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Water as an Economic Good and Demand Management *Paradigms with Pitfalls*

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Abstract: *In certain circles, demand management is seen as one and the same thing as economic pricing. This thinking is stimulated by the Dublin principle that water should be considered an economic good. But is this reasoning correct? Is economic pricing an adequate means to reach more desirable levels of demand? There is considerable misunderstanding about what the concept of water as an economic good implies. In this paper it is argued that water pricing should primarily serve the purpose of financial sustainability through cost recovery. Moreover, in water pricing, adequate attention should be given to equity considerations through, for example, increasing block tariffs. Instead of economic pricing there is a need for defining a reasonable price, which provides full cost recovery but which safeguards ecological requirements and access to safe water for the poor. Giving a reasonable price to water has the additional benefit that it sends out a clear signal to the users that water should be used wisely, but the prime target of water pricing remains cost recovery. A major argument of neo-classical economists is that economic pricing of water will facilitate the re-allocation of water from sectors with lower added value (such as agriculture) to sectors with a higher added value (such as urban water use). However, the value of alternative uses of irrigation water is often grossly over-estimated. Adequate and effective regulations may suffice in order to achieve the optimal allocation of water resources.*

Keywords: *Water pricing, Dublin Principle, demand management, financial sustainability, cost recovery.*

Water as an Economic Good

Since the Dublin conference on Water and the Environment (ICWE, 1992) it has become generally accepted among water resources managers that water should be considered an economic good (the four Dublin principles, see Table 1). However, what this entails is not all that clear. The problem is not with the terminology; it is the interpretation that causes confusion. One can distinguish two schools of thought (Van der Zaag and Savenije, 2000). The first school maintains that water should be priced at its economic value. The market will then ensure that the water is allocated to its best uses. The second school interprets "water as an economic good" to mean the process of integrated decision making on the allocation of scarce resources, which does not necessarily involve financial transactions.

The latter school corresponds with the view of Green (2000) who posits that economics is about "the application of reason to choice." In other words, making the right choices about the allocation and use of water resources on the basis of an integrated analysis of all the advantages and disadvantages (costs and benefits in a broad sense) of alternative options.

The concept of Integrated Water Resources Management (IWRM), in line with the first Dublin principle, implies the following four aspects (Savenije and Van der Zaag, 2000):

- considering all physical aspects of the water resources at different temporal and spatial scales (the integrity of the hydrological cycle and the related quality aspects);
- applying an inter-sectoral approach, recognizing all the interests of different water users (including environmental, social. and cultural requirements);
- giving due attention to the sustainability of water use and the rights of future generations;
- involving all stakeholders, at all levels in the management process, giving due regard to women.

These four aspects, each in a different way, are at variance with the first school's interpretation that "water is just another economic good that needs to have an economic price."

The first aspect of IWRM states that water is not divisible into different types or kinds of water. It may be groundwater at some stage, at a later stage it will become

Table 1. The Four Dublin Principles

1.	Water is a finite, vulnerable and essential resource which should be managed in an integrated manner.
2.	Water resources development and management should be based on a participatory approach, involving all relevant stakeholders.
3.	Women play a central role in the provision, management and safe guarding of water.
4.	Water has an economic value and should be recognized as an eco nomic good, taking into account affordability and equity criteria.

Source: ICWE, 1992

surface water. Earlier in the water cycle it was rainfall and soil moisture. But it all remains the same water. Use of soil moisture diminishes the availability of groundwater; use of groundwater diminishes the availability of surface water, etc. Thus any use of water affects the entire water cycle. Since water is a resource vital to life for which there is no substitute, for water no choice exists between resources. The only choice to be made is how to allocate water, and finding the most efficient way of using it. Water, then, is fundamentally different from other economic goods. If one needs energy, for instance, one can choose between solar, wind, hydropower, fossil fuel, nuclear power, etc. If one needs vitamins, one can choose between different kinds of fruit. The market mechanism works almost naturally for such kind of goods. With water that is not the case. One cannot easily choose another type of water without tapping the same resource.

Related to this first aspect is the temporal variability. The availability of the resource depends on climatic variability, but also on land use and human interference, sometimes hundreds of kilometers away. Also demand varies over time, both in the short and long term, as the structure of the economy and population changes. Later in this paper, an example of the significance of this temporal variation is presented.

The second aspect of IWRM, to consider and balance all sectoral interests, limits the applicability of neoclassical economic principles also. There are important water uses that have a high societal relevance, but a very limited ability to pay, particularly the environmental, social, and cultural requirements. Yet most, if not all, societies respect these interests. Decisions on water allocation appear to be taken seldom on purely "economic" (using the word in the interpretation of the first school) grounds. On the contrary, governments generally take decisions on the basis of political considerations with strong considerations for social, cultural, and sometimes environmental interests. Of course, economic and financial considerations are an integral part of these decisions, but they seldom are the overriding decision variable. This pragmatic approach is in agreement with the second school of thought.

The third aspect, calling for long-term sustainability, makes the application of economic principles (in the classical sense) even more difficult. Economic analysts can easily demonstrate that the future has no value (in monetary terms). The discount rate makes any future benefits (or costs) further than, say, 20 years ahead valueless and irrelevant. This, like the previous aspect, illustrates clearly that economic thinking in this limited sense differs from attributing societal or personal values to things. Most individuals would agree that personal health, happiness, beauty, safety, the future of your children, education and well being are more important than money. Societies (and to a much smaller extent the market) spend large amounts of money on these qualities of life. Yet it is extremely hard to value these qualities in monetary terms, let alone their future value.

Finally, the aspect of participation, which by itself corresponds with the second and third principles of Dublin, requires decision-making processes in which the interests of all stakeholders are considered. This aspect precludes economic pricing, or at least makes it extremely difficult. Proponents of water markets disagree with this point of view, since they believe that if a market is properly structured and supervised all different interests will be well accounted for. Experience has learned that this may be possible for certain sub-systems (aquifers) or sub-sectors (irrigation) of the water sector, but that it is very complicated for more complex systems in a multi-sectoral and multi-interest environment.

In sum, the first (neo-classical) interpretation of "water as an economic good" has led to considerable misunderstanding in the debate, both at the Dublin conference and at the Earth Summit in Rio de Janeiro later that year. This misunderstanding still continues. Many observers feared that the adoption of this Dublin principle would lead to economic pricing of water, which would damage the interests of the poor and make irrigated agriculture virtually unfeasible. As a result, a number of disclaimers were added to the fourth Dublin principle, stating that water is also a "social" good (whatever that may imply) and that water should be affordable to the poor.

In the second school of thought there is no confusion. Water economics is understood to "deal with how best to meet all human wants" (Gaffney, 1997), making the right choices about the most advantageous and sustainable uses of water in a broad societal context. This is fully in agreement with the other Dublin principles and the concept of IWRM. Considering water as an economic good is about making integrated choices, not about determining the right price of water. One can say that water pricing is the pitfall of the concept "water as an economic good."

Water Demand Management

Demand management is defined as the development and implementation of strategies aimed at influencing demand, so as to achieve efficient and sustainable use of a scarce resource. Besides efficiency, it should promote equity and environmental integrity. Water demand management should not be seen as merely aiming at reducing demands or achieving higher water use efficiencies "more crops per drop." Demand management is another approach to water resources management that contrasts with the traditional supply management, aimed at increasing the supply whatever the demand. It differs from supply management in that it targets the water user rather than the supply of water to achieve more desirable allocations and sustainable use of water. Apart from structural measures (such as low-flush cisterns for toilets, leak detection and control systems in distribution networks, and drip irrigation in agriculture) demand management strategies mainly consist of non-structural measures: economic and legal incentives to change the behavior of water users and the creation of the institutional and policy environment that enables this approach.

In short, demand management aims at achieving desirable demands and desirable uses. In principle, this implies that demand management may also include measures aimed at stimulating water demand in sectors where current use is considered by society to be undesirably low. This is the same thing as making the right choices about water utilisation. Hence "water as an economic good" is fully compatible with the concept of "demand management," if well interpreted.

Demand management has many instruments among which:

- Quota: setting an upper limit to the amount of water that may be used for a certain purpose.
- Licence to use: issuing licenses for withdrawals or discharges, subject to control and for a limited period of time.
- Tradable water right: the creation of a water market where stakeholders can buy and sell water rights within a well defined legal framework.
- User charges: pricing of water services related to the type of service and the type of water use. Besides the cost recovery element, these charges may include demand management charges or subsidies to stimulate certain behavior.
- Subsidies, grants, soft loans, product charges, tax differentiation, tax allowances, and other economic incentives to stimulate the allocation of water to certain preferred water uses, or to make undesirable behaviour less attractive.
- Penalties: a system of financial and legal enforcement incentives (fines and premiums) that provide the other instruments with "teeth."

Besides these implementation incentives, an important component of demand management is awareness raising, education, and training. There are many examples where advocacy and the provision of alternative approaches to enhance the efficiency of water use have yielded considerable reductions in water use and pollution.

Although the first school of thought promotes economic water pricing as the most important demand management tool, there is limited scientific evidence to support that claim. Mohamed (2001) shows that in Egypt water pricing is not an effective demand management instrument. Quota are more effective and have the same result.

It appears that also with regard to the concept of "demand management," the pitfall lies in water pricing. Let us have a closer look at water pricing: what the purpose of water pricing is, how it influences demand, and how it may be used to enhance the sustainability of water supply in an equitable manner.

Water Pricing

In contrast to the point of view expressed by the first school, water pricing is not an instrument for water allocation, but rather an instrument to achieve financial sustainability. Only if the financial costs are recovered can an activity remain sustainable. A good illustration of this premise is the "free water dilemma."

If water is for free, then the water provider does not receive sufficient payment for its services. Consequently, the provider is not able to maintain the system adequately, and, hence, the quality of services will deteriorate. Eventually the system collapses, people have to drink unsafe water or pay excessive amounts of money to water vendors, while wealthy and influential people receive piped water directly into their houses, at subsidised rates. Thus the water-for-free policy often results in powerful and rich people getting water cheaply while poor people buy water at excessive rates or drink unsafe water.

Hence water pricing is an important instrument to break the vicious circle of the "free water dilemma." But how high should the price be, and what is the impact of water pricing? To answer this question, it is necessary look at both the costs and value of water. Figure 1 shows the build-up of costs and values according to Rogers et al. (1997).

In the build-up of the costs, Rogers et al. (1997) distinguish: the full supply cost, being the financial costs related to the production of the water, which consist of the operational (O&M) costs and the costs of investments (Capital charges); the full economic cost, which in addition includes the opportunity cost (the cost of depriving the next best user of consuming the water) and the economic externalities (the damage incurred by other parties that is not taken into account); and the full cost, which in addition includes the environmental externalities (environmental damage). The distinction between the latter two is open to discussion. Some economists would say that the economic cost include the full supply cost plus the opportunity cost. These economists consider all other impacts to be externalities. Of these, particularly the environmen-

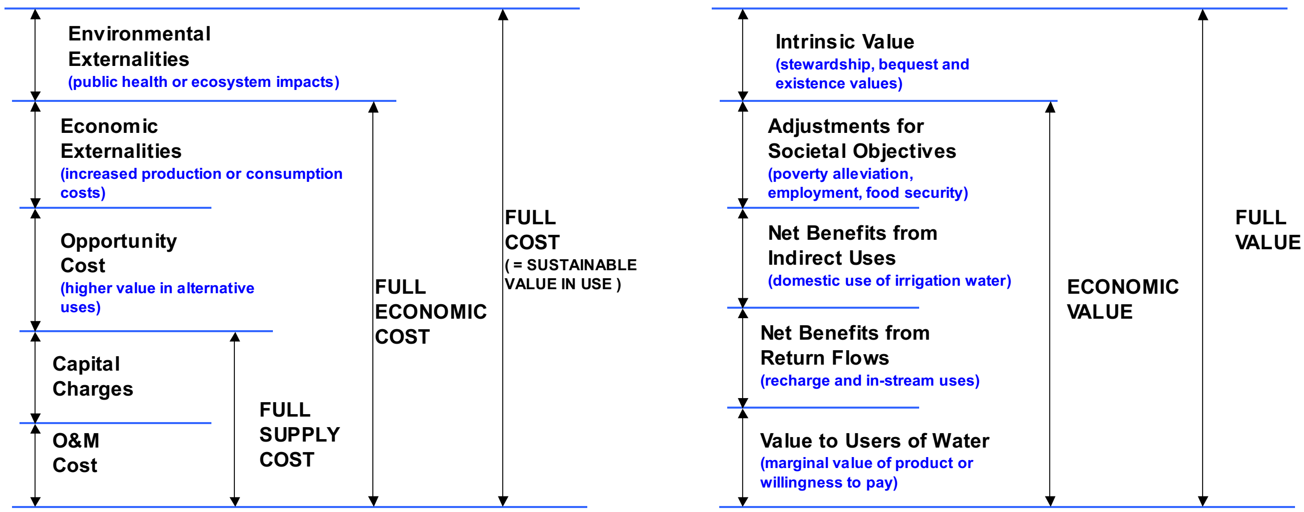

Figure 1. General principles for cost and value of water (Rogers et al., 1997).

tal externalities and the impacts on long-term sustainability are difficult to quantify in monetary terms. Therefore Rogers et al. (1997) make a distinction between economic externalities and environmental externalities. In the broader definition of the "second school of thought," however, both types of externalities should be part of the economic decision problem.

A similar problem arises in the definition of the value of the water. The value to the user may be quantified by his/her willingness to pay, but there are additional benefits, such as benefits from return flows, multiplier effects from indirect uses and in a broader sense the benefits to meeting societal objectives. The latter aspect is often neglected by the "first school" economists since also here it cannot always be quantified in monetary terms, but it is essential to the integrated decision process. The last part, the intrinsic value consists of cultural, aesthetic, and merit values of water, also very difficult to quantify in monetary terms. If we use the definition that economics is "about applying reason to choice" then the Full Cost and the Full Value of Rogers et al. (1997) should be used for making allocation decisions.

It is obvious that a certain allocation of water is attractive when the Full Value is higher than the Full Cost. Determining these values and costs is precisely what is required in economic analysis. Once the decision has been taken to allocate the water on economic grounds, then the next issue is to decide on the financing of the allocation. For the first school, this is no problem. The price should be the Full Economic Cost, or the Full Cost. But that is not necessary. In principle, if society finds the allocation a good idea, then society may decide to finance the allocation completely. This is common practice with security (police and defense), judiciary and administration, and most countries subsidize education and health from government funds. Interestingly, unlike sectors such as security, health, and education, the water sector in many countries is able to attain cost recovery. In certain cities of Zimbabwe, for instance, the water account even produces a surplus which these cities use to subsidize other sectors, such as basic health care.

The decision how to allocate water resources on economic grounds comes first, and should be conceptually separated from the decision how this allocation should be financed.

For water pricing the following considerations are important:

- the institution responsible for the supply of the water should have sufficient autonomy to operate and maintain the system adequately and sustainably;
- only when it has functional autonomy, including financial autonomy, can it perform its task in a sustainable fashion;
- there should be full cost recovery and preferably reservations for future investments;
- it is important to give due attention to equity considerations to prevent that the weakest people carry too high a burden;
- the price should be "reasonable," allowing for full cost recovery, but in line with the ability to pay of consumers;
- those who can pay an economic price (in industries and highly developed urban areas) should pay a high price and by doing so, cross-subsidize the poorer strata of society;
- it is possible, in principle, to provide poor people with a minimum amount of water for free; it is, however, often considered more sustainable to ask for a nominal connection fee (within their ability to pay) or charge a subsidised "lifeline" rate, which gives them a claim on a proper service.

In applying this approach of a reasonable price, one comes automatically to increasing block tariffs, or a stepped tariff system as Kasrils (2001), the Minister of Water Affairs and Forestry of South Africa, calls it. By applying these increasing block tariffs, one can reach full cost recovery, institutional sustainability, equity and, purely as a fringe benefit, send out a message to the large water consumers that water is precious and needs to be conserved. Only in this sense, as an afterthought, is water pricing a demand management tool.

Demand Management Implications of Water Pricing

With ordinary economic goods there is a relation between price and demand following a demand curve. The dimensionless slope of this demand curve is called the price elasticity of demand. It is defined as the percentage of increase in demand resulting from a percentage of increase in price. This elasticity is a negative number since demand is expected to decrease as price increases. The general equation for the demand-price relation (the demand curve) is:

$$Q = cP^{E}$$

where Q is the quantity of demand for the good; P is the price of the good; c is a constant; and E is the elasticity of demand. The elasticity E for water normally ranges between -1 and 0.

This equation is difficult to apply for the water sector as a whole, but for certain sub-sectors (urban water use, industrial water use, irrigation) it may serve the purpose of analyzing the effects of tariff changes. The problem with the equation is that E is not a constant. It depends on the price, it depends on the water use and it varies over time. So it is an equation with limited applicability.

Primary uses of water have a special characteristic in that the elasticity becomes rigid (inelastic; E close to zero) when we approach the more essential needs of the user (Figure 2). People need water, whatever the price. And for the most essential use of water (drinking) few alternative sources of water are available. For sectors such as industry and agriculture demand for water is generally more elastic (E closer to -1), which is more in agreement with the general economic theory. This is because alternatives for water use exist in these sectors (e.g. introducing water saving production technologies, shifting to less water demanding products/crops). For basic needs, however, demand is relatively inelastic or rigid. In urban water supply, elasticities are therefore generally close to 0, unless additional (non-financial) measures are taken. Poor consumers often only can afford to use small amounts of water (the basics), and any increase in tariffs will have little effect because they cannot do with less water. For large consumers (the ones that irrigate their gardens, own cars that need to be washed etc.) the ability to pay is such that the need to save money on water is limited. In the latter case, awareness campaigns, regulation, policing, leak detection, renewal of appliances, etc. are often more effective than the price mechanism per se. The increasing block tariff system, by many societies accepted as achieving the best compromise between efficiency and equity for domestic water supply, poses an interesting paradox with neo-classical economics. It prices the highest value use (the most essential requirements such as drinking and cooking) lowest (first block at "lifeline" tariff), and the lowest value use (less essential uses such as washing a car) highest. The increasing block tariff system is a clear example of societies having decided that neo-classical economics do not apply to the provision of domestic water services.

When the demand for water is inelastic, as is the case for urban water, the water provider may be tempted to raise tariffs, since this will always result in higher revenues, while water consumption drops only slightly. The provider may not be interested in curbing water demand through other means (e.g. through awareness campaigns or through subsidising the retrofitting of houses with water saving devices). It is therefore that water utilities should preferably remain publicly owned. If privatized they should operate within a stringent and effective regulatory environment.

Water Allocation Between Sectors

One of the main reasons why neo-classical economists promote economic pricing of water is that it supposedly facilitates the re-allocation of water from sectors with lower added value to sectors with a higher added value. Such re-allocation will obviously be advantageous to society as a whole. The classic case is the different values attained in the agricultural and urban sectors. According to Briscoe (1996), the value attained in urban sectors is typically an order of magnitude higher than in agriculture. So, if water is currently used in the agricultural sector, the opportunity cost, i.e. the value of the best alternative use, may be ten times higher, subject of course of "location and the hydraulic connections possible between users" (Briscoe, 1996). Thus a shift towards the higher value use is often promoted. However, in economies with many industries depending on the agricultural sector, the multiplier effect of agricultural production is high, and therefore the value added by water may be under-estimated when only using farm-gate prices of agricultural produce (Rogers, 1998).

Whereas the opportunity cost of water for domestic water use may be highest, the moment availability is higher than demand, the opportunity cost of the water will fall to the next best type of use. It is just not possible to consume all the water at the highest value use. The proper opportunity cost for irrigation water may therefore be only half, or less, than the best alternative use (Rogers et al., 1997).

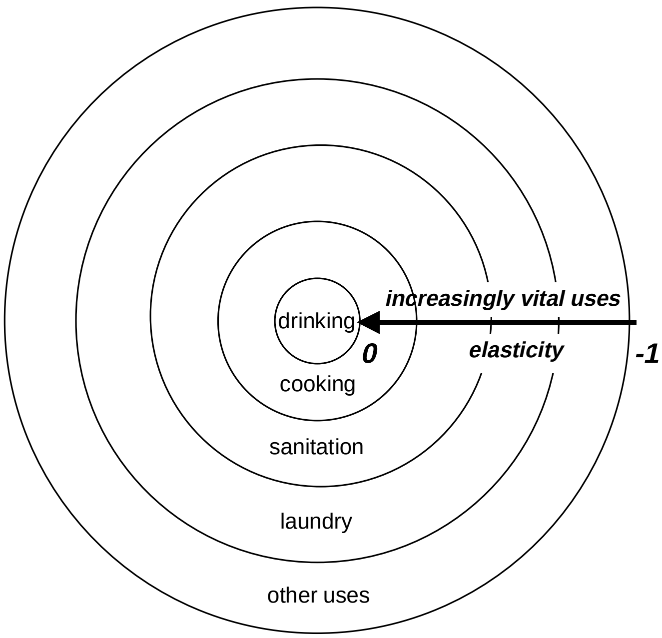

Figure 2. Schematic figure of different uses of domestic water and their dlasticities of demand.

Even then some economists seem to forget that the reliability of supply acceptable to irrigated agriculture is much lower than that for urban water supply: a storage dam yielding x m^3 of water supplied to irrigation at 80 percent reliability, may yield only 0.5x m^3 (or less, depending on hydrology) for urban water supplied at 95 percent reliability. The effective opportunity cost of water used for irrigation should therefore again at least be halved. The resulting opportunity cost is thus only a fraction of what some neo-classical economists claim it to be. This is corroborated by the following observation: in poor neighborhoods in Zimbabwean cities, many households use domestic water (which is charged at between 0.15 and 0.50 US$/m3) for market gardening; indicating that even at these tariffs irrigation appears to be profitable.

The emerging picture, then, is fairly straightforward and common sense: the sectors with highest value water uses should have access to water. In many countries these sectors require only 20 to 50 percent of average water availability, and these demands can easily be satisfied in all but the driest years. In most years much more water will be available, and this water should be used beneficially, for instance for irrigation. There is therefore no need for permanent transfers from agriculture to other sectors, except in the most heavily committed catchment areas of the world. What is needed is a legal and institutional context that allows temporary transfers of water between agriculture and urban areas in extremely dry years. It is our view that no market is required to cater for such exceptional situations. A simple legal provision would suffice, through which irrigators would be forced to surrender stored water for the benefit of urban centers against fair compensation of (all) benefits forgone. This compensation should, however, not be calculated in terms of market prices, since in dry years this price may be many orders of magnitude higher than in normal years. Why should an irrigator be allowed to hold a city's population hostage and be compensated as a speculator?

In those heavily committed catchments where permanent transfers of water out of the agricultural sector are required, normally amicable negotiated solutions can be agreed, provided the laws allow this to happen. Rosegrant and Gazmuri (1996) report a case of a factory financing the construction of a water saving drip irrigation system for an irrigation scheme, thereby obtaining the right to use the water thus saved.

In sum, many economists have not recognized the importance of the temporal variability of water availability, as well as the different reliabilities of supply required by different water using sectors. Figure 3 shows the variation of supply and demand in an imaginary case. It shows that, in general, primary (domestic) and industrial demands, with the highest ability and willingness to pay, require a high reliability of supply, which is normally achieved through relatively large storage provision. Also environmental demands are not the most demanding on the resource. Agricultural water requirements tend to be much higher, fluctuate strongly but also accept a lower reliability of supply.

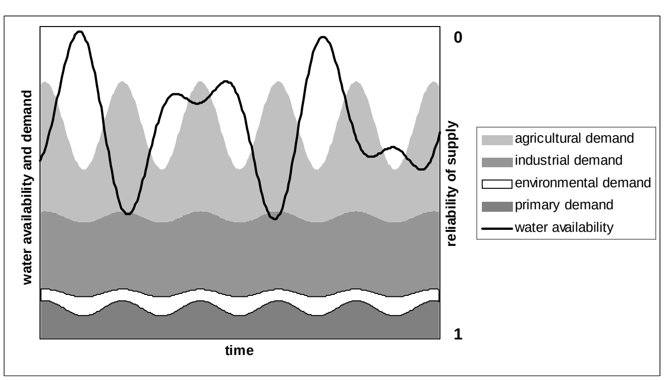

Figure 3. Variation of water availability and demand, and reliability of supply.

Conclusion

This paper has attempted to show that "water as an economic good" and "demand management" are compatible concepts when considered in the context of Integrated Water Resources Management. Both are instruments towards balanced and integrated decisions on the allocation of a scarce resource, for the benefit of society as a whole. Water economics is about making the right choices about water resources development, conservation and allocation. Financial considerations are only a part of this "benefit-cost" analysis and seldom the main consideration. If water pricing is considered the main (or sole) instrument of demand management and economic planning, it will be a major pitfall. Both demand management and economic planning should have much broader scopes, and the core function of water pricing should primarily be cost recovery. If costs are recovered through increasing block tariffs, implicit cross-subsidies are built into the system, which on the one hand satisfy social and equity criteria and guarantee financial sustainability on the other.

In the trade-off between inter-sectoral water uses, the aspect of temporal variability of water availability and of reliability of supply is crucial, and often overlooked by economists. The various water using sectors require different reliabilities of supply, which somehow has to reflect in the price of water. The paper has argued that for this reason the opportunity cost of irrigation water is often overestimated. Applying water for biomass production will remain a significant, and vital, activity in future.

Within sectors, water markets and marginal cost pricing may in some cases be compatible with the concept of Integrated Water Resources Management, provided all externalities are indeed "internalized" and transactions are regulated by a public body (Perry et al., 1997). The paper has argued that for the allocation of water between sectors no markets are required nor are these desirable. Adequate and effective regulations may suffice in order to achieve the optimal use of water resources, acceptable to society at large.

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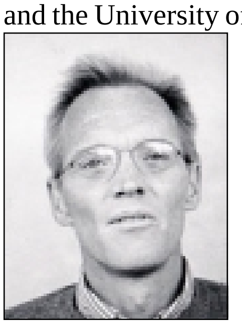

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References

Briscoe, J. 1996. "Water as an Economic Good: The Idea and What It Means in Practice." Paper presented at the World Congress of the International Commission on Irrigation and Drainage. September, Cairo.

Gaffney, M. 1997. "What Price Water Marketing?: California's New Frontier." *American Journal of Economics and Sociology* 56, No. 4: 475–521.

Green, C. 2000. "If Only Life Were That Simple; Optimism and Pessimism in Economics." *Physics and Chemistry of the Earth* 25, No. 3: 205–212.

ICWE. 1992. *The Dublin Statement and Report of the Conference*. International Conference on Water and the Environment: Development Issues for the 21st century. 26–31 January. Dublin.

Jaspers, F.G.W. (submitted). "Principles of Water Allocation in Historic Perspective: From Traditional Customary Water Distribution to Modern Sustainable and Economic Water Allocation Systems." Submitted to *Water Policy*.

Kasrils, R. 2001. "The Value and Price of Water (The Women of Lutsheko)." *Water Science and Technology* 43, No. 4: 51–55.

Mohamed, A.S. 2001. *Water Demand Management: Approach, Experience and Application to Egypt*. PhD dissertation. Delft: IHE Delft and Delft University of Technology.

Perry, C.J., M. Rock, and D. Seckler. 1997. "Water as an Economic Good: A Solution, or a Problem?" Research Report 14. IWMI, Colombo.

Rogers, P. 1998 "Integrating Water Resources Management with Economic and Social Development." Paper presented at the Expert Group Meeting on Strategic Approaches to Freshwater Management on behalf of Department of Economic and Social Affairs, United Nations. 27–30 January. Harare.

Rogers, P., R. Bhatia, and A. Huber. 1997. "Water as a Social and Economic Good: How to Put the Principle into Practice." TAC Background Papers No.2. Global Water Partnership, Stockholm, Sweden.

Rosegrant, M.W. and R. Gazmuri Schleyer. 1996. "Establishing Tradable Water Rights: Implementation of the Mexican Water Law." *Irrigation and Drainage Systems* 10, No. 3: 263–279.

Savenije, H.G. and P. van der Zaag. 2000. "Conceptual Framework for the Management of Shared River Basins with Special Reference to the SADC and EU." *Water Policy* 2, No. 1-2: 9–45.

Van der Zaag, P. and H.G. Savenije. 2000. "Towards Improved Management of Shared River Basins: Lessons from the Maseru Conference." *Water Policy* 2, No. 1-2: 47–63.