu, Mandalay, Nukualofa, Port Vila, Shanghai and Taipei—had no subsidies while others—Delhi (10.9), Colombo (12.1), Bombay (28), and Medan (30)—had very large cross subsidies.

The reform of current subsidy and tax disincentives seems to offer room for a clear win-win situation. But the actual effects of any reductions will depend on the context in which the subsidies are granted in the first place and on the specific way in which they are reduced (Potier, 1996).

4. Need for integrated water resource pricing

The above sections motivated the need for full-cost pricing and listed some of the main requirements of a pricing structure. We further explained how increased water rates could actually help foster efficient use and improve equitable distribution of water. But proper water rates imposed by the public water supplier alone are insufficient to manage the resource. If the suppliers charged the full-cost of water and there were no regulations to protect groundwater sources, consumers will gradually exploit the groundwater sources. If there were no proper wastewater charge structure, consumers will pump groundwater and discharge the waste into the public wastewater system with no penalty.

“The holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programs within the framework of national economic and social policy, is of paramount importance for actions in the 1990s and beyond” (UNCED, 1992, Agenda 21; Briscoe & Garn, 1995).

The holistic management of freshwater requires water-related authorities to work together and formulate complementary pricing schemes that will allow overall efficient use of the resource. In addition, policy-makers must formulate a regulatory backbone that will encourage consumers to adhere to the pricing schemes. This section motivates the need for integrated pricing structures especially in groundwater extraction and wastewater disposal.

Industries' decision to buy from public water suppliers, directly abstract, or treat and reuse depends on many factors. Among these are water quality required by that industry, whether the public supplier charges full-cost from industrial users, and whether direct abstraction licenses whose charges reflect the full economic cost of water are available (OECD, 1999a). If one or more water source components is weakly regulated, industries will exploit that weakness to minimize their production costs. Due to the common-property nature of groundwater and wastewater disposal services firms are likely to ignore social costs unless they are reflected in effluent taxes or extraction taxes. Examples of industrial exploitation of such weak points are rampant. A few examples are given in Sections 4.1 and 4.2.

Integrated water resource pricing requires that the region or utility or the group of water-related service providers integrate water prices, sewerage prices, additional charges for extra-strength effluents, direct industrial abstraction charges, and for direct discharge to watercourses (OECD, 1999a). Unfortunately, in both developing and industrial countries there is a huge gap between the concept of integrated water resources planning and how water resources planning and policy making are actually done. In practice, most water resources planning is done incrementally and is driven by the need to find solutions to relatively immediate and specific problems, and not grand issues of river basin or regional development (Whittington, Donald Lauria, & Xinming Mu, 1989). The World Water Council and the Global Water Partnership's recent attempts to formulate a Water Vision are aimed at bridging that gap. It is inevitable that developing countries gear many of their plans to meet pressing and urgent needs. However, having a longer-term vision that incorporates expanding water supply, managing groundwater, disposing wastewater and charging appropriate fees for different services will help put even those urgencies into perspective.

4.1. Groundwater extraction charges

Groundwater abstraction charges are common in most OECD countries. Belgium, Canada, Czech Republic, France, Germany, Hungary, Italy, Japan, Mexico, Netherlands, Poland, Spain, Australia, and UK (OECD, 1999a) are examples of these. In most countries the abstraction charge depends on the type of use—whether it is consumptive or non-consumptive, and by type of industry. In addition, Belgium, Czech Republic, Finland, France, Hungary, and the Netherlands include an environmental premium in the abstraction charge (Jones 1998). Although the extent of groundwater use in these OECD countries is significant compared to the use of publicly supplied water, direct abstraction charging schemes and structures are still quite new. Nevertheless, the introduction of direct abstraction charges has introduced better management capabilities to authorities and instilled better water use patterns among industries.

The less well-coordinated groundwater extraction policies in Metro-Manila, in the Philippines, on the other hand, are allowing for 6–12 m per year decline in groundwater levels, and salt-water intrusion into freshwater aquifers (Ebarvia, 1997). Since the government does not levy a charge on groundwater extraction, the only expenses to the consumer are the installation and operation of a well and pump.

A similar situation is found in Bangkok. Here the water supplied through the public supply system is already very cheap (about 5 baht/m³ or 13.5 cents/m³). But for large-scale industries, groundwater (including its pumping and transportation) costs even less (about 2 baht/m³ or 5.4 cents/m³). In addition, the groundwater supply is more reliable and is of better quality, therefore, industrial units steadily turn to groundwater sources. The estimated quantity of groundwater pumped in the Bangkok Metropolitan Area (BMA) is over 1.2 million cubic meters per day (MCM/day). The sustainable pumping rate is about 0.6–0.8 MCM/day. The high stress on aquifers is thus causing depletion of aquifers and ground subsidence (Potter, 1994). A Japan International Cooperation Agency (JICA) study showed that, on average, 22% of industrial water consumption can be reduced by conservation measures at costs ranging from 1.30 to 10.10 baht/m³ depending on the industrial sector (Potter, 1994). These conservation costs are less than the BMA-purchased water, but are greater than groundwater costs. So industry has little incentive to conserve. The water supply situation is worsened because the low groundwater costs pull-down the public supply rates. If suppliers were to raise prices to full-cost, all consumers will eventually turn to low-cost, more-reliable groundwater. The only remedy is to set appropriate groundwater charges as well.

4.2. Wastewater and sewerage charges

Charging households and industries directly for their wastewater discharges is not common even today. Usually, the wastewater fee is a fixed percent of the water bill or is a fixed charge per house or is included in the property tax (OECD, 1999c). Charging wastewater dischargers according to the strength and quantity of wastewater will motivate them to conserve water, reuse or recycle water, and switch to cleaner production processes.

Utilities in the Czech Republic, Denmark, Finland, Germany, Hungary, Japan, Korea, Poland, Sweden, England and Wales are among those who levy a composite charge for water supply and wastewater collection services to households. Unfortunately, the bill rarely distinguishes the two

cost components. Although the high combined water and sewerage rates in cities like Boston have prompted residents to reduce water consumption, separating the two charges will further motivate consumers to reduce water use and wastewater discharges. Utilities in developing countries are far behind OECD ones with regards to sewerage billing. Of the 38 utilities surveyed by the ADB in 1993, only 11 even included sewerage surcharges in their water bills to households. By 1997, 25 of the 50 utilities included sewerage charges in the water bill. All other utilities, if they provided sewerage service, provided it free (Asian Development Bank, 1993, 1997).

Sewerage and strength-dependent effluent charges have been more widely used with the industrial sectors in OECD countries. The volume and characteristics of industrial sewage vary considerably from one company to another. Thus, industrial water consumption levels do not represent a good proxy for industrial sewerage and sewage disposal costs. The number of countries in which the costs of industrial sewage services are included in the price of water supply has therefore been decreasing steadily. Utilities in Australia, Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Turkey, UK, and USA are a few that use an effluent charge based on pollution content in water (OECD, 1999b).

While residential users have little freedom of choice for wastewater disposal and for altering the composition of their effluents, commercial and industrial water users have a wide range of technology, input and project choices that affect their water-borne waste loads (Howe, 1997). In countries where sewage service costs have risen significantly, industrial users often find that the public sewer system is no longer the most cost-effective means of sewage disposal. Instead, in-house treatment, recycling and reuse emerge as more economical options, and industries choose to switch to more self-treatment and effluent reuse (OECD, 1999b). Such changes in industrial wastewater discharges invariably affect production processes and reduce water use patterns as well. Therefore appropriate wastewater charges can postpone water utility expansion needs by several years.

Due to increased water rates and more stringent regulation, several industries, including chemical, pulp and paper, textiles, and metallurgy industries, have changed production processes and have made significant progress in reducing their water demands in recent years. Industrial abstractions from public supply in West Germany decreased by one-third since the 1970. There was a sharp decrease in industrial water use in Sweden between 1970 and 1980, and a slow decrease from then on. Industrial water use in the Czech Republic fell by 40% between 1985 and 1993—to cite a few examples (OECD, 1999d). Industry innovates when it has sufficient incentive. Production cost reduction is often its best incentive.

5. More equitable distribution of water with increased water rates

5.1. The “poor” are willing to pay more

One of the main arguments for maintaining low tariffs is to allow the “poor” access to water. This argument has little credibility.

- In the agricultural sector, farmers often spend large amounts of money for pumping groundwater to improve reliability and timeliness of water supply. In Haryana, India, where

irrigation charges for surface water supplies are less than \$10 per hectare per year, farmers are known to spend about \$90 per hectare per year for groundwater irrigation. This is approximately 20% of the net value of output from crops. As such, the farmers have a high willingness to pay for timely, reliable water (Rogers et al., 1998). Farmers will benefit if suppliers improve reliability through improved management that will be possible with higher water charges.

- Low-priced water encourages excessive consumption by those connected to the supply system. This limits utility's coverage. The poor are left to purchase higher priced water from vendors. In OECD countries households spend about 1% of their income on water (OECD, 1999b). In Onitsha, Nigeria, the poor spend as much as 18% of their income on water (Whittington et al., 1989). Water costs in other developing countries' households span the entire spectrum between these two values. Because of the high water price the poor can afford only small quantities of water enough for bare necessities; and often not enough to meet hygienic needs. If utilities were to supply water at higher prices it would encourage conservation, improve water service coverage to reach the poor, and there will be far more equitable water distribution than there is now. If water must be provided to the poor at low-rates, utilities can use tariff structures such as lifeline rates, IBTs, or provide lump sum credits to low-income customers as in the Los Angeles' Metropolitan Water District (Boland, 1997). These strategies allow the utility to improve both equity and fairness towards its community.

6. Sustainable use of water with increased water rates

The UN's Agenda 21 sees sustainable development as a way to reverse both poverty and environmental degradation. A major theme is to eradicate poverty by giving poor people more access to the resources they need to live sustainably. Agenda 21's definition of sustainability includes; economic development, social development, and environmental protection. As discussed above, water pricing can improve economic efficiency and improve social equity, and by using less of the resource more efficiently lead to environmental enhancement. Hence, water pricing helps address all three of Agenda 21's concerns about sustainability of the resource.

In addition to the examples given above, a comparison of water rates in two cities reflects on the sustainability of water resources. The regional municipality of Waterloo in Canada, for instance, uses summer rates that reflect higher water demand in that season (Pearce & Markandya, 1989). This helps to conserve the water available in the summer. In Metro Manila, on the other hand, the user faces the same low cost for the resource regardless of the time of day or season of year (Pearce & Markandya, 1989; Ebarvia, 1997). This leads to deterioration of the resource.

7. Conclusions

Based upon the cases reviewed in this paper we can draw the following conclusions:

- There is ample evidence to support the contention that water is already viewed as an economic good in many, if not most, countries in the world.

- There is ample evidence for the success of pricing policy in water management from many countries in many different sectors of water use.
- This evidence indicates that unless there is integrated pricing of the resource supplied from all sources, the use of pricing will not necessarily lead to the desired outcomes.
- There are clear examples that water pricing can and has improved the distributional equity for the poor in many settings.
- There are clear cases where appropriate pricing has led to improved sustainability of the water resource.

Two policy issues also arise from the discussion of price policy; how to implement the price policy, and how high to raise the prices? The answers to these questions depend upon the nature of the property rights assigned to water in different countries. With completely privatized ownership rights to water one could expect that under a laissez-faire approach, something akin to the full-economic cost would be charged for water. If the environmental externalities were to be protected, then the government would have to intervene with some sort of command and control or tax policies. If in addition there were many poor people demanding water the government may wish to intervene with subsidies to the weakest users. If government controls the water rights it may wish to push for full-cost recovery including environmental externalities. Under no circumstances should the price of water be allowed to sink below the full-supply cost. There is a wide range of policy options available to implement price policy in the water sector. These range from direct pricing to green taxes, to effluent fees, to direct subsidies to utilities or the users. We do not say that subsidies should not be used at all. But the choice of policy depends crucially upon the local political and social conditions. Finally, we have not advocated that full-cost be unequivocally the only criterion for setting water prices. We argue that knowledge of the full-cost is the most important ingredient in water policy formulation.

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Water Is An Economic Good: How to Use Prices to Promote Equity, Efficiency, and Sustainability. *Water Policy* 4(1):1-17. Ross-Zuj, J. 2007, February. *Handbook of Water Use and Conservation: Homes, Landscapes, Industries, Businesses, Farms*. WaterPlow Press, Amherst, MA, 464 pp. Visser, W. 2007, February. But water has been recognized as an economic good for many centuries before 1992. Throughout Europe and the early United States private water supply companies thrived in a wide variety of settings. The "sanitary revolution" of the 19th century saw the demand for public ownership and management of most of these companies in the name of public health. This, of course, did not obviate the need for water to be treated as an economic good, but a heavy emphasis on the public-good nature of water and its disposal led to the development of heavily subsidized public systems. This paper focuses on the role of prices in the water sector and how they can be used to promote equity, efficiency, and sustainability. *Corresponding author. Tel. Rogers, P., de Silva, R. and Bhatia, R. (2002) Water Is an Economic Good: How to Use Prices to Promote Equity, Efficiency, and Sustainability. *Water Policy*, 4, 1-17. [https://doi.org/10.1016/S1366-7017\(02\)00004-1](https://doi.org/10.1016/S1366-7017(02)00004-1). has been cited by the following article: Cereal-forage crop rotations and irrigation treatment effect on water use efficiency and crops sustainability in Mediterranean environment. *Economic and Land Use Impacts of Improving Water Use Efficiency in Irrigation in South Asia*. Farzad Taheripour, Thomas W. Hertel, Badri Narayanan, Sebnem Sahin, Anil Markandya, Bijon Kumer Mitra. DOI: 10.4236/jep.2016.711130 1 308 Downloads 1 923 Views Citations.