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Kuwait, 14-18 May 2005

MODULE FIVE
ECONOMIC DIMENSIONS OF IWRM

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MODULE 5 ECONOMIC DIMENSIONS OF IWRM	
RATIONALE	<p>Water provides important benefits to humankind through its use as a commodity and an environmental asset. However, it is difficult to appropriately value water resources for physical, social, cultural and economic reasons. This makes water a classic non-market resource. The full value and the cost of water-related services are rarely fully assessed, and market prices, when available, seldom reflect these values and are often subject to biases.</p> <p>Despite these difficulties, increasing water scarcity is limiting the availability of water for commodity and environmental uses. This requires decision-makers and their advisors to consider the economic aspects of integrated water resource management to ensure that water resources are appropriately valued and allocated to their most efficient and beneficial uses. This is particularly important when decisions must be made on trade-offs between water development projects, water reallocation proposals, natural heritage or recreation initiatives and other water policies that affect different socio-economic groups.</p> <p>This module provides an overview of some of the economic dimensions of integrated water resources management, including how to value and cost water-related services in quantitative terms; how perceiving water as an economic good does not diminish its role in social and environmentally sustainable development; how different cost recovery mechanisms can support efforts to achieve sustainable financing of water-related services; as well as that the financing challenges and opportunities present in the ESCWA region as it seeks to meet its growing water sector investment needs. It also clarifies important definitional difference between the value, cost and price of water. This module also serves as an introduction for module 10 on the “cost and price of water” and module 11 on “public private partnership”.</p>
OBJECTIVES	<ol style="list-style-type: none"> 1. To introduce the economic characteristics of water goods and services and non-market monetary valuation methods 2. To clarify concepts related to the value and cost of water, economic evaluation methods and their data requirements 3. To familiarize water resources managers with the key economic implications of water policies and practices 4. To introduce economic instruments and policy options for water conservation and sustainable use 5. To raise the issue of water sector financing and cost recovery and explore options for financial sustainability
MAIN REFERENCES & BACKGROUND MATERIAL	<ul style="list-style-type: none"> - Audelo, J.I. and A. Y. Hoeksrtra. (2001). <i>Valuing water for agriculture: application to the sambezi basin countries</i>, Globalization and water resources management: the changing value of water, AWRA/IWLRI – University of Dundee International Specialty Conference. - Briscoe, John. (1998). <i>The Financing of Hydropower, Irrigation, and Water Supply Infrastructure in Developing Countries</i>. - GWP. (1998). <i>Water as a social and economic good: How to put the principle into practice</i>, TAC Background Paper No. 2. - GWP. (2000). <i>Integrated water resources management</i> TAC Background Papers No. 4. - ESCWA. (2001). <i>Current water policies and practices in selected ESCWA Member Countries</i>, E/ESCWA/ENR/1999/15. - ESCWA. (2003). <i>Updating the assessment of water resources in ESCWA</i>

	<p><i>Member Countries</i>, E/ESCWA/ENR/1999/13.</p> <ul style="list-style-type: none"> - ESCWA. (2003). <i>Assessment of the role of the private sector in the development and management of water supply in selected ESCWA member countries</i>, E/ESCWA/SPDP/2003/14. - J.I. Audelo. (2001). <i>The Economic Valuation of Water, Principles and Methods</i>, IHE, DELFT, The Netherlands. - Le Moigne, Guy, Subramanian, Xie Eei and Sandra Giltner. (1994). <i>A Guide to the Formulation of Water Resources Strategy</i>. World Bank Technical Paper No. 263. - Young. (1996). <i>Measuring Economic Benefits for Water Investments and Policies</i>, World Bank Technical Paper No. 338. - Netherlands Water Partnership. (2003). <i>Success Factors in Financing Local Water Management</i>, a contribution to the Third World Water Forum in Japan, march 2003. - Sadoff, C.W. (1996), <i>The price of dirty water: pollution costs in the Sebou Basin</i>, The World Bank, Environmental Economics Series Paper No. 038. - Saghir, Jamal. (2000). <i>Exploring the New Opportunities for Project Development in the Water Industry</i>. Paper presented at the Middle East Economic Digest/Middle East Summit. - Saghir, Jamal, Manuel Schiffler and Mathewos Woldu. (2000). <i>Urban Water and Sanitation in the Middle East and North Africa Region: The Way Forward</i>. The World Bank Institute. - Winpenny, James. (2003). <i>Financing Water for All</i>, Report of the World Panel on Financing Water Infrastructure (March); - World Bank, UNDP and FAO. (1995). <i>Water sector policy review and strategy formulation – a general framework</i>, FAO Land and Water Bulletin 3.
SUGGESTED INTERNET LINKS	<ul style="list-style-type: none"> - http://lnweb18.worldbank.org/essd/essdext.nsf/18DocByUnid/-46DB7D11F6CE603F85256B50006925FF/\$FILE/-the financing of hydropower for Un commission.pdf - http://www.ihe.nl/vmp/articles/Short-Courses/SHO-SFWM.html - http://www.gwpforum.org/gwp/library/FinPanRep.MainRep.pdf
DELIVERY OPTIONS	
DIRECTLY RELATED MODULES.	10, 11

SESSION TOPIC SYNTHESIS	
<p>QUESTIONS FOR DISCUSSION</p>	<ol style="list-style-type: none"> 1. Is the concept of water as an economic good accepted in your country? Is it practiced in any way? How could/should it be practiced? 2. How does water resources management impact economic growth and patterns of development in your country? 3. Do you believe there is or could be an importance for economics in the management of water resources in your country? If so, where do you think the contribution of economic analysis or tools would be greatest? 4. What are the advantages and disadvantages to using economic (market-based) tools for water resources management? 5. Discuss the issue of financing of the water sector (gap between financing demand and financing resources, origin of financing resources and cost recovery) 6. In your country, how is the water sector being financed? Would you consider this form of financing sustainable? If not, what are the options available? Which one is preferred?
<p>BACKGROUND</p> <p>As competition for water grows among users, water resources management decisions will involve increasingly complex trade-offs with significant implications for economies, growth and the distribution of benefits and costs associated with water allocation decisions. The economy-wide impact and equity implications of water resources management policies will therefore demand increasing attention, as well as the challenge of securing sufficient financing to meet water sector development needs. This module focuses on these broad economic dimensions within the context of IWRM.</p> <p>Water allocation decisions impact economic growth and development patterns. It is well accepted that water is a prerequisite for growth and poverty alleviation. What is less often considered is the effect that inter-sectoral water resources allocation has on economic structures, growth and patterns of development. The agriculture, industry and services sectors, for example, often pose competing demands for water use. The allocation of water among them will enable or constrain their relative growth, and give rise to very different economies over the medium term, with differing welfare impacts both in terms of overall growth and the distribution of this growing wealth. Similarly, the incentives for water use within sectors will have welfare, growth, and equity implications. In agriculture, for example, the balance between traditional subsistence agriculture (which generally targets the very poor and provide greater employment opportunities) and high-tech production (which generates higher value-added to a smaller immediate beneficiary groups) will significantly affect the value of agricultural production and the distribution of these gains.</p> <p>WATER AS AN ECONOMIC GOOD</p> <p>The Dublin Principles state “<i>water has an economic value in all its competing uses and should be recognized as an economic good</i>”. This reflects the growing recognition of water as a scarce and productive resource whose use is compatible with social objectives such as economic efficiency, environmental sustainability and equity. Defining water as an economic good allows decision-makers to view water resources and water-related services as commodities that can be bought, sold, used or conserved. Appropriately valuating a water resource thus allows decision-makers to allocate water to its greatest socio-economic and environmental use. However, determining the value of water is a complex matter given its physical nature (liquid, mobile, variable) and its characteristic as a classical non-market, open-access resource with poorly defined property rights. Furthermore, water is a natural asset whose value resides in its ability to provide goods and services over time. Values derived from water can be divided into different types: use value (also known as extrinsic values or direct use values, i.e.: agriculture, industry, hydropower, navigation, households) and non-use values (also called intrinsic values, passive use values, or existence values, i.e., related to aesthetics, culture, religion or nature). Water may also have an option value, which</p>	

describes the fact that there may be individuals who do not wish to use the water resource now and who are willing to pay or forgo current benefits to preserve the resource for future generations or for some future use. Different methods are available for determining how water users and decision-makers value water in quantitative terms.

The value of water is different from the cost of supplying water or a water-related service. The full cost of water represents the cost of supplying a water resource (capital charges, O&M costs), plus an assessment of *opportunity costs* and the cost of *externalities* associated with the implementation of a certain project. Determining the *opportunity cost* allows the decision-maker to examine whether an alternative water project using the same water resources might yield greater benefits for less cost. If so, this represents a cost (forgone benefits) to the current project and a potential loss of efficiency or equity. Incorporating the cost of *environmental and economic externalities* into the decision-making process allows for the indirect effects (costs and benefits) of a given project to be appropriately included in a water allocation (and investment) decision. Economic externalities might include impacts on human health or agricultural development, while environmental externalities might take into consideration impacts on upstream and downstream water users, wetlands or biodiversity. Efficient and equitable water allocation decisions can be achieved when the value of water is equal to the full cost of supplying the water and/or water-related service. Pursuing projects that are closest to achieving this balance helps to ensure that socio-economic and environmental considerations are appropriately incorporated into water allocation and investment decisions

THE IDEA OF COST RECOVERY

In a full cost recovery framework, the price of water charged to water users should equal the full cost of supplying the resource. However, in reality, it is unlikely that the full cost of supplying water service will equal the full value of the resource, or that a project can fully recover its costs from direct user fees and charges. Accordingly, *it is left to water decision-makers to make political decisions regarding how closely the full cost of water corresponds to the price of water*, as manifested in water tariffs, user fees and other financial instruments. Socio-economic priorities and equity considerations may prompt decision-makers to provide subsidies to certain user groups for certain water users or impose different tariff schedules for different types of water use based on national development priorities. However, these political decisions must be based on a clear understanding of the economic value and cost of water so that prices can be effectively determined. Should income generated by the collection of water user fees be insufficient to cover the full cost (supply costs, plus opportunity costs and externalities), then alternative funding instruments and a comprehensive strategy for ensuring the sustainable financing of a water-related service are also needed.

SUSTAINABLE FINANCING

Despite growing demand for water supply and sanitation services, the cost of investment in water projects and their operation and maintenance is getting so high that many governmental budgets can no longer afford them. Water users are also often not able to cover the full costs of these services alone. Accordingly, water professionals face the daunting challenge of securing sufficient financial resources to meet growing demand for services. The identification of alternative financing techniques for cost recovery is thus an issue of great urgency. Conceivable strategic options may involve turning over some water utilities or water projects to financially autonomous public or private organizations, relying on local water users associations, pursuing public-private partnerships or turning to bilateral donors and multilateral financing institutions for assistance. Accordingly, if water needs are to be satisfied, it is essential that water professionals not only propose efficient and equitable water projects, but also formulate sustainable financing strategies and cost recovery mechanisms to ensure that planned projects can be realized.

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MODULE 5 ECONOMIC DIMENSIONS OF INTEGRATED WATER RESOURCES MANAGEMENT

A. INTRODUCTION

Water is fundamental for life and plays a key role in development. It is the most important natural resource, permeating all other natural and productive resources. Water acts both as an input and output in the production process and a sink for some of its by-products. It is well accepted that water is a prerequisite for growth and development, and is a fundamental component of poverty alleviation. However, what is less often considered is the effect that inter-sectoral water resource allocation has on economic development patterns. For example, the agricultural, industrial and services sectors (e.g., for municipalities, tourism) often pose competing demands for water use. The allocation of water among them will enable or constrain their relative growth, and give rise to very different economies with differing welfare effects in terms of overall growth and the distribution of wealth. Similarly, water use within a sector has welfare, growth and equity implications. In agriculture, determining the appropriate balance of water use between traditional subsistence agriculture (which generally targets the very poor and provides greater employment opportunities) and high-tech production (which generates higher value-added to a smaller number of beneficiary groups) will significantly influence agricultural output and income distribution.

IWRM advocates the need for economic efficiency, which is a fundamental component of sustainable development. One interpretation of the concept of economic efficiency is the production of the desired level of goods and services with the minimum amount of resources. Hence, economic efficiency seeks to allocate resources to their greatest benefit and to prevent resource waste. In the case of water resources, since the least costly sources of water have already been developed in many countries, appropriate water valuation and water demand management tools represent the best alternatives for achieving further economic efficiency in the water sector. In most cases, prices determined by the market mechanisms improve the allocation of natural resource among competing users. However, the distinctive features and characteristics of water resources (see box 1) usually deprive them from that type of allocation efficiency. In many developing countries, water markets are also not sufficiently developed and pricing techniques are not effectively applied to recover the costs of supplying and distributing water resources.

BOX 1. CHARACTERISTICS OF WATER

1. Water supply and irrigation projects typically exhibit increasing return to scale and therefore are prone to natural monopolies;
2. Many water resources investments produce joint products, such as recreation, electric power and irrigation, which complicates water pricing and allocation decisions;
3. In some of its uses, water is a public good, where one person's use does not decrease nor subtract from its value to others;
4. Water activities are often characterized by externalities, the benefits and costs of production and consumption affect individuals or entities other than those involved in a transaction;
5. Water is a basic human right that has special cultural, social and religious values, which mark it off from other economic goods.

Source: (Le Moigne et al., 1994)

As competition for water grows among users, water resources management decisions will involve increasingly complex trade-offs with significant implications for economic growth, development and the distribution of benefits. The economy-wide impact and equity implications of water resource management policies therefore demand increasing attention. Increasing water scarcity and budgetary constraints are also limiting the ability of governments to satisfy the needs of competing users today and threatening their ability

to secure water for future generations. Governments are no longer able to provide effective services at subsidized rates and water organizations are struggling to find sufficient funding for building and operating water development projects. This is prompting many water decision-makers to reconsider their water management strategies from an integrated perspective. It is thus important that water resources professionals understand the economic (not just the financial) implications of their policy decisions.

B. THE ECONOMIC DIMENSIONS OF WATER WITHIN THE IWRM CONTEXT

B.1 Water as an economic good

An economic good is a physical object or service that can be valued and sold in the marketplace. Property rights empower an individual to buy, sell, use or conserve a good or service. Many past failures in water resources management are attributable to the fact that water is viewed as an “open access resource” with incomplete property rights, instead of a valued economic good. This is partly due to the physical nature of water, whose fluid and mobile state renders it difficult to assign it property rights (this makes water a “high-exclusion cost” resource).¹ This results in a situation where water rights are rarely defined or well enforced, which leads water users to ignore the impact of their water use decisions on others (e.g., present and future generations or the environment).

Additionally, in a situation of competition for scarce water resources, viewing water an open access resources has the adverse effect of allocating water to its lowest value use since the market system provides no incentives to value water as a limited asset. In order to extract the maximum benefits from the available water resources there is a need to change perceptions about water and to recognize the total economic value of the water, particularly when making water allocation decisions.

As an economic good, water is considered a finite and vulnerable resource that should be allocated according to the principles of efficiency and equity. Viewing water as an economic good, however, does not change the fact that water is also an important social and an environmental good. Water resources may have different values depending on their use and availability. As such, water resources do not necessarily require full-cost pricing, but rather a full-cost management approach by governments. This means that the value as well as the cost of water has to be calculated and be known to make efficient, equitable and effective management decisions.

B.2. Value and cost are two different things

While the Dublin principles refer to water as an economic good, water is referred to as an economic *and social* good in Chapter 18 of Agenda 21. Concern has thus been voiced about the social consequences of viewing water as an economic good: How could these affect the access of poor people to water? Viewing water as strictly an economic commodity may also restrict ones ability to consider the environmental effects of a certain type of water use and its impact on sustainability.

Determining the value and the cost of water is thus an important way for ensuring that the social, economic and environmental aspects of water use are considered when making water use decisions. The first step is to distinguish between the value and the cost of water. The *value* of water is derived from determining the socio-economic and environmental benefits of water in its current or proposed use. Water values are

¹ A number of special characteristics distinguish water from most other economic good and resources. On the physical side, water is a liquid. This trait makes it mobile: water tends to flow, evaporate and seep as it moves through specific units of the resources. Water supplies also tend to be variable due to natural climatic fluctuations, so that the risks of shortage and of excess are among the major problems of water management. This means that assigning water property rights that can “exclude” usage by some are very expensive and difficult to enforce, thus causing water to have a “high-exclusion cost”.

determined by human perceptions and priorities regarding a certain water use and may be used to incorporate sustainability concepts associated with environmental stewardship or preferences regarding water conservation for future generations. Values also help to signaling consumers' willingness to pay for additional investments in water services or improved water-related services. Water valuation methods contribute to determining the most rational allocation of water as a scarce resource based on needs and interests and can be calculated using a variety of techniques. The *cost* of water involves determining the actual cost of delivering water and/or a certain water service. Costing methods provide a means for considering the various cost components of a project and are particularly useful when all costs are considered within an integrated framework (e.g., the direct and indirect costs of a project). Water costs thus not only take into consideration basic supply costs, but also the costs and benefits that could be achieved by alternative water uses, as well as impacts that a project may imposed on non-targeted users. Water costing also provides an instrument for supporting cost recovery decisions. Determining the value and the cost of water is thus essential because when the value and the cost of water are equal the water professional can determine that the water resource is being allocated to its best use and that the sustainability of the project is most likely to be realized. Furthermore, both the value and the cost of water can significantly contribute to helping decision-makers determine water tariffs, water prices and water-related services charges.

Water value concepts

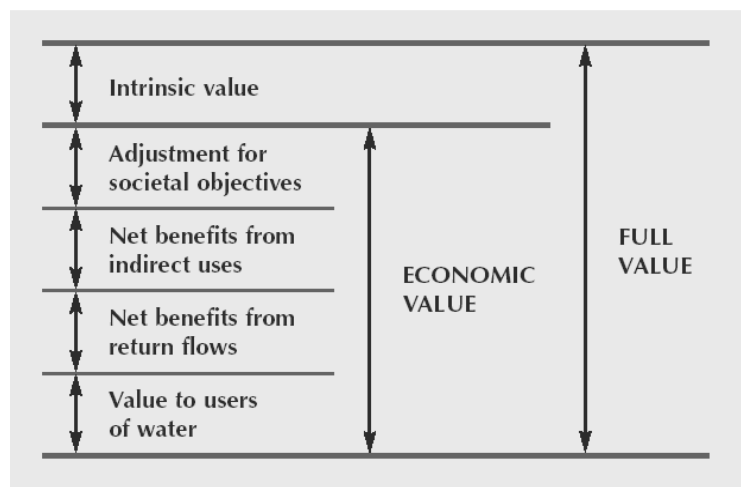
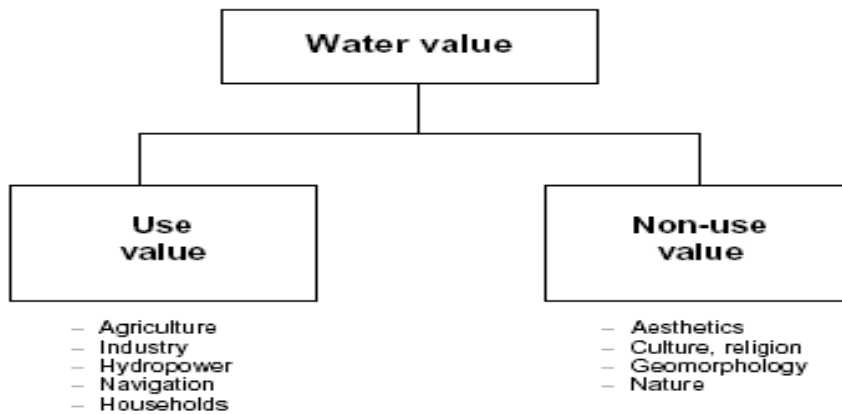


FIGURE 1: GENERAL PRINCIPLES FOR VALUING WATER

The following concepts of water value have been found useful within IWRM. The full value of water consists of its economic value (or use value) and its intrinsic value (Figure 1). The economic value depends on the user and the way it is used (refer to Annex A for detailed definitions or GWP TAC Background Paper 2) and represents: *value to (direct) users of water, net benefits from water that is lost through evapotranspiration or other sinks (e.g. return flows), and the contribution of water towards the attainment of social objectives*. The intrinsic value includes non-use values such as bequest or existence values.

As a natural asset, the value of water resides in its ability to create flows of goods and services over time. Values derived from water can usually be divided into two types: use value (also known as extrinsic values and direct use values, i.e.: agriculture, industry, hydropower, navigation, households) and non-use values (sometimes called intrinsic values, passive use values, or existence values, i.e., aesthetics, culture, religion, geomorphology, nature). Another common term used in water valuation is 'option value', which describes the fact that some individuals who do not wish to use the water resource now are willing to pay or forgo current benefits to preserve the resource for future generations or for some future use. This therefore clearly represents a non-use value for the current generation; but depending on its potential use by future generations, an option value could be either a use value or a non-use value (Figure 2).

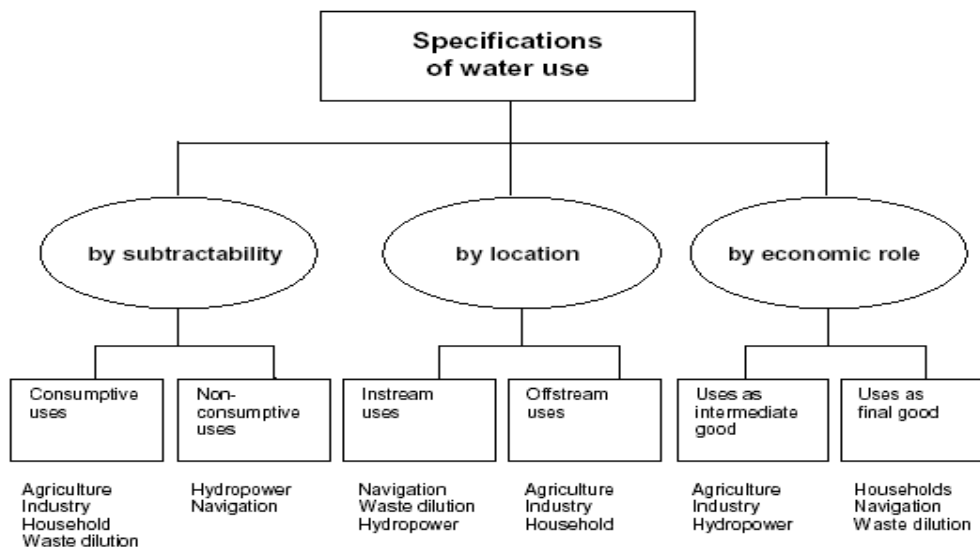
FIGURE 2. TYPES OF WATER VALUES (AGUDELO, 2001)



Water Valuation Methods

As an alternative to market prices, decision-makers can use shadow prices or accounting prices to reflect economic benefits or values that are needed to provide a basis for water valuation decisions, including related investment and allocation policies. Valuation techniques often differ between intermediate goods or producer goods (i.e., those employed to make products that will be eventually used by consumers) and final goods or consumer goods (i.e., those provided for human satisfaction). A summary flowchart is given below to demonstrate the types of valuation methods one may use in different situations (Figure 4).

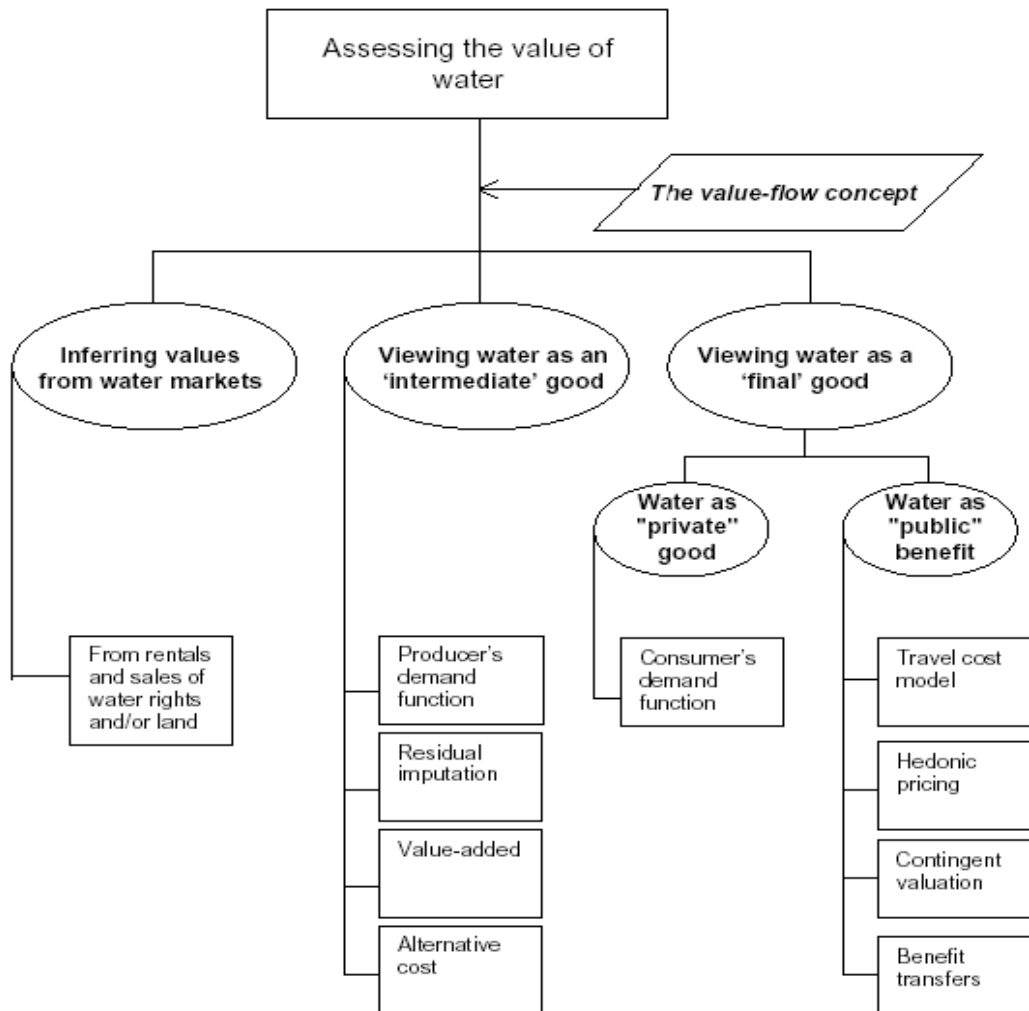
FIGURE 3. FURTHER SPECIFICATIONS OF WATER USE



Below is a brief elaboration on some of the most commonly used valuation techniques noted in Figure 4. As illustrated in Figure 4, there are several valuation techniques that may be used to assess the value of water used as a final good for the public benefit. Such water use might include water used for amenity and recreational purposes. These valuation techniques are based on determining the *revealed preferences* or *stated preferences* of actual or potential consumers of the proposed water use, which can be determined in a variety of ways. The *revealed preference method* relies on observations of *actual* expenditure choices made by consumers, which reveal their net *willingness to pay* for a certain water use (or environmental amenity). This is revealed by the differences in expenditure choices made by consumers for different levels or types of water-related uses that already exist. Techniques for applying this method include the:

- *Travel cost method*: This is the most widely used technique for implementing the revealed preference method. It is premised on determining the cost of travel to a recreational site (e.g., park, lake, river for swimming) for different consumers. If the cost of traveling to the destination varies widely between consumers, consumers would respond to higher travel costs in the same way that they would respond to higher entrance fees. Based on this information, the analyst can then derive a demand schedule for recreation at the site based on the cost of travel.
- *Hedonic price method*: This revealed preference approach applies to markets for goods that have several attributes that are recognized by consumers, but the attributes cannot be unbundled when purchasing the good. The partial derivative of the hedonic price function with respect to the characteristic of interest in the good yields a measure of the marginal value of that characteristic. The information can then be used to value the distinct components of a multi-functional type of water use (e.g., water channeled through a public park (recreational value) that also serves a wetland for endangered species (biodiversity value), and also filters impurities and improves water quality for downstream users (water quality value).

FIGURE 4. VALUATION METHODS



The *stated preference approach* (also called the *contingent valuation method*) simulates a *hypothetical* market condition and asks respondents to complete a survey in which they are asked to express their willingness to pay for existing or potential type of water supply or quality that is not currently available on the market. In cases where water is viewed as an “intermediate good” in the production process, the

alternative cost technique is best applied. This technique is applied using the assumption that ‘if a given project (which achieves an output) costs *less* than the next-best public or private project (which can also achieve the same output), then the cost of the next best project can be assigned as the benefit to the public project under consideration.’

Other valuation techniques elaborated in ESCWA (2001) can also be applied when market prices of water are lacking or distorted. For instance, for domestic uses of water an analysis of observations concerning what people pay for domestic water supply, including the time cost involved in collecting water, can be applied and analyzed in a similar way as the travel cost method to determine a consumers value for a water resource benefit. Examining the value of water sold through private vendors for domestic use is another way of revealing the preferences and willingness to pay of consumers for water. For irrigation projects, the value of marginal product of water² in different uses should provide an understanding about the maximum level of water charges that consumers are willing to pay. When such figures do not exist, the net return on grown crops after excluding all costs other than water costs provides an upper boundary figure on what farmers can pay for water. Near major urban areas, the opportunity cost of water used for irrigation is it’s the amount water is valued for domestic or industrial consumption.

Water cost concepts

In traditional water costing circles, the full supply cost of water is commonly used as the basis for calculating water costs and prices. In such a case, the full supply cost of water is simply a representation of the combined capital charges and operation and maintenance (O&M) costs associated with supplying the water service. However, when looking at water supply and demand in an integrated framework, the **full cost** of water should be considered.

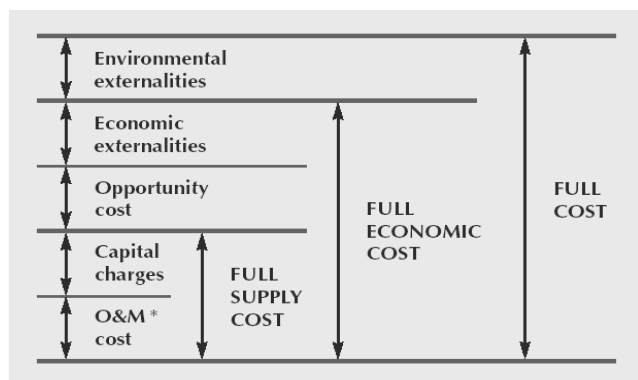
As illustrated in Figure 5, the full cost of water includes the full supply cost, the opportunity cost of water in its next best alternative use, as well as the economic, public health and environmental externalities associated with the water use.

Opportunity costs: An examination of opportunity costs allows the water professional to consider what would be the costs and benefits of allocating water for a certain project to its next best use. The exercise is important as it may occur that an alternative water use scenario for the same water resources might yield greater benefits for less cost.

In this case, the opportunity cost of moving forward with the planned project – instead of the alternative – may be significant and result in a misallocation of the resource. The opportunity cost of water is zero *only* when there is no possible alternative use for the water.

Economic and environmental externalities: Incorporating economic and environmental externalities into water cost decisions are a fundamental component of IWRM. Externalities represent the indirect effects (and sometimes unintended impacts) of a planned water use, and may impose additional costs or indicate supplemental benefits provided by a planned project. Economic externalities may represent indirect effects to public health, human settlements or agricultural development. Environmental externalities are closely related, but also take into consideration impacts on upstream or downstream water uses, shared water

FIGURE 5. GENERAL PRINCIPLES FOR WATER COSTING



* O&M = Operation and Maintenance

² The “marginal product of water” is defined as the increase in the value of production due to an increase of applied irrigation water by one unit while holding other inputs constant. The “value of the marginal product of water” is the outcome of multiplying the marginal product of water by the market price of the product itself.

resources, sewage and sanitation, wetlands or natural resources. Consideration of externalities should also be incorporated into opportunity costs assessments so as to most effectively determine the costs of a planned water project (refer to Annex A for more details and definitions).

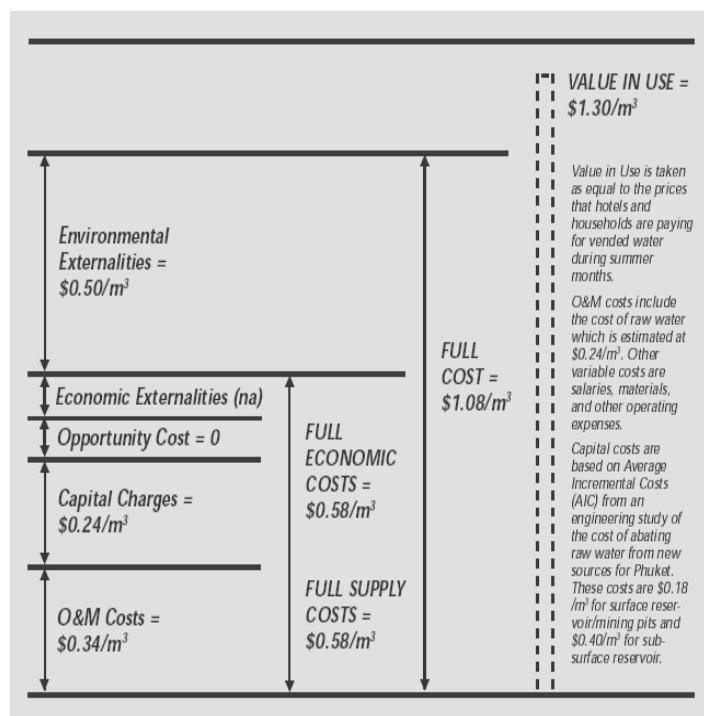
Estimating Water Value and Water Cost: Illustrative Examples

Three examples are quoted from the GWP TAC Background paper 2 for three primary water users sectors (urban households, industry, and irrigated agriculture) are presented here to illustrate empirical estimates of the principle that water is a social and economic good, and the methodologies involved.

Illustrative Example 1: Value and cost of water for urban households in Phuket, Thailand

FIGURE 6. COSTS AND VALUES FOR URBAN WATER SUPPLY IN PHUKET, THAILAND.

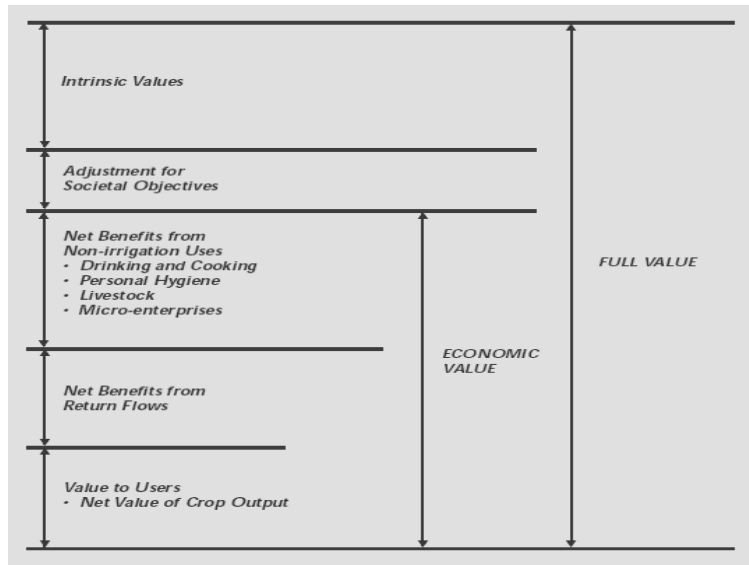
The island community of Phuket, Thailand depends heavily on its urban water resources to support the local tourism sector that dominated the local economy prior to the Tsunami of December 2004. Because there were no alternative uses of water for agriculture or industry prior to 2004, the opportunity cost for alternative water uses is set at zero and the full economic cost is determined to be equal to the full supply cost, as presented in Figure 6. Environmental externalities are taken into account by estimating the costs of wastewater treatment (\$0.50/m³). Thus, the **full cost** of water is estimated at \$1.08/m³. The **Value in Use** (\$1.30/m³) of local water resources was estimated from data on the “willingness to pay” of urban consumers and hotels for vended water during the summer months by examining their stated preferences through past behavior. This value is relevant for three months in summer when there are extreme water shortages on the island. The gap between the value and costs implies a problem with water sustainability in Phuket (or the need for more evaluation of the estimates given above). Some problems may arise because of the relative inaccessibility of the resource for alternate uses. The gap may also indicate a need for water storage or incentives for water conservation.



Illustrative Example 2: Value and Cost for Irrigated Agriculture in an Arid Zone: Haryana, India

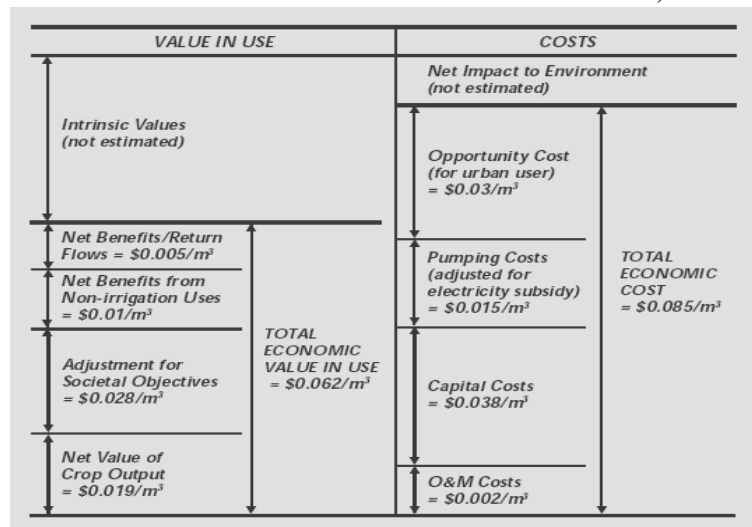
FIGURE 7. ESTIMATION OF VALUE OF WATER IN IRRIGATED AGRICULTURE

Haryana is in an arid region of India where irrigated agriculture is used to support the local food supply and supplement local income. Estimating the economic value of water used in irrigated agriculture in the area involved computing the three components of water valuation illustrated in Figure 7. Positive economic externalities include health and income benefits from the use of irrigation water for drinking, personal hygiene and livestock maintenance. Net benefits should also be estimated from return flows from irrigation recharging the aquifer. An adjustment for societal objectives must be made, represented by the societal benefits of food availability (particularly in rural areas) and of low food grain prices resulting from additional output from irrigated agriculture. A premium may also be attached to other benefits derived from crop output (e.g., income). Furthermore, an adjustment must be made also for employment creation.



The total economic value of water diverted to irrigated agriculture is thus estimated at \$0.062/m³ (Figure 8). The full economic costs of water supply for agriculture is estimated at \$0.085/m³ and includes O&M costs, capital costs, pumping costs, and opportunity cost of water (in the urban household use). The gap between the costs and values clearly indicate the lack of sustainable water use in the community. In using the analysis, care must thus be taken to ensure that the societal benefits of water use in the irrigated agricultural sector are not undervalued (e.g., benefits accrued to women or children might be more closely examined). Should the findings of a reassessment prove consistent, then local leaders and water use decision-makers would need to more closely collaborate and partner to better allocate local water resource to a higher beneficial use.

FIGURE 8. ESTIMATION OF VALUE IN USE FOR IRRIGATED AGRICULTURE AND COSTS OF WATER IN HARYANA, INDIA



Illustrative Example 3: Costs and Values in Jamshedpur, Subernarekha River Basin, India

This example estimate costs and values of water used in agriculture, urban areas, and industries near Jamshedpur in the Subernarekha river basin in eastern India. Figure 9 displays the value in use for irrigated agriculture and cost of water for the region, while Figure 10 displays the same for urban and industrial sectors. The value of water in urban households is estimated from the average willingness to pay in urban areas of Jamshedpur, while the value of water to industry is estimated based on the average of the net value added per unit of water for the 21 industrial units in the region.

FIGURE 9. ESTIMATION OF THE VALUE IN USE FOR IRRIGATED AGRICULTURE AND COSTS

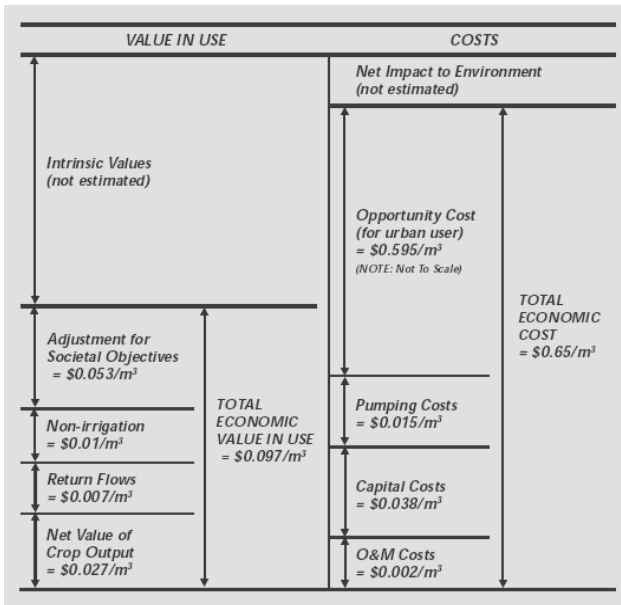


FIGURE 10. ESTIMATION OF THE VALUE IN USE FOR URBAN AND INDUSTRIAL SECTORS

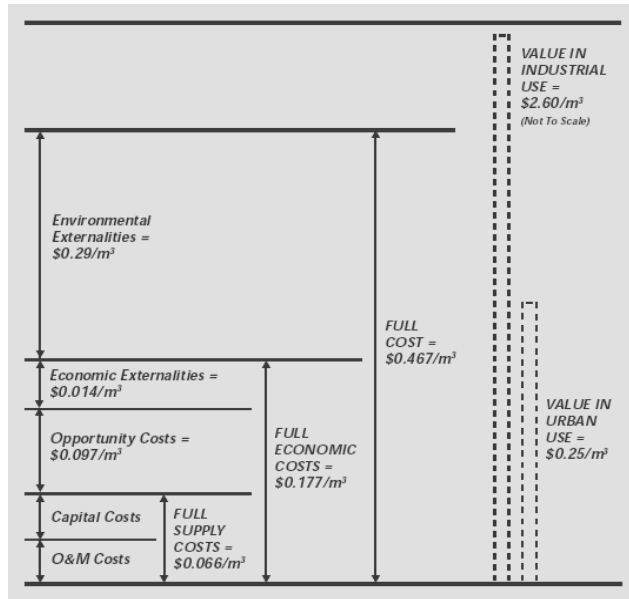
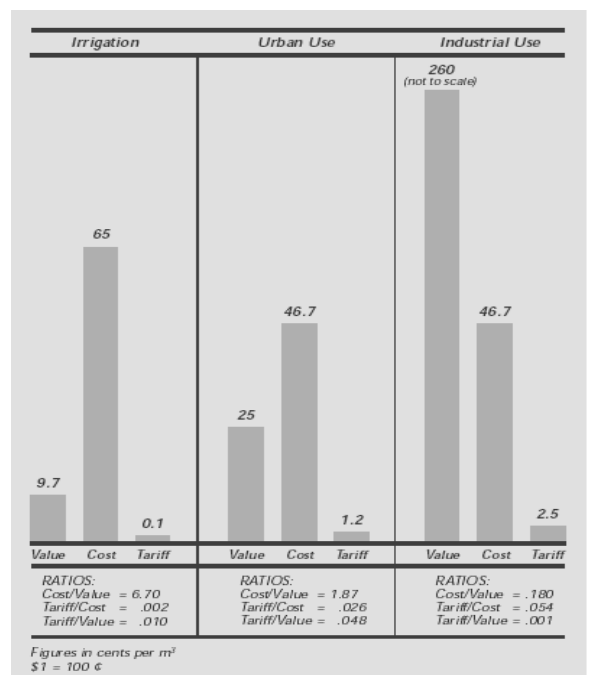


Figure 11 gives a comparison of values and costs of water in the three sectors within the river basin. The value of water in industrial use is approximately six times the full cost of the supply of water, including the costs of economic and environmental externalities. In contrast, the value in use in the urban households sector is lower than the full cost of supply. In the case of agriculture, the value in use is much lower than the full economic cost, which includes the opportunity costs of water used in irrigation, which implies that under the current situation there may be issues with sustainability, and given the very low tariffs, there may be opportunities to use tariffs to reach a more sustainable allocation of water.

FIGURE 11. COMPARISON OF VALUE IN USE, COSTS AND TARIFFS FOR THE THREE SECTORS

From the above examples, the following conclusions emerge:

- It is important to estimate the full cost of water used in a particular sector and this should include the opportunity cost of water as well as the environmental externalities. The full cost should present the context for setting water prices, effluent charges, and incentives for pollution control.
- In estimating the value of water, it is critical to reflect societal objectives of poverty alleviation and food security, and incorporate the net benefits from return flows and non-irrigation uses of water.
- The value and cost of water should be taken into account when setting water tariffs.
- Raising water tariffs and levying effluent charges can be used as economic instruments for improving economic efficiency and environmental sustainable water use.



These concepts are more fully elaborated in the sections below.

B.3 Financing of the Water Sector and Sector's Financial Sustainability

Financial resources in the water sector are used for service delivery (e.g., potable water, irrigation, sanitation), overall resource management, conservation and protection of water resources, and projects to balance out water supply and demand over time and space. Financial resources are also needed to protect against risks and extreme events that may impact people and public goods (e.g., floods and droughts). Satisfying these needs requires significant financial resources and access to various funding mechanisms. Sustainable financing is linked to the need for cost recovery and improved charging policies to support the operation and maintenance of water systems and provide for new investments. In a perfect world, all the costs of investing in and operating water services are recovered eventually. The main sources of revenue for water projects are charges and fees levied on users. However, social and cultural norms often render it difficult to adopt full cost pricing principles to water services (e.g., where the price charged for water and water-related services is equal to the full cost and full value of water). The collection of these fees is also often difficult for water authorities in developing countries, particularly when tariff increases are involved.³ Government subsidies, national taxation exemptions, regional and international grants, voluntary contributions and in-kind assistance are types of funding instruments for water services that may be used to supplement or even surpass income generated from user fees.

Obtaining and allocating sufficient financial resources to satisfy water needs is thus a major challenge for water professionals. Funds to meet these needs may be sought from national governments, local communities, individuals, commercial banks, the private sector, NGOs and the donor community. However, none of these sources can fill the gap alone, and a combination of these is usually needed. Financing needs in the water sector are also often very large since water projects tend to be indivisible and capital-intensive. Many countries have investment backlogs preventing the implementation of planned water projects. Contributions from international and bilateral donors are also declining, while the need for water development projects is growing.⁴ Private financing through loans is available, but the risks involved in lending to certain groups, such as municipalities or farmers' associations may be too high or too costly.

Ultimately, the availability of funds for water projects depends on the developmental priorities and policies of a country. These priorities must adapt to the realities of water resource management, and water policies must also adapt to and be integrated into national and local development strategies. The integration of these policies can be realized through a country's national development strategy and national budget. However, in order for this policy integration to be realized, governments need a clear water resource management plan and a supporting funding strategy that estimates overall investment requirements and identifies funding sources. Additionally, while most water sector services and resources management investments are at present provided through the public sector, improvements in the O&M of public water authorities can make for more financially efficient services. The private sector can also help to mobilize resources and stimulate greater efficiency. Better coordination between public and private financing instruments and public-private partnerships can more effectively mobilize financial resources (*Module 11*). However, both public and private operators require strong

³ Collection of water tariffs can be made more acceptable if: consumers are consulted about proposed tariff increase as they are being planned (e.g., by applying one or more of the valuation techniques noted in the previous section); users are informed about a new tariff schedule prior to its application; residents receive better services following a tariff increase; and/or if the impact on poorer users is cushioned.

⁴ On a global scale, it was suggested that the annual investment in the water sector in developing countries should double from its current value of about US\$ 90 billion per year to about US\$ 180 billion over the coming twenty years (from the *World Water Vision 2003*). This estimate refers to investment in new infrastructure alone and takes no account of the ongoing cost of maintenance, rehabilitation, and replacement.

public monitoring and regulations that take into consideration the socio-economic impacts of water tariffs on different segments of the population. Furthermore, the water sector is very diverse and different financial instruments may be appropriate for different services. For instance, in local and rural areas, community financing is an option. Also, not all funding options cost money directly: water sector efficiency and savings can also benefit from improvements resulting from investments in other sectors (e.g., power and advanced education and training).

Water pricing⁵

An assessment of the value and cost of water helps to determine what is the most efficient and equitable allocation of a water resource, e.g., where value equals cost. *In a perfectly balanced economic world, the cost of supplying a water-related service should be equal to the price charged for using (e.g., demanding) that service.* However, the delivery of a water supply or sanitation services entails significant costs that water users can not bare alone. Additionally, it is very seldom that water prices take into consideration opportunity costs or externalities associated with the provision of a certain water service since they are usually not even able to provide sufficient income to cover supply costs. As such, water prices rarely represent the full cost or the full value of a water resource. Instead, water prices reflect a series of political decisions and trade-offs that result in an “appropriate” tariff schedule for various water uses. However, setting water prices at levels *below* the full cost of supply requires decision-makers to then develop alternative financings strategies to cover the shortfall in income caused by subsidized user fees. Otherwise, insufficient financial resources will be available to cover the full cost a certain project (e.g., investment capital costs, O&M, opportunity costs and externalities).

Water prices can thus be adjusted to ensure that water is used as both a social and economic good. For example, a certain water service may entail high supply costs, but social concerns may require providing direct subsidies (e.g., reduced water prices) for a specific disadvantaged group of users. Targeting subsidies to a specific group (e.g., poor farmers) has a less distorting effect on water markets than subsidies that are “across the board.” To be politically palatable, subsidies also have to be justified and transparent or tensions may emerge from other user groups. In situations involving conflict over water, attempts should also be made to at least estimate the full economic cost as the basis for allocation decisions. Water prices may be also used as an economic tool for influencing the behavior of water users to advance different economic development objectives. In such cases, water prices might be raised or reduced according to political priorities identified in national development strategies. However, reference to the full cost of water is still important in this case since it allows the policy-maker to determine how high or low prices may be set and the shortfall (or surplus) in income that must be generated to ensure the financial sustainability of a project.

The goal of full cost recovery

Full cost recover should be the goal of all water professionals, unless there are compelling reasons for not doing so. Full cost recovery means that the full cost of supplying a water resource is recovered by user fees and/or other financial instruments. However, as noted above, while the full cost needs to be estimated and made known for the purpose of rational water allocation and management decisions, it need not necessarily be charged to water users. That is a political decision left to the water decision-maker. However, the cost will have to be borne by someone and that cost accounting should be included as an integral part of the decision-making process. Water professionals must also realize that the cost of investment in water projects, their operation and maintenance is getting so high that many governmental budgets can no longer afford them. Improving community services, such as drinking water supply and sanitation, will only be possible if certain mechanisms

⁵ Care should be taken to clearly distinguish between the value, cost and price of water because each figure contributes a distinct piece of information to the decision-making process. In the real world, it is also nearly never the case that the value, cost and price of water are equal to one another.

are set up for at least partially recovering costs from users. Accordingly, the need to consider cost recovery mechanisms should be highlighted to decision-makers as an issue of great concern and urgency. Conceivable strategic options may include transferring the ownership, management or operations of over some water utilities to financially autonomous public or private organizations. In some cases (e.g., rural and irrigation water supplies), relying on certain NGOs, such as water users associations or community groups may prove to be more effective for managing and financing local water services and resources.

When discussing, analyzing and promoting cost recovery concepts, it is suggested that decision-makers and users consider the following issues:

- a) The provision of high quality services to users is a precondition for effective cost recovery: relying on users to cover the cost of water supply and services will be viable only if users have confidence in or are guaranteed that the water will be of good quality and the services are reliable;
- b) Different levels of cost recovery could be identified for different categories of users: differentiation between groups and cost recover levels should depend on sets of criteria and are best achieved through economic analysis and consultation with the user groups;
- c) Evidence that serious efforts are planned for optimal use of the existing water resources would help in mobilizing additional financing from national and international sources, both public and private;
- d) Financial and regulatory instruments to facilitate private investments and redirect public savings to sustainable development actions should be developed; and
- e) Financial self-sufficiency of local services with decentralized management and authority can be achieved by soliciting the participation of users and the mobilization of local entrepreneurs through joint initiatives.

B.4 Investment Policies

Through economic policies and public policy decisions, governments may advertently or inadvertently have a significant effect on the water sector. Policy-makers should be aware of all these potential effects and should include in the development of investment policies the role and potential impact of every level of investors: public, private sector, communities and individuals. Governments thus have a responsibility for assessing water-related investment policies as they relate to:

- *Macroeconomic developments:* monetary, fiscal and trade policies all affect the pace and type of development of the economy in general and the water sector specifically. For example, currency devaluation may lead to a boom in irrigated crop exports; tax incentives might result in the growth of water-intensive industries, and trade liberalization may cause changes in the mix of products produced, causing changes in water use.
- *Public investment:* policies encouraging investment in many sectors affects demand for water, such as housing, industry, transport, power and energy, agriculture and tourism.
- *Public and private investment in the water sector itself:* the water sector is capital intensive with potentially very large financial needs for irrigation, water supply, wastewater treatment, and flood and environmental protection. The choice to invest in one project may thus limit investment options for another project.

Once policy guidance is reasonably clear, a national water investment strategy based on IWRM should be prepared. The strategy should be demand-driven and identify sources of funding for an affordable, realistic program covering all aspects of water sources management.

A workable investment strategy for the water sector should include:

- Identification of water sector goals and listing of associated projects needed to achieve those goals;
- Estimates of investment requirements for realizing listed project;
- Allocation of responsibilities for fundraising (e.g., among central and municipal government, communities, autonomous agencies, private companies);
- Identification of sources of grants and concessional loans (e.g., bilateral and multilateral donors such as the World Bank);
- Definition of the role of the private sector and financial targets for concessions, joint ventures, etc.;
- Assessment of the scope and potential for alternative approaches, such as demand management or economic instruments to reduce capital needs;
- Assessment of the scope for investment at the community/household level;
- Charging schemes for water and wastewater discharges; and
- Clear assessment of the roles of public and private sectors and associated regulatory instruments.

A national financing strategy could also identify internal instruments that may be instituted for achieving financial objectives. This might include: promoting the adoption of appropriate standards and technology, adopting economic tools (tariff incentives) and legal instruments (penalties) to encourage commercial enterprises to undertake their own investment in water conservation or effluent treatment, using of revenues from water-related services to cover recurrent O&M costs with a portion automatically saved to support the cost of future investments in expanding and modernizing the system. Internal sources of funding can be supplemented by borrowing and the injection of equity capital. However, in the long run, both these types of financing have to be repaid or reimbursed from the cash flow from water sales and so should thus not be regarded as additional sources of income.

B.5. Water Sector Financing in the ESCWA Member Countries

The full supply cost of water-related infrastructure varies depending on project scope, scale, location as well as other criteria and determines the basic investment costs of a project. On average, investment costs run between \$1,000 and \$3,200 per inhabitant, based on an assumed per capita consumption rate of 180-220 m³ per year (490-600 liters/day) living in a three-person household. Fay and Yepes (2003) use World Bank figures to estimate that new investments in water supply and sanitation cost \$1,100 per connected household (\$400 for water supply delivery and \$700 for sanitation service). Based on the average household size of 5.12 per dwelling in the ESCWA region,⁶ the cost of new investment for water supply infrastructure can thus be estimated at \$78 per capita for water supply and \$137 per capita for sanitation infrastructure for a combined total of \$215 per capita for new investments. However, this costs excludes maintenance and other management components related to operation, capital financing, capital depreciation, taxes, the cost of rehabilitating existing facilities, as well as additional investments needed to offset any environmental or economic externalities that may result from the project. Furthermore, when examining these costs, it is important to note that the cost of financing water supply and sanitation projects is likely to increase over time in the ESCWA region due to increasing water scarcity, greater industrial pollution and agricultural run-off into surface waters (which increases the cost of ensuring adequate water quality), increasing urbanization and population growth. On the other hand, the emergence of new technologies may reduce the cost of water supply through desalination or other water purification mechanisms and improvements in the efficiency of water installations may reduce O&M costs in the long run. In the year 2000, there were 165.6 million persons living in the ESCWA region, of which 17.6 million persons lacked access to an improved water source and 19.6 million persons lacked access to adequate sanitation

⁶ Figure represents the average household size for eight participating countries in the Arab region.

facilities. Taking into account moderate population growth projections, this means that ESCWA Member States will need to provide 137 people with water supply services and 139 million persons with access to sanitation by the year 2025. Using the regional per capita investment costs estimated above, the minimum amount of new investment funds required to satisfy current and forecasted water investment needs in the ESCWA region until 2025 is \$30 billion (\$10.7 billion for water supply and over \$19 billion for sanitation), in addition to funds needed for O&M, capital financing and the rehabilitation of existing facilities.⁷ It should be noted that this is a relatively conservative estimate since the World Bank estimates water supply and sanitation investment needs for the MENA region to reach \$40 billion between 2000 and 2010 alone.⁸

While these figures provide a regional picture, each country has its own water investment needs and priorities to address over the coming decades. Water supply and sanitation needs for ESCWA Member States are estimated in Tables 1 and 2 respectively. Egypt requires the most funding and represents nearly 21% of regional investment needs until 2025 (see Figure 12). Recent information from Egypt also estimated that the cost of eliminating leakages from its water distribution network (water currently lost at rate of 40-50%) is estimated at LE 20 billion renovating (\$6.6 billion at the 2003 exchange rate of US\$1=LE3.05); renovating its 421 water supply treatment plants is estimated at LE 1.4 billion (\$462 million) and repairing its 27 wastewater treatment plants will cost another LE525 million (\$173 million).

TABLE 1. WATER SUPPLY CAPITAL INVESTMENT NEEDS FOR ESCWA MEMBER STATES UNTIL 2025

	Total # of people requiring access to an improved water source by 2025 ('000)	Water investment needs (2000-2025) (\$ Million)	% Share of regional investment in water (2000-2025)
Bahrain	247	19.3	0.18
Egypt	28,930	2,260.1	21.07
Iraq	20,794	1,624.5	15.14
Jordan	3,950	308.6	2.88
Kuwait*	1,305	102.0	0.95
Lebanon	1,084	84.7	0.79
Oman	4,421	345.4	3.22
Palestine	4,401	343.8	3.20
Qatar	189	14.8	0.14
Saudi Arabia	21,144	1,651.9	15.40
Syrian Arab Republic	14,460	1,129.7	10.53
United Arab Emirates	862	67.3	0.63
Yemen	35,545	2,777.0	25.88
Totals	137,331	10,729.0	100.00

Source: ESCWA (2003), pg. 21.

⁷ It should be noted that this estimated does not include investment needed to build or repair water related infrastructure destroyed during military conflicts in Iraq and elsewhere after the year 2000.

⁸, Note that Saqhir (2000) estimates that 45 million and 80 million lack access to safe water and sanitation, respectively, in the MENA region, which includes Algeria, Iran, Morocco and Tunisia in addition to ESCWA Member States.

TABLE 2. SANITATION INVESTMENT NEEDS FOR ESCWA MEMBER STATES UNTIL 2025

	Total # of people requiring access to sanitation by 2025 ('000)	Sanitation investment needs (2000-2025) (\$ million)	% Share of regional investment for sanitation (2000-2025)
Bahrain*	247	33.8	0.18
Egypt	28,251	3,862.4	20.28
Iraq	22,171	3,031.1	15.91
Jordan	3,802	519.8	2.73
Kuwait*	1,343	183.7	0.96
Lebanon	1,119	153.0	0.80
Oman	3,076	420.6	2.21
Palestine	3,954	540.6	2.84
Qatar	206	28.2	0.15
Saudi Arabia	20,127	2,751.7	14.45
Syrian Arab Republic	12,841	1,755.6	9.22
United Arab Emirates	940	128.5	0.67
Yemen	41,233	5,637.4	29.60
Totals	139,310	19,046.3	100.00%

Source: ESCWA (2003), pg. 22.

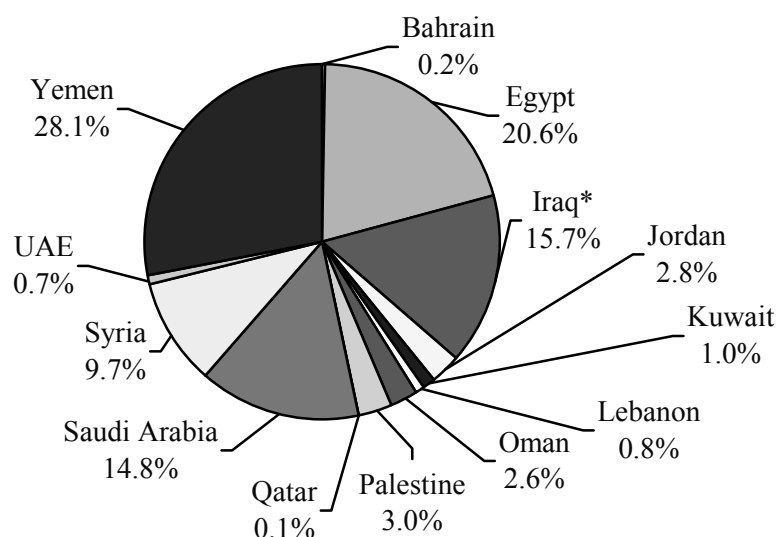


FIGURE 12. ESCWA MEMBER STATES NEW INVESTMENT NEEDS IN WATER AND SANITATION AS SHARE OF REGIONAL NEEDS (2000-2025)

ESCWA Member States are pursuing a variety of mechanisms to secure sufficient financings to support new investments in water supply and sanitation. Apart from national budget allocations, loans and grants have been secured from official development assistance (ODA), multilateral financial institutions and regional development funds. Indeed, bilateral donors (Japan, Germany and the United States) as well as global and regional institutions

such as the World Bank and Arab Fund for Economic and Social Development (AFESD) have provided significant support for water and sanitation projects in the ESCWA region. The World Bank estimates that eight Arab countries (Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, Tunisia and Yemen) spent \$800 on water and sanitation projects between 1996 and 1999, and that \$500 of this total was covered by ODA. Egypt has traditionally been among the top ten largest recipients of ODA from OECD countries in the area of water and sanitation. The number of public-private partnerships in the water sector has also significantly increased in recent years – particularly in Tunisia and Morocco. Private investment dollars also support water investments in Gulf countries, with Governments also actively pursuing partnerships in the area of water desalinization (*Module 11*).

Accessing sufficient financial resources to meet growing water infrastructure needs is thus a major constraint for the Governments of the region. However, several mechanisms and instruments are available to help reduce the burden on government budgets. Sustainable financing objectives that seeks full cost recovery of water investments through direct charges and supplementary sources of funding should thus be part of the decision-making framework of water professionals if funds are to be secured and made available to meet the growing water supply and sanitation needs of the region.

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ANNEX ONE: GENERAL PRINCIPLES ON VALUE AND COST OF WATER⁹

1. GENERAL

There are several general principles involved in assessing the economic value of water and the costs associated with its provision. First, an understanding of the costs involved with the provision of water, both direct and indirect, is key. Second, from the use of water, one can derive a value, which can be affected by the reliability of supply, and by the quality of water. These costs and values may be determined either individually, as described in the following sections, or by analysis of the whole system. Regardless of the method of estimation, the ideal for the sustainable use of water requires that the values and the costs should balance each other; full cost must equal the sustainable value in use.

It may be pointed out that the value in alternative uses and opportunity costs are determined simultaneously when water supplies match water demands for user sub-sectors over time and space. Water markets, if functioning, will perform these functions of matching water demands (both for quantity and quality) with supplies if appropriate policies (regulatory and economic incentives) are used to take care of externalities. In the absence of such well-functioning water markets, efficient water allocations (and resulting values and costs) can be obtained by using multi-period, multi-location systems analysis models. With the advent of high-speed computers and efficient software, it is now possible to obtain empirical estimates of values and costs using a systems analysis model on a personal computer.

However, where such systems analysis models are not available for the practical purposes of estimating values, costs and tariffs, a partial equilibrium approach should be followed. This requires estimating the Opportunity Cost of water when used in a particular sub-sector in order to reflect the cost to society of depriving other sectors of the use of this water. For example, while evaluating the full economic cost of water used in the industrial sector, it becomes necessary to estimate value in the best alternative foregone, which may be urban households or agriculture. Similarly, estimating the economic cost of water used in irrigation requires the estimation of the value of water used in the industrial and urban sectors.

2. COMPONENTS OF FULL COST

Figure 1 shows schematically the composition of the various components that add up to make the costs. There are three important concepts illustrated in this figure: the Full Supply Cost; the Full Economic Cost; and the Full Cost. Each of these is composed of separate elements that need further explanation.

a. Full supply cost

The Full Supply Cost includes the costs associated with the supply of water to a consumer without consideration of either the externalities imposed upon others nor of the alternate uses of the water¹⁰. Full Supply Costs are composed of two separate items: Operation and Maintenance (O&M) Cost, and Capital Charges, both of which should be evaluated at the full economic cost of inputs.

O&M cost: These costs are associated with the daily running of the supply system. Typical costs include purchased raw water, electricity for pumping, labor, repair materials, and input cost for managing and operating

⁹ Extracted and summarized from GWP Background TAC paper 2: "Water as a social and economic good: how to put the principle into practice", the full document can be downloaded from www.gwpforum.org (Library/documents)

¹⁰ Water resources exhibit externalities in the sense that they have the property of "mutually interfering usage". Individuals take the valuable commodity of clean water from the same environment which they then use to dump wastes, thus interfering with the use of the no-longer-clean water by themselves and others. In economic parlance these aspects are referred to as "externalities".

storage, distribution, and desalination/treatment plants. In practice, there is typically little dispute as to what are considered O&M Costs and how they are to be measured.

Capital charges: These should include capital consumption (depreciation charges) and interest costs associated with reservoirs, treatment plants, conveyance and distribution systems. There is some disagreement about the calculation of Capital Charges. Older methods use a backward accounting stance and look for the costs associated with repaying the historical stream of investments. Modern methods stress a forward-looking accounting stance and look for the costs associated with replacement of the capital stock with increasing marginal costs supplies. These coupled with the O&M Costs approximate the long-run marginal costs.

b. Full economic cost

The Full Economic Cost of water is the sum of the Full Supply Cost as described in the previous section, the Opportunity Cost associated with the alternate use of the same water resource, and the economic externalities imposed upon others due to the consumption of water by a specific actor.

Opportunity cost: This cost addresses the fact that by consuming water, the user is depriving another user of the water. If that other user has a higher value for the water, then there are some opportunity costs experienced by society due to this misallocation of resources. The Opportunity Cost of water is zero only when there is no alternative use – that is no shortage of water. Ignoring the Opportunity Cost undervalues water, leads to failures to invest, and causes serious misallocations of the resource between users. The Opportunity Cost concept also applies to issues of environmental quality.

Economic externalities: As a fugitive resource, water results in pervasive externalities¹¹. The most common externalities are those associated with the impact of an upstream diversion of water or with the release of pollution on downstream users. There are also externalities due to over-extraction from, or contamination of, common pool resources such as lakes and underground water¹². There may also be production externalities due, for example, to the agricultural production in irrigated areas damaging the markets for upland non-irrigated agriculture, or forcing them to change their inputs. The standard economic approach to externalities is to define the system in such a way as to “internalize the externalities.” In here economic and environmental externalities are separated, realizing that in some cases it will be difficult to distinguish exactly between them. The externalities may be positive or negative, and it is important to characterize the situation in a given context and estimate the positive or negative externalities and adjust the full cost by these impacts.

Positive Externalities occur, for example, when surface irrigation is both meeting the evapotranspiration needs of crops, and recharging a groundwater aquifer. Irrigation is then effectively providing a “recharge service.”

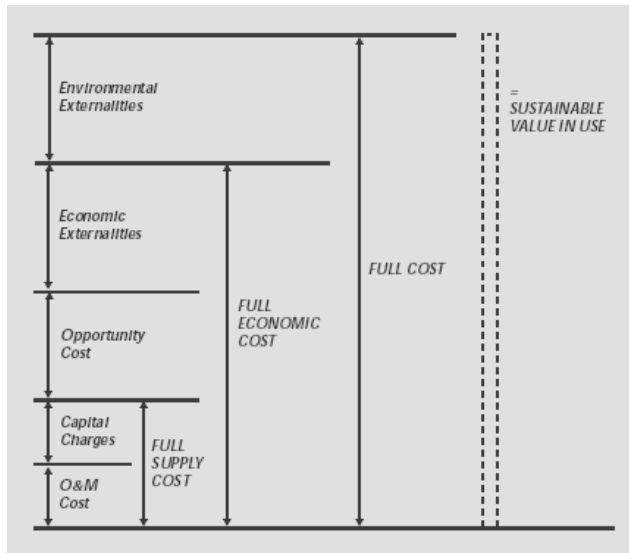


Figure 1. General Principles for Cost of Water

¹¹ By this it is meant water literally moves from one place to another, and, unless it is abstracted and stored, it cannot be easily owned by any one user.

¹² Common pool resources, such as village commons, groundwater aquifers, and lakes are available for use to everyone, unless regulatory mechanisms exclude some persons or levy charges for their use.

However, the net benefit of this “recharge service” will depend on the overall balance between total recharge (from rainfall and surface irrigation) and the rate of withdrawal of groundwater. Under conditions where groundwater is being “mined,” the recharge from a surface system provides a net benefit that will be equal to the value of net additional crop output attributable to this additional volume of water. When the total recharge is greater than total withdrawal (but still does not result in a high groundwater table), the net benefit from the “recharge service” will be equal to the reduction in the cost of water pumping. This saving in costs may be small (equal to the cost of fuel or electricity) if it does not result in significant savings in investment costs as a result of a higher groundwater table. Hence, the net benefit of the positive externalities would have to be carefully assessed against the additional capital costs of reservoirs and/or the costs of conveyance and distribution of the “leaky” surface irrigation systems.

Negative Externalities, as discussed in Briscoe (1996), may impose costs on downstream users if the irrigation return flows are saline, or where return flows from towns impose costs on downstream water users. One method used to account for these externalities is to impose a salinity levy on users, depending on their water use patterns. This is used in the Australian state of Victoria, and the surcharge is determined by the cost of restoring the saline water to its original condition (and is generally greater than the abstraction cost which users have to pay). Where return flows from towns impose costs on downstream users, one approach (in the German Ruhr and French systems, Briscoe 1995) is to levy a charge on urban consumers for restoring the wastewater to an acceptable condition. These negative externalities should result in additional costs to users who impose these externalities on others.

c. Full cost

As such, the Full Cost of water consumption is the Full Economic Cost of water plus the costs imposed by Environmental Externalities. These costs have to be determined based upon the damages caused, where such data are available, or as additional costs of treatment to return the water to its original quality.

Environmental externalities: We make a distinction between Economic and Environmental Externalities. The Environmental Externalities are those associated with public health and ecosystem maintenance. Hence, if pollution causes increased production or consumption costs to downstream users, it is an Economic externality, but if it causes public health or ecosystem impacts, then we define it as an Environmental externality. Environmental Externalities are usually inherently more difficult to assess economically than the Economic Externalities, but we argue that it is possible, in most cases, to estimate some remediation costs that will give a lower bound estimate of the economic value of damages.

3. COMPONENTS OF THE VALUE OF WATER

For economic equilibrium, the value of water, which we estimate from the Value in Use should just equal the full cost of water. At that point, the classical economic model indicates that social welfare is maximized. In practical cases, however, the Value in Use is typically expected to be higher than the estimated full cost. This is often because of difficulties in estimating the environmental externalities in the full cost calculations. However, in many cases it may be lower than Full Cost, Full Economic Cost, and even below Full Supply Cost. This is often because social and political goals override the economic criteria.

The value of water depends both upon the user and to the use to which it is put. Figure 2 shows schematically the components of the Value in Use of water, which are the sum of the Economic and Intrinsic Values. As shown in the figure, the components of Economic Value are:

1. Value to Users of Water
2. Net Benefits from Return Flows
3. Net Benefits from Indirect Use
4. Adjustments for Societal Objectives

a. Economic Value

Value to users of water: For industrial and agricultural uses, the value to users is at least as large as the marginal value of product¹³. For domestic use, the willingness to pay for water represents a lower bound on its value, as there is additional value to the water as described below¹⁴. There are numerous studies that attempt to compute the marginal value of water use by industry and agriculture, and willingness to pay by domestic consumers (see, for example, Briscoe 1996; Gibbons 1986; Desvougues and Smith 1983, Griffin et al. 1995; Singh et al. 1992; Whittington et al., 1987; World Bank 1995).

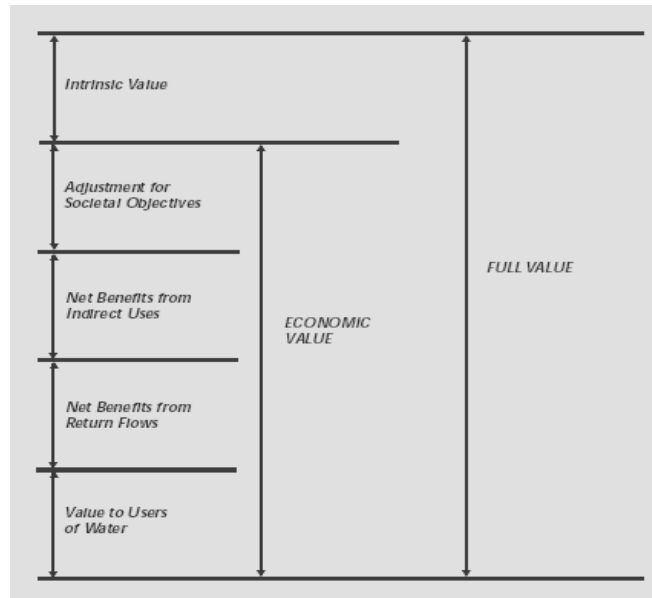


Figure 2. General Principles for Value in Use

Net benefits from return flows: Return flows from water diverted for urban, industrial, and agricultural uses constitute a vital element of many hydrological systems, thus the effects of these flows must be taken into account while estimating the value and cost of water (Briscoe 1996; Seckler 1996; Sinha, Bhatia and Lahiri 1986). For example, a part of the water diverted for irrigation may recharge the groundwater table in the region and/or increase the returns to the river/canal downstream. However, the benefits from the return flows will critically depend on the proportion of water that is “lost” to evaporation (due to open drains and canals) or to other “sinks.”

Net benefits from indirect use: The typical example of these benefits occurs with irrigation schemes that provide water for domestic use (drinking and personal hygiene) and livestock purposes, which can result in improved health and/or higher incomes for the rural poor. For example, in areas of northwest India (Haryana and western Uttar Pradesh) where groundwater is saline, irrigation canals not only provide water for domestic and livestock uses, water in these canals recharge the groundwater table, thus enabling the pumping of water from handpumps and shallow tubewells. In the absence of this sweet water, use of saline groundwater by animals is reported to result in about a 50% reduction in the output of milk (Bhatia and Raheja 1986). In many arid regions of Haryana, the Indian Punjab and the Pakistani Punjab, income from livestock accounts for a significant proportion of the income of poor households, particularly in the drought season. In addition to livestock, irrigation canals provide water for wildlife, flora and fauna and provide in-stream benefits. In some canals in southern India, canal drops are known to be used for installation of small and mini hydro plants. These indirect benefits have to be included while estimating the Value in Use of water that is diverted for agricultural purposes. Ignoring these benefits could result in a serious underestimation of societal benefits available from the volume of water that is diverted for irrigation. Irrigation is also known to have some adverse environmental and social impacts, which result in hardships for poorer households. Such adverse consequences include, *inter alia*, waterlogging and salinization of

¹³ This reflects the additional value to the consumer (or society) of an additional unit of water.

¹⁴ for example, the willingness to pay may be estimated by using “bidding games” where consumers indicate their monthly payments for a given service.

soils, declining groundwater tables (which result in dry handpumps and shallow tubewells), and pollution of water from agrochemicals and waterborne diseases (Vaidyanathan 1993).

These environmental impacts can be considered in terms of the negative benefits in estimating the value of water in agriculture. Alternatively, they can be added to the Environmental Externalities component of the Full Cost of water.

Adjustment for societal objectives: For water use in the household and agricultural sectors, there may be an adjustment made for societal objectives such as: poverty alleviation, employment and food security (particularly in rural areas, where food grain prices tend to be high in the absence of the additional food output gained from irrigated agriculture, and where it may be difficult to supply imported food grains). Such adjustments are over and above the value of water to the user and should be added to reflect various societal objectives, as described in the section on irrigated agriculture. Extreme care must be taken in the use of these adjustments, with full consideration of the alternatives to meet these goals.

The estimates of these values are not to be arbitrarily set, but should be determined on the basis of the best available methods that give the real gains to the society from price differentials among sectors.

Intrinsic Value to achieve the Full Value

The concept of economic value, it should be noted, does not assign any value to concerns such as stewardship, bequest values, and pure existence values. While these are difficult to measure they are, nevertheless, valid concepts and do reflect real value associated with water use (or non-use).

A comprehensive review of the different types of benefits occasioned by environmental management is given in Desvougues and Smith (1983). The benefits are split into the two major categories of “current user values” and “intrinsic values.” The current user values themselves are split into two major categories of “direct” use and “indirect” use. In terms of Figure 2, these intrinsic values are generally difficult to define and estimate, but in some cases they could be considered as externalities of use of the resource, and hence, are relatively easy to incorporate. In other cases, for example with bequest value, they may always be difficult to locate in the conceptual scheme. One way to approximate intrinsic values is to estimate hedonic price indices associated with the consumption of goods and services (see hedonic price method in main chapter under water valuation methods). For example, Harrison (1973) estimated the price of housing based upon a regression of price on several economic, location, social, and environmental variables. In this way it is possible to relate the actual behavior to the desirability of various intrinsic values, such as a “water view,” and “green vistas” associated with irrigation works, or instream flow and quality requirements.

4. Other issues to be considered

The effects of reliability of water supply on cost and value: The value of water depends crucially on the timing and reliability of the water supplies. Timeliness is most critical in irrigated agriculture where water shortages during critical stages of plant growth result in reduced crop yields. Lack of reliable irrigation supplies in public irrigation systems, particularly in South Asia, are responsible for low crop yields and farmers’ lack of willingness to pay the full cost of water. Pumping of groundwater (e.g. in northwest India and Pakistani Punjab) improves timeliness and reliability of water input, and, hence, has resulted in relatively higher crop yields. For example, in four Indian states (Punjab, Haryana, Andhra Pradesh and Tamil Nadu), land-receiving groundwater irrigation produced roughly twice as many additional foodgrains per hectare as land receiving canal irrigation (Repetto 1994; Chambers 1988; Dhawan 1988).

However, improving reliability and timeliness in water supplies entails higher costs in terms of additional storage capacity and/or pumping. For example, in the northwestern state of Haryana, where the irrigation charges for surface water supplies are less than \$10 per hectare per year (\$/ha/yr), farmers are known to spend as much as \$90/ha/yr in irrigation costs. These irrigation costs account for as much as 20 percent of the net value of output from these crops and indicate that farmers' willingness-to-pay (as well as actual payments) are quite high for timely and reliable water supplies for irrigation. Hence, those institutional and financing arrangements that ensure reliable water supplies are likely to be more sustainable for improving water use efficiency than those that concentrate only on cost-recovery.

Reliable and adequate water supplies are also critical for households and industrial users. High investment costs are incurred and high prices are paid by households as part of the coping strategies adopted in the face of uncertain water supplies (World Bank Water Demand Research Team 1993; World Bank 1995). For example, poor people, especially in urban areas, often must pay very high prices for obtaining adequate water supplies of acceptable quality (Bhatia and Falkenmark 1993).

Reliable water supplies for industry and thermal power plants are critical for maintaining desired production levels. Because water for industrial and power purposes is also required during the dry season, provision of water for these users entails high opportunity costs as well as high supply costs. Providing reliable water supplies during the dry season results in higher storage costs and higher evaporation losses in reservoirs and canals. These costs must be considered while evaluating the benefits and costs of industrial water supplies. Further, the need to provide a given quantity to industry in a dry season may result in lower area under irrigation when their peak water requirements coincide during a particular fortnight. This has to be factored in when calculating the opportunity costs of water in the industrial and urban sectors.

Water quality concerns in cost and value: As in the case of reliability, water quality influences both values and costs. The first three to four liters of water used for drinking purposes must be of the best quality and provide high value to the consumer as well as to society. Water for bathing, washing and personal hygiene need not be of the same quality as that used for drinking and cooking purposes. Flushing of toilets, cleaning, and gardening require varying qualities of water, resulting in differing levels of value, and hence willingness to pay. Industrial processes can use recycled water for process, cooling, and for transporting waste materials. Similarly agriculture needs differing water qualities, resulting in differing values and costs of provisioning the water. In particular, the demand for various water qualities for different uses provides incentives for recycling and re-use of water, with a view to matching demands with supplies.