

Analysis

3.1 Factors influencing Water Pricing

Water is the survival need of the humankind and all living beings. Fresh water is renewable but exhaustible. It is part and parcel of the economy but yet its true value is not yet assessed. In fact it is difficult to value each and every use of water in the economy. Besides economic value it has also got cultural, social and religious values. Boulding observed that *"the sacredness of water as a symbol of ritual purity exempts it somewhat from the dirty rationality of the market"*. In many cultures, goals other than economic efficiency play an unusually large role in selecting water management institutions. Some religions, such as Islam, even prohibit water allocation by market forces.

Water has two additional features that further complicate its management: bulkiness and mobility. The value per unit of weight tends to be relatively low (placing water among the commodities that are termed "bulky"). Unlike petroleum, the costs of transporting and storing water are generally high relative to its economic value at the point of use. Water is also difficult to identify and measure because it precipitates, flows, evaporates, seeps and transpires. This evasive nature means that exclusive property rights, which are the basis of a market economy, are hard to establish and enforce.

Many water management problems are site-specific (local) and so elude uniform policy treatment. While water consumption and quality requirements are tied to local populations and development levels, local water availability usually

changes with climatic variations throughout the year and over longer cyclical swings. These supplies may be highly variable and unpredictable in time, space and quality. In regions throughout India, for instance, most rainfall is concentrated during a three-month period and there are large year-to-year variations. Water projects that attempt to compensate for extreme seasonal variations such as floods and droughts frequently require enormous investments. This is a classical "natural monopoly" situation in which a single supplying entity is the most economically efficient organizational arrangement. On the other hand, most economies of size for pumping groundwater are achieved at relatively small outputs and multiple suppliers can therefore operate efficiently. However, aquifers are usually hydraulically linked with rivers or streams - part of a river's volume may come from underground flows and rivers may replenish groundwater stocks. This hydraulic linkage is affected when an aquifer is heavily pumped. A lowered groundwater table may draw water from a connected stream, reducing its flow to surface water users. Aquifer management is often complicated by the aggregate impact of the actions of many individuals. Even though each individual may have a negligible impact when taken alone, the sum total can be of major importance like in South Asia. One tube well has little effect on the total water supply, but thousands of tube wells can quickly deplete an aquifer. Establishing effective pricing policies or otherwise to regulate these many small, scattered decision-makers is extremely difficult.

3.2 Economic attributes of water use

Water provides four types of important economic benefits: commodity benefits; waste assimilation benefits; aesthetic and recreational benefits; and fish and wildlife habitats. Individuals derive commodity benefits from water by using it for

drinking, cooking and sanitation. Farms, businesses and industries obtain commodity benefits by using water in productive activities. These commodity benefits represent private good uses of water which are rivals in consumption (e.g. one person's or industry's water use precludes or prevents its use by others). Government policies and regulations that concentrate on improving market access and competition are important means for improving the productive and allocative efficiency of the commodity uses of water.

The second and increasingly important economic benefit of water is waste disposal. Water bodies have a significant, but ultimately limited, assimilative capacity, meaning that they can process, dilute and carry away wastes. But when the human actions exceeds its assimilative capacity, it need to be regulated either through pricing mechanism or administrative regulations.

Recreation and aesthetic benefits and fish and wildlife habitats are gaining increased attention now-a-days. In developed countries, more and more people are focusing their recreational activities around lakes, rivers and seas. In developing nations, as incomes and leisure time is growing water-based recreation is becoming increasingly popular and an adequate supply of good-quality water helps in providing a basis for attracting the tourist trade. Likewise, information and knowledge about how humans have an impact on ecosystems have raised concern about the fish and wildlife benefits provided by water. Fish and wildlife habitats are related to both commodity and recreational uses.

Waste assimilation and recreational and aesthetic values are closer to being public goods than private goods. Public goods are non-rivals in consumption - one person's use does not preclude use by others. For example, the enjoyment of an attractive water body does not deny similar enjoyment to others. Non-rival goods

require large amounts of resources to exclude unentitled consumers from using the good. Exclusion costs are frequently very high for water services such as flood control projects and navigation systems. Goods and services that are non-rivals in consumption are normally better suited to public sector interventions, including ownership, provision and regulation.

Rapid depletion of aquifers is one of the major water problems of India where pumping rates exceed the natural recharge resulting in rapid exhaustion of groundwater stocks and the consequent increase in pumping costs; the intrusion of poorer-quality water into the deposit being exploited; salt water intrusion from rapid pumping near seacoasts, subsidence of overlying lands due to compression developing cracks on earth's surface and damage to buildings, roads, railroads, etc. Another consequence of over pumping may be the interruption of flows in neighbouring wetlands and streams; deprived of their water source, they are reduced in size or may dry up altogether. Other adverse effects from over pumping result when residential or farmers' wells dry up because of the presence of larger and deeper wells.

From a broad perspective, aquifer exploitation can bring about either or both of two types of social dilemma. First, overdraft is an example of a class of resource problems, usually called "common pool" problems (R. Gardner, 1990). A common pool resource can be defined by two characteristics. The first is subtractibility²³ and the second is the high cost of excluding potential beneficiaries from exploiting the resource. Fugitive or mobile resources, such as water, petroleum or migratory fish and wildlife, are typical examples of resources with high exclusion costs. The issue

²³ Resource withdrawn by one individual is not available to another individual user.

here is can the pricing be an instrument to solve the common pool problem of the ground water use?

The roots of the problems associated with common pools are found in the inadequate economic and institutional framework within which the resource is exploited (Young, 1993). Common pool resources have been typically utilized in an "open access" framework, within which resources are used according to a rule of capture. When no one owns the resource, users have no incentive to conserve for the future and the self-interest of individual users leads them to overexploitation. The characteristics of the economic institutions governing their use is the fundamental issue in managing common pool resources.

3.3 Impact of Macroeconomic decisions

Macroeconomic policies and sectorial policies that are not aimed specifically at the water sector can have a strategic impact on resource allocation and aggregate demand in the economy. A country's overall development strategy and use of macroeconomic policies - including fiscal, monetary and trade policies - directly and indirectly affect demand and investment in water-related activities. The most obvious example is government expenditures (fiscal policy) on irrigation, flood control or dams which obviously affects the supply side of water management. When the trade and exchange rate policy aims at promoting exports for foreign exchange or reduction in export taxes the same may encourage exports of high-value, water-consuming crops i.e. export of virtual water²⁴.

²⁴ Refers to the hidden flow of water if food or other commodities are traded from one place to another. For instance, it takes 1,600 cubic meters of water on average to produce one metric tonne of wheat.

National development strategies food self-sufficiency strategy may subsidize water-intensive inputs to encourage farmers to produce more rice. By providing financial incentives for rice producers, the government is influencing the demand for water and private irrigation investment through pricing policies. Such intervention may show cascading effects which may be inter-sectorial (when agricultural sector is provided with an economic advantage in access to water vis-à-vis the industrial sector), intra-sectorial (water used for biofuel gains an economic advantage over water used for other crops), distributional (rice producers with more land and access to water gain over those with less land and water) or environmental (increased pesticide and fertilizer use are likely to affect water quality). The encouragement of farmers with other inputs and minimum support price in India has led to over exploitation of ground water as well as environmental degradation in many areas particularly in north-western part of India.

With the continuing importance of structural adjustment and stabilization programmes, many developing countries are implementing fundamental changes in macroeconomic and sectorial policies. Typical adjustment programmes call for a greater reliance on markets, more open trade, fiscal austerity and a phasing out of producer and consumer subsidies (input and product markets). Budget-reducing measures imply increased competition between and within sectors for funding new water projects. In these situations, the overall economic, social and environmental implications of choices must be carefully addressed. For example, when governments must choose between financing either irrigation projects or hydroelectric power projects, there is an additional social opportunity cost of the irrigation water

in countries that are dependent on imported energy sources. In India the multipurpose projects are more tilted towards hydroelectricity than the benefits from different uses of water.

3.4 Linkage between Water and Development

Water is both a resource and a sector; a key to social development, environmental integrity and economic growth. As a sector, water requires infrastructure development and operational funds, while as a resource it cuts across sectors and requires integrated approaches to management. Water development is fundamental to economic and social development, and those developments in turn increase the use of water and have environmental consequences. The Bonn 2011 Nexus Conference has opened up a global debate on inter-linkages of natural resource pressures in water, energy and food, and advanced efforts to move beyond conventional sector thinking. Mobilizing water is critical for agriculture, ecosystem services and energy, but water and the services it provides are threatened by climate change, population growth, degrading water quality and extreme hydrological events (floods and droughts). A strong link has been demonstrated between water resources development and economic development. Water is interlinked in different ways in countries depending upon their economic development. Water is therefore both the subject of change when various users decide how to allocate and consume it, as well as being an enabler of such change. The stage and nature of a country's development defines its relationship to water resources. This was highlighted, in the Presidency Paper to the European Commission, The Role of Water in EU Development Policy. Mature institutions and hydraulic infrastructure that have harnessed hydrology have clearly been a pre-condition for the broad-based development and growth achieved in the developed world. In some cases, actions

may restore environmental assets that were lost during periods of rapid industrialization, while 'green economy' interventions seek to mitigate environmental damage at the same time as generating further economic and social opportunity. *"Water has always played a key role in economic development, and economic development has always been accompanied by water development."* World Water Assessment Programme (UNESCO, 2009)

3.5 Economic organization of the water sector

In competitive markets, government's primary role is to emphasize "incentive structures" and to establish "rules". Some of the most important rules are the laws governing the establishment of property rights and the enforcement of contracts. If water as a commodity, or the economic system in which water is used, meets the preconditions for a market system, government interventions can be minimized. Market economies experience shortcomings called market failures. Market failures occur when incentives offered to individuals or firms encourage behaviour that does not meet efficiency criteria or, more generally, because efficiency or economic criteria fail to satisfy national social welfare objectives. In these cases, the public sector may intervene to influence water provision and allocation. Market failures affecting water resources include externalities, public goods and natural monopolies. In other cases, even efficient markets may not meet societies' equity criteria so public intervention is necessary to compensate for distributional inequity.

Externalities are inherent in water sector activities like detrimental effect of saline return water flows caused by irrigation on downstream water users, water-logging of downslope lands through inefficient irrigation practices etc. Since most

irrigators do not normally consider the external costs they impose on others, governments attempt to protect affected individuals through regulations, taxes, subsidies, fees or technical standards. In recent years, the acceptance of "polluter pays" principle in industrialized countries is a step in that direction.

Water storage projects and flood control programmes represent examples of *public goods*. The market does not adequately supply public goods because private entrepreneurs cannot easily exclude non-paying beneficiaries and capture a return on investment. For example, it is not possible to exclude people living along a river from the benefits of a flood protection plan on that river.

Natural monopoly is a common situation in the water sector. In case it is a private monopoly in urban water supply, irrigation or even hydropower there is likelihood of charging exorbitant prices by restraining production and stop to innovate due to lack of any incentive. Public regulation or public ownership can mitigate the undesirable effects of a private, profit-oriented monopoly. When increasing returns exist, the lowest-cost production is that of a single producer. Society is likely to benefit by regulating or owning the monopoly rather than by encouraging competitive suppliers. More than one competitive supplier would present much higher distribution costs. While free competition is viewed as the most efficient system for allocating resources, potential market imperfections can accentuate income disparities. Societies' public welfare goals often incorporate a broad range of social objectives. Water projects provide important investment strategies both for human welfare (drinking-water and food supplies) and for infrastructure to support economic development.

3.6 Government failures

Even in the event of market failures, public sector interventions or non-market approaches may not lead to the socially optimum solution. In many cases, non-

market responses to market failures lead to less than optimal outcomes and creates various problems like:

"Products" are hard to define. The outputs of non-market activities are difficult to define in practice and difficult to measure independently of the inputs that produced them. Flood control or amenity benefits of water storage reservoirs are examples of water system outputs that are hard to measure.

Private goals of public agents. The internal goals, or "internalities", of a public water agency as well as the agency's public aims provide the motivations, rewards and penalties for individual performance. Examples of counterproductive internal goals include budget maximization, expensive and inappropriate "technical-fix" solutions and the outright non-performance of duties and motivation in the form of by gifts or other inducements, to violate operating rules for a favoured few (Wade., 1982).

Spill overs from public action. Public sector projects can also be a major source of externalities. Salinity and waterlogging of downslope lands can occur just as easily from inappropriately managed public irrigation projects as from private irrigators.

Inequitable distribution of power. Public sector responsibilities, however noble their intent, may not be scrupulously or competently exercised. Yet the monopoly control of water supplies by public agencies provides certain groups or individuals with much power over the economic welfare of water users.

The economic organization of the water sector also a factor for water pricing as a private enterprise would go for its profit maximization while a public entity may survive in an inertia of inefficiencies if remain dependent on the government for meeting its revenue requirements besides other failures discussed above.

3.7 Drivers of demand for Water

A growing, increasingly prosperous and rapidly urbanizing global population will demand more food, more energy and more water resources to meet their needs. These demands will emanate from various factors like:

(i) Increased Water Consumption

In the absence of any change in consumption patterns, by 2030 the shortfall between demand for, and supply of, water is projected to be 40%. Much of this growth will be in least developed and developing countries, while urban growth will also increase, to 60% of world population by 2030.

(ii) Increased food demand and changing diets.

Projections show that providing food supplies for a world population of 9.1 billion people in 2050 would require an overall increase in provision of "on-the-plate" food by some 70% by 2050. Some of this demand can be met by reducing food (and water) wastage. Without reduced wastage, food production in developing countries would need to almost double.

(iii) Increased demand for and access to energy.

Almost all of the increase in energy demand will come from non- OECD countries as greater numbers of people gain access to electricity. Indeed forecasts suggest that world energy consumption will grow by approximately 50% between 2010 and 2040. A shifting in energy sources may also add pressure on water. For example, increasing demand for biofuels implies increased consumptive use of water to grow fuel crops, as compared to water use in hydropower, which can be used again downstream.

(iv) Climate change impacts.

Climate change will compound pressure on resources, as will policies to adapt to and mitigate. Furthermore, these pressures will be unevenly distributed

around the world with the greatest impacts occurring in populations and locations characterized by low resilience.

(v) New geopolitical dynamics.

The World Economic Forum has suggested that new dynamics could be triggered by a scramble for resources, potentially coalescing around national interests and alliances, thus causing a retreat from multilateral globalization that would risk throwing international organizations into question, and leave global companies to face a baffling political landscape. Such changing scenario would have an impact on the demand for water.

3.8 Water policies and demand management

For most of the twentieth century, policy-makers have focused their attention mostly on the supply side management of the water resource like capture, store and deliver water effectively. Economists have evaluated public water supply and policy options through benefit-cost analysis (BCA). The main purpose of BCA is to assure that scarce resources (such as labour, capital, natural resources and management) are all employed to their best advantage. BCA attempts to quantify the advantages and disadvantages to society of alternative policies or actions in terms of a common monetary unit²⁵. However, with new water-related problems arising in many parts of the world, policy-makers are increasingly emphasizing non-structural approaches to water management like demand management, scientific research, education and persuasion to coordinate how humans use water. These demand-side policies attempt to address the human causes of water prob-

²⁵ For example, water resource management depends on the government's ability to establish an appropriate legal, regulatory and administrative framework. In fact, markets are based on a system of enforceable private property rights. Private water markets require secure and transferable property rights, including the right to exclude other users.

lems such as water quality degradation, overexploitation of aquifers and the decreasing availability of water flows to meet non-consumptive water uses (hydroelectric power, pollution assimilation and fish and wildlife habitats). Hence, the focus has now shifted towards management of both demand and supply side issues with the aim to promote least-cost, environmentally-sound water planning etc. On the supply side, large hierarchical organizations usually control the capture, storage, conveyance and distribution of surface water. Demand-side organizations, for example water user associations, are established to represent the interests of irrigators and to introduce and enforce water allocation rules.

However, in 21st century, it is evident that the regulations alone have failed to balance the requirements in water sector. The supply side remaining the same the demand side requirements are growing at an exponential rate which is difficult to accommodate unless there are structural changes in the allocation of resources. In this context the pricing plays an important role.

3.9 Investment Projection

It has been estimated that the Water for Sanitation and Hygiene would require \$536 billion and treatment of waste water between \$135 to \$ 975 billion considering the treatment cost ranging from \$0.3019 to \$1.6420 per m³ assuming the generation of waste water to be in the range of 450 km³ to 595 km³. The above cost does not include the infrastructure cost which has to be put in place as only 31% is treated now. In case this is not done there is a cost for non-treatment also. There are more than 503 million hectares of land with irrigation potential around the world. It is estimated that US\$0.6 billion per year is required for maintenance of infrastructure in Africa. If this is scaled up, the global cost would be \$31 billion per year. Hydropower is a significant growth sector, with investments estimated at

US\$50–60 billion annually, or almost \$2 trillion of the \$11 trillion investment in energy infrastructure between 2005 and 2030. Environmental services- annual investments required for ecosystem restoration at \$113 billion per year. Capacity Building would be 10% of infrastructure investments. Conservative estimates of global investments in a post-2015 water for development agenda range between approximately US\$ 1.25 and 2.25 trillion dollars per year over a 20-year period. It is difficult to estimate the cost of governance. It is also reported that the corruptions costs between 10 to 30 % of the investments in water. With such huge investments on card it is difficult to imagine the allocation of funds for the water sector unless there is appropriate policies towards water pricing.

3.10 Mobilizing financial resources

The most critical challenge for financing the implementation of sustainable development goals is the scale and continuity of investment. The financing will have to come from taxation at the local and national levels, user charges, cross-subsidies, private investment or targeted ODA and FDI. In the recent past, most of the financing for water-related infrastructure has been raised at the local level. This is likely to continue. During the 1990s, for example, most financing of water and sanitation originated from domestic public sectors (65–70%) and private sectors (5%), with only 10–15% from international donors and 10–15% from international private companies. For developing countries like China and India, which are home to more than half of the global un-served population, it was basically the domestic investment in water infrastructure. By not charging appropriately the export products from the developing countries which is mostly water rich raw materials a latent subsidy is being passed to the developed world. Moreover, underpricing of water may be a hindrance for generating sufficient domestic funds for its sustainable development in developing countries. The other option of getting overseas funding

as FDI may not happen without a revenue recovery model. In case developing countries resort to loans from international and commercial banks they may slip in to a debt trap. In this context an appropriate pricing of water is extremely important.

3.11 Place of Water Sustainable Development

Many cultures in the past had recognized the need for harmony between the environment, society and economy without referring to it as sustainability. No agreed definition of sustainable development has yet emerged; but this concept most frequently has referred to the description given in the report 'Our Common Future'²⁶ that identifies this term with the activity which meets present needs without compromising the ability of future generations to meet their future needs. In spite of this definition and programmes of the EU there is wide gap in awareness about environmental issues and without a state intervention, and incentives like prices, sustainable development is unlikely. For such a development a stable economy is an important precondition, although difficult to reach by most developing countries.

Ring et al. (1999) as quoted by Pawel et al (Pawel Nakamori) claim that sustainable development does not present a fixed state but rather a process of change towards a more environmentally sound and socially equitable way of life. Helm (D, 2000) argues that sustainability is a recognition that without intervention the global environment will not be able to provide a reasonable standard of living for future generations. Nevertheless, delivering all goals of sustainable development like economic development, a better environment, a concern for the poor simultaneously is probably beyond the capabilities of policy makers (Atkinson, 2000). Some opponents to sustainable development say that its cost is large and

²⁶ Popularly known as Brundtland Report, 1987.

they propose rather weak sustainability. Ecologists and ecological economists take a rather different approach, i.e. strong sustainability.

To fully understand what "sustainable consumption of water" means is an extremely difficult task. There is no really global or unified strategy on how to handle the variety of water problems existing in the world. This is probably one reason why the Brundtland report and conference of the United Nations in 1992 overlooked the water issue. According to OECD (1998), water consumption "*should meet basic needs for water servicing without jeopardizing the ability of future generations to meet their water needs and while protecting the water need of the environment*".

Although water resources are renewable, water systems can be so degraded that they are potentially lost, and the ecosystem can be dependent on a minimum quantity and quality of water to the threshold below which they are damaged. For many countries the availability of water is the main determinant of economic growth, industrial structure and national trade. Currently, water is over consumed worldwide and wasted in large part because consumers do not receive appropriate signals about the value of this resource (OECD, 1998). The literature emphasizes a big concern about improving pricing signals in order to move towards sustainable consumption. A reform of pricing regimes and tariffs systems is important, not only for the incentives this would bring to commercial and residential consumers to rationalize their consumption, but also for proper revenues of water companies. Although it is largely accepted that water has an economic value in all competing uses and should be treated as economic good, the amount of money paid for water does not reflect the environmental cost of water (OECD, 1999). There is a great deal of concern about how much, if at all, low-income consumers

should pay for this basic commodity (Constance, 1999). Proponents of low prices are arguing that the impact of economic instruments - applied to public water supply - on health, together with the affordability of water to poorer consumers' needs to be considered. Additionally, there are technical complications in how to set charge that would best reflect water value.

A tariff is a system of procedures and elements which determine the customer total water bill. If a metering system is in place a volumetric rate which when multiplied by the volume of water consumed in a charging period gives rise to volumetric charge for that period. According to the criterion of economic efficiency, the volumetric charge components of the pricing structure could cover any cost that varies with demand on a system (short and long term) or peak demands made on it, while the fixed element should be left to cover only the costs that do not vary with consumption or cannot be accommodated in the variable element. The variable part of the tariff gives consumers incentives to use water efficiently, and the fixed part allows covering overhead expenses by water works. For the metered customers the charge for water can be influenced by the ratio between the standing and variable charge. Based on the actual cost of the water supplier, the standing charge should be more than 80 percent²⁷ (EEA, 1999) of the total charge with the remainder as variable charge, since the fixed assets are prevailing. According to (OECD, 1998), measuring the volume of used water is the only means to show the value of water to the consumer. It creates strong incentives for consumers to use water more efficiently and is a precondition for proper application of tariffs policy. Economic regulator OFWAT of privatised companies in England and Wales is

²⁷ European Environment Agency (EEA), Copenhagen

opposed to universal domestic metering, but it supports the metering where water is a scarce resource or is consumed in large amounts.

Demand for a product, including water, generally reacts to a change in price. When the price goes up, consumption falls as people conserve water to avoid paying higher bills. The leaks are repaired and water saving measures are introduced. When price goes up demand goes down accordingly. Elasticity of demand is a measure of how much demand changes in response to a change in price.

Often there is a gap between the cost and the rate applied for water consumption. Municipal water utilities set prices in relation to average cost and do not exploit their monopoly position by charging prices that generate significant accounting profits. Moncur and Pollock (Pollock, 1998) remark that most water utilities adhere to policy ignoring scarcity rents, but they also base price on average, instead of marginal costs due to the "non-profit" character of publicly owned enterprises. Further, water utilities operate under strong political incentives to hold prices down using various accounting practices. The absence of market allows them to accommodate political constraints on price levels and ignore some costs, like scarcity rents. The above analysis show that more sustainable water consumption can only be reached by proper water pricing. The development of appropriate water pricing systems, aimed at promoting sustainability of water management is badly required. In the absence of economic water pricing, users have no incentives to conserve such a rare good as water. This leads to the need for additional capital to expand the supply system and sewerages. A full cost pricing can lead to the elimination of the need for new waterworks or expanding of the old one, but it implies higher cost for producers and higher prices for consumers. Nevertheless, the long-term benefits in terms of more sustainable growth outweigh these

short-term costs, although some aid to low-income consumers can be needed in foreseeable future. Transparent water prices can also have an impact on water demand through the information the consumer receives. The prices have a psychological effect on consumers and thus modify their behaviour. Water pricing needs to act as an incentive for achieving the environmental objective and an adequate recovery of the costs of water services.

It has been well acknowledged through different studies that appropriate pricing can bring in the required water use efficiency which is the need of the hour though not the sufficient condition for sustainable development. McKinsey (2011) as reported by FAO estimated that tackling municipal water leakage could generate US\$167 billion in savings, while more efficient irrigation techniques could generate US\$115 billion. The water use inefficiency in agriculture sector has been highlighted by the Transparency International by stating "*As water scarcity is becoming a global crisis, the inefficient performance of the dominant water user, irrigation is the gorilla in the room.*" (International global Corruption report 2008). Increased water use efficiency across sectors is likely to generate surplus to meet the requirements of the poor without additional investment and reduce the charge for all consumers. Water pricing can play an important role in it by acting as an incentive for all the stakeholders.

However, economically efficient use of water resources is not necessarily sustainable as every unit of resource used today is at the cost of foregone use of a unit tomorrow. This is relevant to over extracted reserves of groundwater and poses the question of how much groundwater to pump now and how much to save for future needs. On the other hand, sustainability can be interpreted as a requirement that human well-being does not decline through time. Therefore, adoption of

sustainable development as a goal creates a need for economic valuation to establish that human well-being does not decline through time. With 'weak' interpretation of the concept, sustainability can be defined such that the primary condition is for the aggregate stock of capital not to decline. This requires valuation of the capital stock to establish the extent of the stock and to monitor whether it is in decline. Thus, valuation can support pursuit of sustainability at the very least by helping to focus policy-maker and public attention on threatened resources. However, the economic valuation of water resources is a crude and inexact science. The value of water varies widely according to factors such as the use it is put to, the socio-economic characteristics of users, its availability in space and time, as well as the quality and reliability of supply. It is not proposed that technocratic decisions on allocation should be made solely on their basis of estimates, or that they should be made in a routine fashion. Rather, it is proposed that the estimates obtained are useful for highlighting more general themes in water use that have major implications for policy (Briscoe, 1996).

3.12 Assessing Environmental and Resource Costs

The assessment of environmental and resource costs (and benefits) is a big challenge as it requires a good understanding of the functioning of the hydrological cycle within the river basin, and the ability to assess the impact of particular uses on other uses and water bodies. This requires expertise and tools that are not always available or operational, but that constitute the basis for any sound decision made with respect to water resources management. Existing methodologies for the monetary valuation of environmental and resource costs, and more particularly ecology-related environmental costs, are often not sufficiently robust. These methodologies, which are mainly used by researchers, need to be further developed and made operational in the context of water policy planning. Where mitigation

measures to restore water quality or quantity can be identified, a practical way of incorporating environmental and resource costs into prices is to estimate the costs of mitigation measures and then adapt water prices and charges accordingly.

3.13 Setting the right water prices

The water supply, demand, benefits and cost information provides a solid basis for defining water pricing policies that promote an efficient use of water resources and limit pollution by different economic sectors. In theory, the overall optimum of water use is reached where the marginal benefits from water use match the marginal costs, including environmental and resource costs.

Pricing structures should include a variable element (i.e. volumetric rate, pollution rate) to ensure they serve an incentive function to water conservation and reduction of pollution. However, the weight of the variable element needs to be balanced against the need to ensure the recovery of financial costs and thus the sustainability of water services and infrastructure. This particularly applies in situations with highly uncertain water supplies, or where prices lead to an effective reduction in consumption and pollution.

Water prices should be set at a level that ensure the recovery of costs for each sector (i.e. agriculture, households, industry). Overall, it is important to ensure that the most polluting and least efficient sectors pay for their pollution and use. A significant reduction in existing pressures on water resources can be expected through a sectorial recovery of costs of water services.

Water pricing policies should consider both surface water and groundwater. This will limit possible negative induced effects the development of more efficient pricing for one source of water could have on the other source of water. However, this does not necessarily mean the same price of water for both sources. For example, in situations with very limited good quality groundwater, lower prices for

surface water can encourage the use of surface water for economic sectors, keeping good quality groundwater for household needs and human consumption.

Assessment of the administrative costs of new pricing policies is necessary to guarantee that the predicted gains in efficiency outweigh the costs of establishing and managing the new system. Such costs may be particularly high when complex policies are established, which involve detailed monitoring and metering or the evaluation of a large range of environmental and resource costs.

Water pricing policies should also include an implementation plan. The introduction of water pricing that better account for economic and environmental principles will need to be phased in for reasons of both affordability and political acceptability. This is particularly true for users and sectors that do not currently pay for the full financial costs of services (e.g. agriculture) or that may already face problems of affordability (e.g. some social groups). Phased implementation gives users time to adjust to new conditions and thereby minimize the burden on any affected group. It also increases the predictability of that system for both users and suppliers.

The provision of water at artificially low prices to account for social and affordability objectives is a crude instrument for pursuing equity objectives. This form of subsidy encourages inefficient use and pollution. Thus, in situation of unsustainable water use, social concerns should not be the main objective of water pricing policies although they need to be taken into account while designing new pricing policies. And social concerns are better dealt with through accompanying social measures.

For some sectors or users, specific pricing schemes can be proposed such as rising block pricing that combine affordability and economic efficiency objectives, e.g. the combination of a free basic water allowance with high unit prices as an incentive to reduce excessive and non-basic water uses whilst keeping the revenue collection to the level needed to finance water services. Nonetheless, a clear ex-ante and ex-post assessment of both the social welfare effects and impacts on household water demand of such pricing policies is necessary to ensure that both social and environmental objectives can be and have been met.

Overall, the application of economic and environmental principles into pricing policies and the level of application of the cost recovery principle are likely to vary according to specific socio-economic conditions. In regions with currently low levels of basic water services and where social and economic development are key objectives (e.g. developing countries, regions of accession countries), subsidies to support large investments can be required. And past (sunk) investment costs may not be recovered from users. However, water pricing should keep its incentive element and account for depreciation and replacement costs to ensure the renewal of the infrastructure and therefore the sustainability of the basic water services provided.

3.14 Pricing Policies and Spatial Scale

Financial costs are better assessed and managed at the scale of the water service suppliers but assessment of environmental and resource costs and benefits it has to be done at the river basin level. This assessment may require a new organization or the assignment of this task to an existing organization as it is a sensitive issue for trans boundary river basins involving different countries. For the collection of environmental charges one may favor their inclusion in a single "water

bill" to minimize administration costs which is already practiced in several EU member states. As a result, financial transfers are required, between the supplier of water services collecting the water charges and the organization that will address environmental or resource damage issues.

3.15 Role for Users and Consumers

Adaptation in the existing institutional framework may be required to support the move to incentive pricing reflecting the environmental costs of water use. In particular, consumers and users need to be involved. Bottom-up approaches to water pricing achieved through public participation and transparency are essential in (i) contributing to the definition of water pricing policies, (ii) increasing the chances of successful implementation, and (iii) making these policies socially and politically acceptable. Consultation of stakeholders also provides water service suppliers with valuable information on the potential impact of price changes and on how to design their services in the most efficient way.

The involvement of users and stakeholders can take varying forms. The objectives of users' associations participating in price policy development will vary depending on the users they represent. Purely domestic water consumers' associations and irrigators' associations are more likely to aim for a decrease in water price combined with improvements in the quality of water services, and may not consider larger environmental issues that may be better defended by environmental Non-Governmental Organizations. A broad stakeholder consultation involving all users concerned, is key to the development and acceptability of pricing policies with clear environmental goals. As a result of the quasi-monopoly situation of most water suppliers (whether public or private), the water prices charged to consumers is necessary to ensure that prices adequately reflect existing costs and do not hide inefficiency. Efforts are needed to ensure that assessment and valuation methods

are made easily available and understood fully in their strengths and limitations. Overall, each user should pay for the costs resulting from its use of water resources, including environmental and resource costs. Moreover, prices should be directly linked to the water quantity used or the pollution produced. This ensures that prices have a clear incentive function for users to improve water use efficiency and reduce pollution.

3.16 World Bank on Pricing of Water

International organizations like the World Bank also studied the water pricing prevalent in various countries and have recommended that:

- i) Utilities should be required to estimate the long run marginal cost of their own operations investment and operating costs over say a 20- year period. Such estimates should be monitored and updated on a continuous basis, requiring an expanded long-term planning capability.*
- ii) Local governments should develop the capacity to assess the environmental consequences of alternative water development.
 - a) Programs and estimate the costs of environmental damage, including the costs of environmental protection measures where appropriate.*
 - b) Local governments should also develop the capacity to estimate water depletion costs on a regional level.*
 - c) Estimated environmental and depletion costs should be charged to the concerned utility by the local authority, and, in addition to the long run marginal supply cost, be the components of a pricing policy based upon MOC.**

- d) *Water tariffs for commerce and industry should cover full MOC²⁸; for residential consumers, the first block should be about 40 liters per capita per day, with the second block gradually increasing to full MOC.*
- e) *Utilities should be required to submit strategies to concerned local government so they can fully implement MOC pricing within a time frame, which will be based upon costs, incomes, and public acceptability; the strategies should involve a program of public education and stakeholder involvement.*
- f) *A system should be devised in which such MOC estimates can be integrated into regional and national water management and economic planning systems.*
- g) *Parallel pricing reforms should be carried out for other water uses, in particular for agricultural use and large scale industrial abstraction.*
- h) *Existing policy is to meter individual industrial, commercial, and residential consumers on a case-by-case basis, but this will need to be accelerated as water supply costs increase.*
- i) *Utilities should study demographic and income patterns in their area, while continually updating such information, in order to devise efficient and equitable cost recovery mechanisms using non-price mechanisms if metering is not justified.*

²⁸ Marginal opportunity Cost = marginal direct cost (MDC) + marginal external cost (MEC) + marginal user cost (MUC). The MDC is the cost of abstraction water abstraction, such as the costs of labour, equipment and materials adjusted for any subsidies, taxation etc. MEC is the external costs that arise from unsustainable resource use. MUC is the scarcity premium. It relates to the value of the opportunity foregone by exploiting the resource at present rather than in the future. It also incorporates increases in the costs of future resource use and exploitation that occur as a consequence of current use and exploitation.

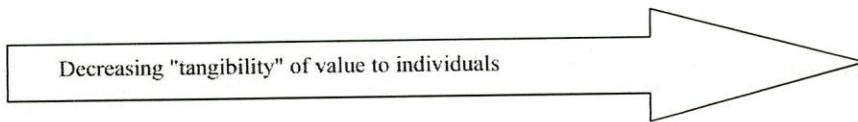
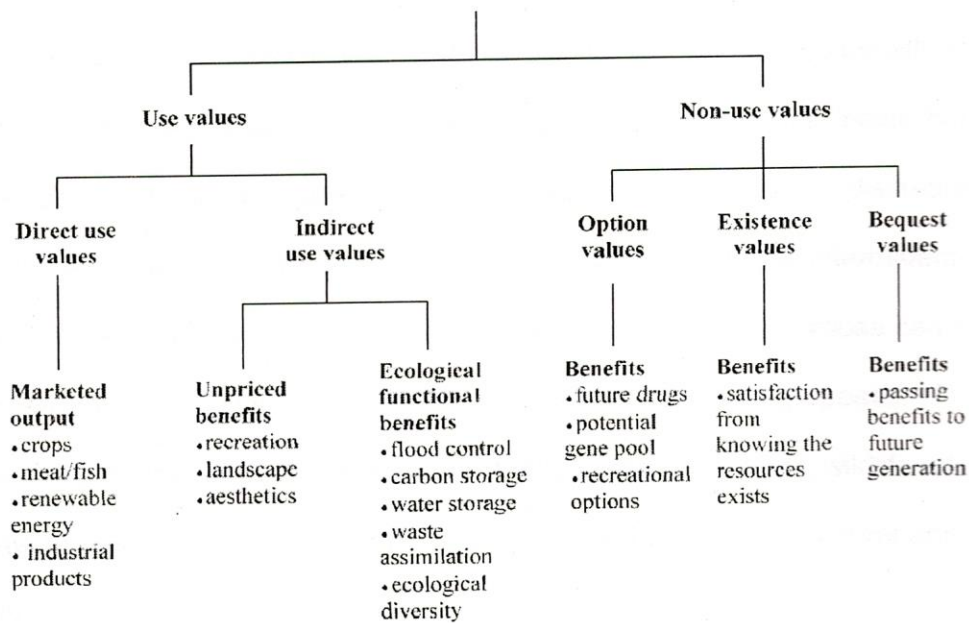
3.17. Necessary Requirements of water pricing

The successful development of water pricing policies that account for economic and environmental objectives is highly information-dependent. Sound estimates of key variables and relationships, e.g. concerning current demand, benefits and costs functions, are needed to ensure that appropriate price structure and level can be identified, and that its impact on water demand, cost recovery and the environment can be assessed. It is important for proper pricing policies that polluters and users are clearly identified and that consumption and contribution to pollution are known.

3.18 Estimating Value of Water

The conceptual framework of treating water as an economic good is comprised of two components: the value of water and the cost of water. The interaction of these two components contributes to the foundation which the realistic pricing of water resources is based on. Water has different value to different users. As schematically illustrated below, the total economic value of water is the sum of use values and non-use values. Use value is derived from the utility gained by an individual from direct or indirect use of water. Non-use value is predicated on the notion that people often appreciate water even when they are not actually using it. It consists of bequest value and existence value. Option value is based on how much individuals are willing to pay today for the option of preserving the water for future use. Bequest value, while excluding individuals' own use values, is the value that people derive from knowing that their future generation will be able to benefit from the water in the future. Existence value means that an individual places value on the fact that water, and the functions it supports, exist.

TOTAL ECONOMIC VALUE OF WATER (Hodge, 1992)



Water has a value to users, who are willing to pay for it. Like any other good, consumers will use water so long as the benefits from use of an additional cubic meter exceed the costs incurred. The value of water to a user is the maximum amount the user would be willing to pay for the use of the resource. For normal economic goods which are exchanged between buyers and sellers under a specified set of conditions, this value can theoretically be measured by estimating the area under the demand curve. Since markets for water either typically do not exist or are highly imperfect, it is not simple to determine what this value is for different users of water. There are numerous studies that attempt to compute the marginal value of water use by different sectors, mainly in agriculture, industry and domestic use and some of the important findings are like (1) The value of water for many low-value crops (such as food grains and fodder) is universally very low. (2) Where

reliable supplies are used on high-value crops, the value of water can be high, sometimes of a similar order of magnitude to the value of water in municipal and industrial end use. (3) The value of water for household purposes is usually much higher than the value for most irrigated crops. (4) The value for "basic human needs" and for household uses is much higher than the value for discretionary uses. (5) Reliable supply water has higher value than that of the intermittent and unpredictable supply water. (6) The value of water for industrial purpose can be of a similar order of magnitude to that of supplies for household purposes. (7) The value of environmental purposes such as maintenance of wetlands, wildlife refuges and river flows also vary wildly, but typically fall between the agricultural and municipal values.

3.19 Pricing of Water for Sustainability

Although water resource is renewable, it does not mean that water resource could be developed and used without limits. The renewal of water resource needs a certain environmental conditions. For example, periods of renewal of atmospheric water is 8 days, water in river channels is 16 days, soil moisture is 1 year, water in swamps is 5 years, water storage in lakes is 17 years and groundwater water is 1400 years, etc. (UNDP, 1998). Humankind should realize that there is a limitation to development and usage of water resource. Sustainable development and usage of water resources means that the environmental conditions which is needed to ensure water resources being renewable should be guaranteed. The rate of development and usage should be lower than the renewable rate of water

resources. The efficient water pricing should act as an incentive to reduce the pressure on water resources²⁹ and the environment, to protect the renewal of water resources, and to ensure that available resources are efficiently allocated between water uses. Efficient water pricing should ensure water resources are developed and used sustainably. The sustainable water resources development and usage means that water resources are developed and used harmoniously with the surrounding environment. Nature is a huge and complicated system and its sub-systems interact with each other. Water resource system as one important sub-system undertakes the task of flow of matter and energy transfer. All socio-economic and environmental activities on this planet are entirely dependent on this system, which distributes freshwater independent of human will. Water resource development and usage will certainly affect the inherent law of the system itself and further affect other related systems. Thus, sustainable development and usage of water resource should emphasize that water resource is in harmony with the surrounding environment. Efficient water pricing should have an impact on the water demand of different uses. As a result of the direct impact of pricing on water use, the pressure on water resources can be reduced. This can lead to the reduction of over-abstraction of groundwater resources and the recharge of aquifers, the increase of flows in rivers and the restoration of the ecological status of rivers. The pricing should also be effective to mobilize financial resources to ensure the financial sustainability of water infrastructure and service suppliers. Because of the properties of water as economic good, water suppliers on one hand have to face the market and on the other hand have to be regulated by administrative department, both of

²⁹ Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. (Environment in the European Union at the turn of the century, European Environment Agency (EEA), 1999)

these could result in insufficient revenue. Financial sustainability could make water suppliers develop and supply services more efficiency.

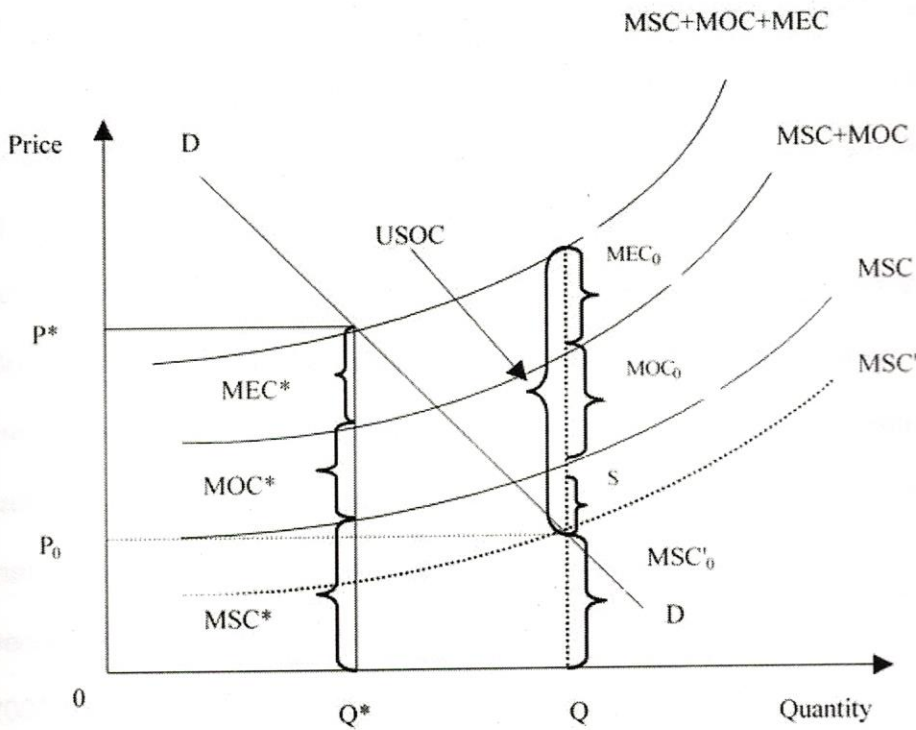
To achieve sustainability The Commission of the European Communities (CEC) has proposed that water pricing needs to reflect the Financial Cost (supply cost + capital cost) plus Opportunity Cost (the cost of forgone opportunities which other uses suffer due to the depletion of the resource beyond its natural rate of recharge or recovery) plus Environmental Externalities (costs of damage that water supply and uses impose on the environment and ecosystem).

Full cost pricing is supposed to bridge the gap between private and social costs by internalizing all external costs. Full cost pricing is going to charge not only the production cost but also full scarcity cost for resource depletion and full damage cost for environmental degradation. When we adopt the principle of full cost pricing to water price set, the Full cost pricing is given by the following formula (Panayotou, 1994).

$$P = MSC + MOC + MEC$$

Where P = price, MSC = marginal supply cost; MOC = marginal opportunity cost; MEC = marginal environmental cost.

Figure 1: Full Cost Pricing of Water



In the above figure the unaccounted social cost, i.e. $USOC = S + MOC_0 + MEC$ at Price P_0 (current water price); Q_0 is the corresponding production and consumption of water and S represents subsidies which is common for water services in many countries. MSC_0 is the marginal supply cost with subsidies. When full cost pricing is adopted, the price becomes P^* which represents

$$P^* = MSC + MOC + MEC.$$

Q^* represents optimal quantity of production and consumption.

The above analysis show that the full cost pricing can bring in the required water use efficiency for the society as well as effectiveness for water supplier. When water supplied at is full-cost pricing, it can send a right signal to users for using water in a sustainable manner. It obviates the need for construction of additional reservoirs, water treatment facilities, and waste water disposal plants to meet

growing demand; financial resources necessary for mitigation of environmental impacts of dam construction are also saved hence reduces the burden on the state budget. With increasing supply costs, marginal cost pricing results in financial surplus that can be used to finance environmental improvements, to provide basic services to poor people at subsidized rates. As per the report of World Water Commission since the arithmetic of water in coming decades does not add up, there must be a redoubled effort at technological, financial, and institutional innovation to ensure that environmental quality is improved and people's needs are met. The Commission emphasizes that unless full-cost pricing for water services becomes accepted practice, none of these will succeed (World Water Council, 2000). However, since full-cost pricing internalize all external costs (both opportunity and environmental costs), it is true that full cost pricing implies higher prices for the consumers and producers in the short-term, but the long-term benefits in terms of sustainable economic growth often outweigh these costs. Just as Mr. Abaza, Chief of Environment and Economics Unit at United Nations Environment Program (UNEP), said, "*Without full internalization of those costs, a country could not achieve sustainable development*" (Abaza, 1994). So far water has been traditionally subsidized to achieve very specific socio-political objectives of food security, provision of clean drinking water, and increasing the income and health of the rural poor. If full cost pricing is to be introduced, other policy instruments have to be developed to achieve the same objectives if necessary to offset the negative impacts on the poor.

Because water resources are often non-marketed, it is extremely important to ensure that, where possible, the 'true' economic value of these resources is ac-

counted for when making investments, or decisions concerning water. 'Accounting' or 'shadow prices', determined through the economic valuation of water resources, are employed in such decision-making in place of market prices. Unless water resources are priced correctly, and those prices internalized in decisions, distortions arise. These bias investment and policy decisions against concerns about water resource depletion and degradation, resulting in misallocation of resources and suboptimal social welfare.
