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Managing water as an economic good: rules for reformers

J. Briscoe

The World Bank, Washington DC, U.S.A.

Abstract

This paper extends a previously-developed framework for the management of water as an economic resource, by showing how positive and negative externalities can be taken into account. The main focus of the paper, however, is on assessing the lessons of experience which emerge from successful reforms. The following emerge as a tentative set of "rules for would-be reformers":

- initiate change only when there is a powerful, articulated need for reform;
- have a clear strategy for involving all interested parties in the discussions of reform, and for addressing fears seriously, with effective, understandable information;
- pay attention to general principles, but be sensitive and innovative in adapting these in different institutional and environmental contexts;
- do not advertise water markets as a silver bullet or a panacea, but ensure that they are part of an effective water resource management system;
- start with the relatively easy problems to get experience and build momentum for reform;
- acknowledge that there are no perfect solutions, and don't let the best become the enemy of the good;
- pay close attention to prescribing institutional arrangements which will address legitimate third-party issues, but which will simultaneously minimize transactions costs.

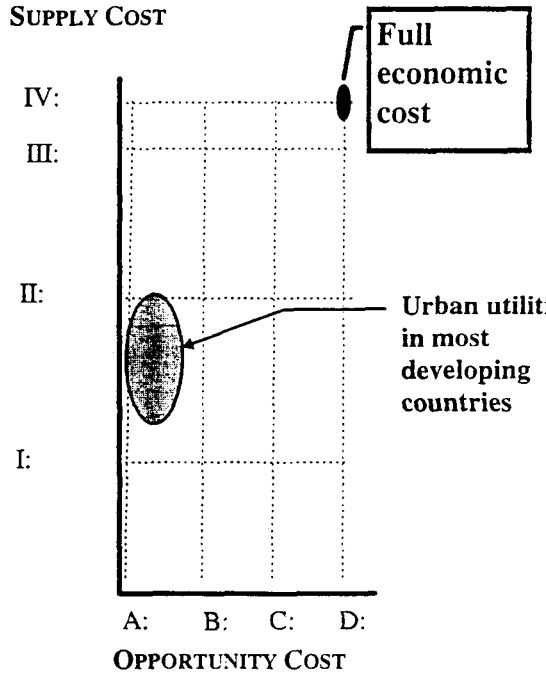
Keywords
economics, managing transitions, politics, strategy, water markets, water resources management.

1. A basic conceptual framework for water as an economic good

A recent paper to the World Congress of the International Commission on Irrigation and Drainage (ICID) [1] outlined the theoretical underpinnings of the idea of "water as an economic good", and presented information on the value of water in different end uses, and the supply and opportunity cost of water in different sectors and settings. This paper focuses on just two (but two major) water-using sectors -- urban water supply and irrigation.

1.1. Urban water supply

Urban water supply is a low-volume, high-value (typically between 10 and 100 US cents per cubic meter [1]) use. The supply costs (incurred in financing and operating the abstraction, transmission, treatment and distribution systems) are relatively high, while the opportunity costs (imposed on others as a result of use of the water) are quite low. Accordingly, the priority issue for the economic management of urban water supplies relates primarily to the supply cost axis (as illustrated in Figure 1).



Legend:

Supply Costs:
I: Operations and maintenance costs only
II: Average financial (capital + O&M) cost, with capital valued in terms of historical costs
III: Average financial (capital + O&M) cost, with capital costs computed in replacement terms
IV: Long run marginal cost of additional supplies

Opportunity Costs
A: Water can be used only by an individual user
B: Water can be leased or sold to neighbors
C: Water can be leased or sold within a limited district
D: Water can be leased or sold to any urban or agricultural user

Fig. 1. Supply cost, opportunity cost and full economic cost for urban water supply

Conventional economic wisdom suggests that users should be charged full marginal costs -- level IV in Figure 1. In most developing country situations, however, aiming for economic perfection is neither practical nor helpful. Instead, it is imperative that tariffs be set in a way that is understandable, transparent and legitimate and that forces suppliers to be accountable (and thus produce services efficiently). In the urban water supply sector, this "common-sense" pricing approach will therefore mean:

- focusing on supply costs and
- aiming to increase user charges first up to level II and then up to level III (in Figure 1).

1.2. Irrigation

In developing countries most irrigation -- 90% in World Bank-financed irrigation projects -- is for foodgrains. This type of irrigation is a high-volume, low-value user of water (with values generally less than 1 US cent per cubic meter). But there is an important and growing sector of high-value irrigation (often fruits and vegetables), with typical values between 5 and 15 cents per cubic meter of water [1].

The supply cost of irrigation water for usually modest, but when there is competition with either urban uses or high-value irrigation, the opportunity cost is high. In the Limari Basin in Chile, for example, the supply cost (which is partially subsidized) is about 0.5 US cents per cubic meter, whereas water trades at about 5 US cents per cubic meter [2]. In California, a typical financial charge to an irrigator is about $5 per acre foot (0.4 cents per cubic meter), whereas water trades at the equivalent of about $150 per acre foot (12 cents per cubic meter) [3].

From the perspective of treating water as an economic good, the great challenge in irrigated agriculture is how to ensure that farmers take into account the opportunity costs, which are often an order of magnitude higher than current charges. This is the essence of the appeal of the approach of water markets -- as described in the Chilean case [2] "the genius of the approach is that it ensures that the user will

face the appropriate economic incentives, but de-links these incentives from the tariff, which is set on "common-sense" grounds". Or, in the case of the California Water Bank (which is a formal mechanism for pooling surplus water rights for rental to other users) the key is " the ability to increase the value of water without an increase in the cost to the farmer (that) is a politically acceptable way of sending the signal to users of the true value of water" [4]

There are many vital issues relating to charges for supply costs in irrigation. Experience [5] has shown that cost recovery in and of itself achieves nothing, unless the money collected is used efficiently to improve the quality of services provided. Recent experience in Mexico confirms this -- since management of irrigation systems has been transferred to users' associations, recovery of operation and maintenance costs has increased from 30% to about 80% .

In terms of economic signals to irrigators, however, as illustrated in Figure 2, the "vertical axis" (supply costs) is relatively short, and the "horizontal axis" (opportunity costs) is often long. That is, from the perspective of the economic allocation of water, the key challenge is to ensure that farmers are aware of the opportunity cost of the resource, and that there are institutional arrangements for ensuring that water moves to higher-valued uses. This paper will, accordingly, focus primarily on the opportunity cost issues and not the supply cost issues in irrigation.

The ICID review [1] concluded that it was inappropriate, on a number of counts, to think of rolling opportunity costs into water tariffs (as has been suggested in several countries, notably Chile [2] and South Africa). This is so for three main reasons:

- because the information requirements are very onerous (opportunity costs vary dramatically by place and season, and even sophisticated research studies cannot estimate them in a way that is universally accepted);
- because the levying of such charges would (usually correctly) be perceived as expropriation by those who currently use the water;
- because it would defy common sense -- using the numbers cited earlier in this paragraph it would mean that farmers in Chile, Australia and California would be asked to pay more than 10 times the cost of providing the services they receive!

Emerging international experience is clear -- from a conceptual, practical and political perspective, the appropriate approach for ensuring that the scarcity value of water is transmitted to users is to clarify property rights and to facilitate the leasing and trading of these rights.

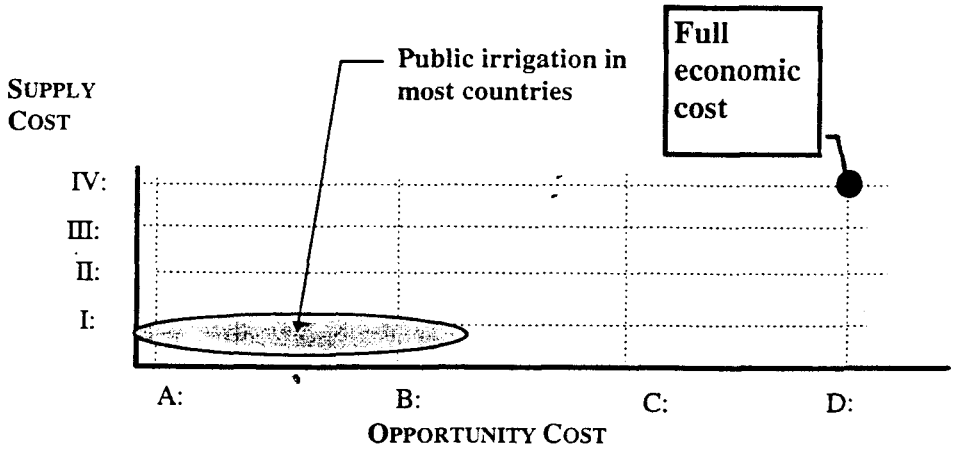


Fig. 2. Supply cost, opportunity cost and full economic cost for public irrigation

2. Expanding the framework to take account of externalities

Discussions stimulated by the ICID paper have confirmed [6] that this is a useful and practical approach, but that the basic framework needs to be expanded to take account of return flows and the positive and negative externalities they generate.

2.1. Negative externalities

Use of water by one user commonly has negative impacts (externalities) on other users. For example, pollution from a town can mean that downstream users have to incur additional treatment costs. Similarly, drainage water from irrigation fields often carries high levels of salts, nutrients and pesticides, leading to losses of aquatic habitats [7]. These externalities are easily incorporated into the conceptual framework of the ICID paper, by simply increasing the supply costs to include the cost of mitigating the negative externalities (Figure 3).

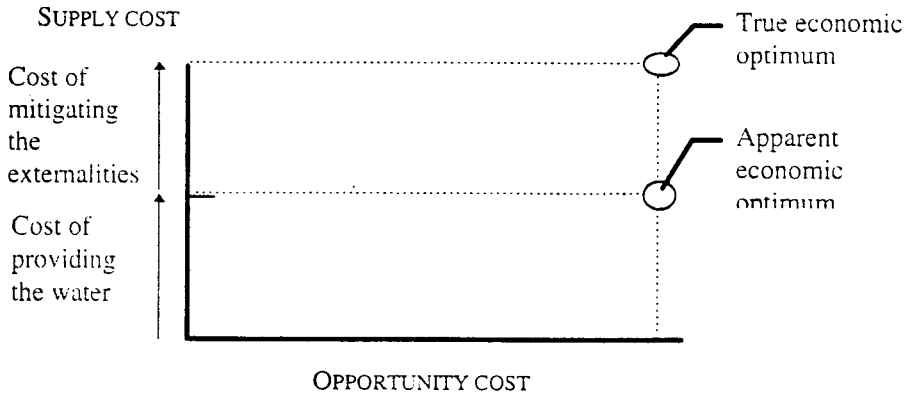


Fig. 3. Incorporating negative externalities

The implications of Figure 3 are evident in practice in the real world. For example, in many countries cities are required to meet specified wastewater (or receiving water) quality standards. The utility does this by treating its wastewater, and passing on the costs of this treatment to its customers. Similar practices are now starting to emerge for non-point sources of pollution. In the Murray-Darling Basin in Australia, for instance, the major water quality problem is the high levels of irrigation-induced salinity [8]. The Murray-Darling Basin Commission has now specified maximum salinity fluxes from its different member states. Salinity control measures are required to stay within these limits, with the costs of these control measures being passed on to irrigators in their water bills. (These costs are considerable. In the state of Victoria, for instance, irrigators pay roughly equivalent amounts -- about 1 US cent per cubic meter for water and a similar amount as a salinity levy [9]. In the Colorado Basin it costs, on average, about $70 to remove a ton of salt [10]. For a program which aims to reduce salinity levels by 200 ppm, this equates to a cost of about 1.5 cents per cubic meter. This is a very substantial amount -- it compares to typical water levies of about 0.4 cents per cubic meter [3]).

2.2. Positive externalities

Return flows constitute a vital element of many hydrologic systems. For example, farmers in the Gangetic Plain who apply more surface irrigation water than is required for evapotranspiration are, in effect, recharging the aquifer which underlies their fields, thus performing an aquifer recharge service for farmers who use groundwater. As Seckler [11] and Fredericksen [12] point out, analyses which concentrate on (apparently low) farm-level irrigation efficiency do not take into account the fact that basin-level efficiency may be high. This observation is

important because it means that the benefits of apparent efficiency improvements at the farm level may be illusory or even negative at the system level.

Consider the case where surface water irrigation is both meeting the evapotranspiration needs of crops, and recharging a groundwater aquifer which is subsequently used for irrigation. It is apparent that the surface water users are providing a "recharge service" to the groundwater users. What should the groundwater users pay the surface water irrigators for this service? An upper limit on this charge would be the cost of a formal recharge system (with which the groundwater users could recharge their aquifer). In such a case, the relevant charges to surface and groundwater users would be as shown in Figure 4. Once again, this is a "common sense" approach, with surface water users effectively getting a credit from groundwater users for the recharge service they are providing.

In many circumstances, of course, surface and groundwater users are the same population, in which case the notion of a monetary transfer from a user (to himself!) would not be sensible. Furthermore, in many areas where there is conjunctive use, there are countervailing "distortions". In Indian irrigation systems, for instance, headwater and tailwater users are charged the same (very low!) price for water. On the one hand, since tailwater users make greater use of groundwater, they "get an implicit subsidy" from the headwater users. On the other hand, the quantity and reliability of the service to the headwater users is far superior, probably more than offsetting the implicit subsidy.

Real-world experience shows that where there is a will there is a way -- there are practical solutions to the non-consumptive use issue [13]. In the Western United States there are a variety of methods for taking account of return flows from irrigators. Under the laws of most Western states, return flows "belong to the stream". The practice of the Northern Colorado Water Conservancy District is consistent with this. While each water user has the full right to purchase, sell, trade or rent rights to the primary, consumptive flows, the District retains all rights to the return flows of water.

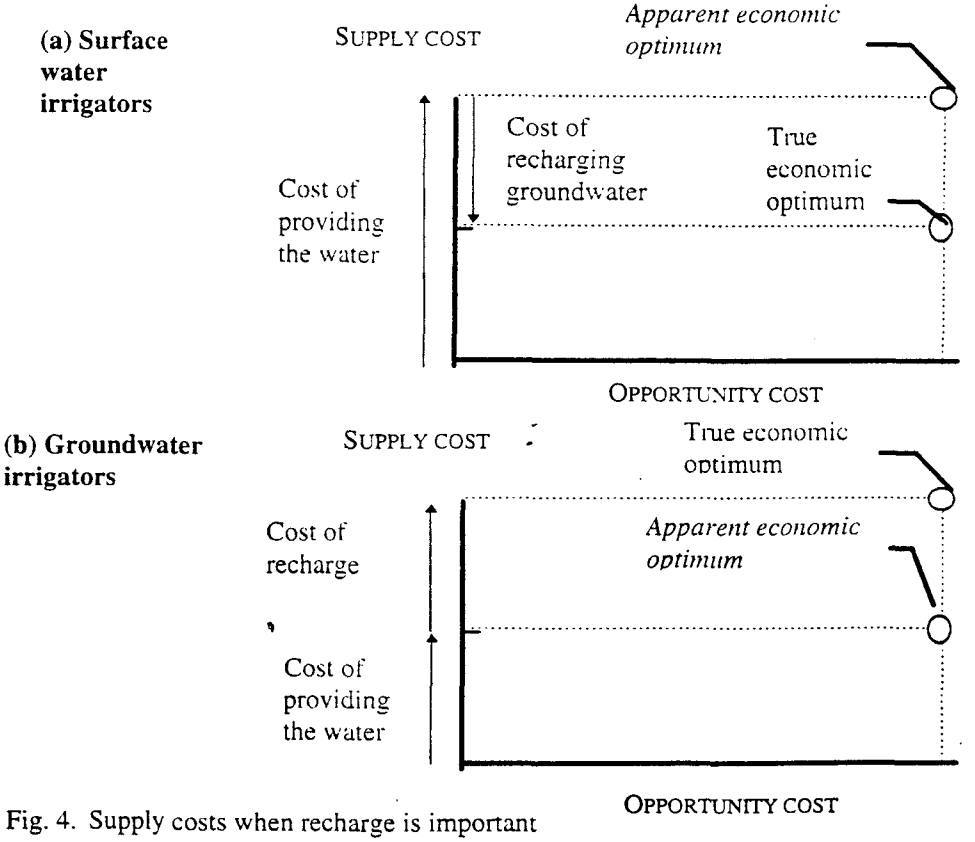


Fig. 4. Supply costs when recharge is important

In this, as in all other aspects of water management, it is necessary to find a balance between the ideal and the practical. When water rights are sold in the Western US, the quantity of water that may be transferred to a new use will be limited to the amount of water which was deemed to be consumed historically. This is typically done by a State Water Engineer who makes an estimate based on the factors such as the type of crops cultivated, soil type and climate [13].

Finally, while the return flow issue is generally raised in the context of the pricing of irrigation services [11,12], the distinction between consumptive and non-consumptive use is not relevant only to irrigation. Indeed, taking the US as an example, consumptive use as a percentage of withdrawals was 56% for irrigation, compared with 17% for urban water supplies, 16% for industry and just 3% for thermoelectric power [14].

2.3. Negligible externalities

There are many situations in which return flows have neither a positive nor a negative value for other users in a basin. For example, where return flows accrue to low-value "salt sinks", they have no value. Or where return flows discharge into the ocean, they are also effectively "lost" from the system. In such cases there is no need for modification of the use-opportunity cost analysis presented on Figures 1 and 2. The 1989 agreement between the Imperial Irrigation District (IID) in California and the Metropolitan Water District (MWD)which serves Los Angeles, is a good illustration of such a case. Under this agreement, the MWD pays $120 million for conservation activities (mostly canal lining, but also operations modernization) in the IID. In turn, the MWD obtains the 130,000 ML of water which are conserved. This agreement was possible in part because there are few externalities -- the IID is at the lower end of the river system, and there are no opportunities to reuse return flows, which are therefore considered "wasted" [15].

3. Rules for implementing a reform program

There is an emerging global consensus on both the necessity for more effective management of water resources, and on the principles of effective management. The Dublin Statement of the pre-UNCED Conference on Water and the Environment [16] remains the clearest of such statements, articulating three principles. The three "Dublin principles" are:

- The "ecological principle", requiring the holistic management of water;
- The "institutional principle", requiring that management be participatory, with responsibility "at the lowest appropriate level", and with greater involvement of NGOs and the private sector and women; and
- The "instrument principle", requiring that water be managed as an economic resource.

Where the notion of "water as an economic good" was once an issue of interest primarily to theoreticians, in recent years the principle has been translated into practice in many settings, with varying degrees of success. What are the lessons to be gleaned from this growing body of experience?

3.1. There must be a demand for reform

The first requirement for reform is that there must be a demand for reform. Unless the shoe pinches, reform is unlikely to take place. This is an obvious and yet often-neglected fact, especially by water professionals who see basin-wide management, for example, as self-evidently necessary in all places. A couple of examples suggest where the impetus for managing water as an economic good might arise.

The most obvious type of water stress is scarcity. Accordingly, wherever there is scarcity, there has been an endogenous move by local citizens to develop some form of informal water market. That these markets have been invisible and usually illegal does not mean they have not existed, nor that they have not become very sophisticated, as illustrated by the water markets of Gujarat [17]. In such settings, formalization of water markets greatly reduces transactions costs, and is thus welcomed by those who have been trading "in the black market". The Australian case is informative -- "the major impetus for the development of water markets came from users rather than the government.... all the government did was remove the legislative obstacles to transferability" [9]. Similarly, in urban areas of most cities of the developing world there are sophisticated water vending systems which fill the void left by poorly-performing utilities [18]. Because the unserved (usually the poor) typically pay 10 times as much for a liter of water than do the served, there is a tremendous implicit demand for reform which can be tapped. (As in all black markets, however, there are those who thrive on the distortions. Jakarta, where vending is very widespread and very lucrative, proves a general point to which we will return later, namely that there will be losers in reform processes [19], and that their interests have to be identified and dealt with.)

Scarcity is a great impetus for change, and so is pollution. In 1857 the slogan of the day in London was "India is revolting and the Thames stinks". The result was Chadwick and the sanitary revolution in the United Kingdom. Similarly, in the early part of this century, the pollution of the Ruhr River in Germany, and its threat to the operation of the industrial heartland, mobilized industry and society to do something. The upshot was the Ruhrverband, a revolutionary approach to water quality management which was built on the twin principles of management by stakeholders and using economic instruments to provide incentives for efficient use and for waste reduction [20]. And when France started recognizing the importance of its river pollution problems, it adapted, in 1964, the Ruhr approach on a national level, with the result being the famed "River Basin Financing Agencies". And now, when the water quality situation in the Paraiba do Sul river (which is the sewer of Sao Paulo and the drinking water supply for Rio de Janeiro) becomes intolerable, the states involved (Rio, Sao Paulo and Minas Gerais) are forming a Ruhr-French type basin agency, again grounded on participation and the use of economic instruments, to deal with the problem [21].

All stresses and challenges do not have to be the "natural challenges" of scarcity and pollution. Stresses in the economic and institutional machinery can also act as an impetus to change. Of particular importance here is the overall view which a society takes of its economic development process. Thus, in settings as diverse as Chile, Australia and Peru, it has been the articulation of an open, export-oriented, growth-driven economic development strategy which has been critical in providing the impetus to improving the economic performance of water (and other factor) markets.

The possibilities of reform are, therefore, greatest when there is a confluence of "natural" challenge (scarcity or pollution) and institutional reform-mindedness, as exemplified by Chile in the 1980s and Australia today. The basic point here is simple -- creative responses in dealing with water as an economic resource will only happen when there is a problem to be addressed, when that problem is perceived to be important, and when there is a political climate conducive to reform.

RULE #1:
Initiate reforms only when there is a powerful need, and demonstrated demand, for change.

3.2 Water is special -- dealing with the "exceptionalism syndrome"

Water is a good with special properties -- it is the basis of life itself, it is not produced, it is unitary, it is fugitive [22]. These particular attributes have long made water "special", in symbolic, religious, and legal terms. It is no wonder, therefore, that there is much skepticism and concern about the effects of reforms which purport to treat water as an economic good.

3.2.1. *Concerns about "the end of irrigated agriculture"*

A common concern is that treating water as an economic resource will mean "the end of irrigated agriculture". While this will certainly be true in some local areas, the overall effect on the quantity of water used in irrigated agriculture will be small. There are two reasons for this -- first, because irrigation is a dominant withdrawer and even more dominant consumer of water in all countries where irrigation is important. The changes in the United States illustrate the general point: between 1960 and 1990, while withdrawals for municipal purposes almost doubled, irrigation's share of total consumption fell by only 4%. As concluded by the US Department of Agriculture: "Growth in non-agricultural water needs, particularly in areas with limited supply-enhancement opportunities, may be met by relatively small shifts in national irrigation water use. However, small national shifts may mean large adjustments in local irrigated activity."[14] The implications of this are obvious -- it is essential that the reform debate be informed by solid analysis which can distinguish the legitimate (and in this case local and limited) concerns from extravagant "doomsday" claims.

3.2.2. *Concerns about the thinness of the market*

Another set of skeptics have the opposite concern. They claim that water markets are, in practice, very "thin", so thin that the notion of a functioning market allocating resources is an illusion.

First some facts. In Chile the number of transactions varies very widely, in a way that is systematically related to water stress and structural changes [2]. In most basins stresses are not yet great and so transactions are rare [23]. But in highly-stressed basins, there are many transactions. For example, in Santiago County, over a one-year period, 3% of total water rights were transferred (with 94% of transferred water moving from one farmer to another) [24]. In Australia (where there are currently both area-of-origin restrictions and restrictions on trades out of agriculture) about 2.5% of all water is leased each year and about 0.3% sold. The Northern Colorado Water Conservation District illustrates how important the cumulative effects of transfers can be -- in 1957, 98% of deliveries from the Colorado-Big Thompson Project were used in irrigation; in 1989 this figure was down to 73% [25].

3.2.3. *Concerns about the impact on the poor*

There is a common and reasonable concern that treating water as an economic good will inevitably be damaging to the poor, especially in terms of supplying "basic human needs". This concern acquires particular validity because most interventions to "keep tariffs low" are defended in the name of the poor.

In the urban water sector the evidence is compelling and consistent throughout the developing world. Giving politics a central role in determining tariffs has meant three things -- costs are too high because utilities are not accountable to users; coverage is low, with the poor always the last to get services; the underserved have to resort to buying from water vendors, typically at prices 10 times those which they would have to pay an efficient utility [18]. This has aptly been labeled "the hydraulic law of subsidies" [26]-- the subsidies follow the water, and the water flows to power and influence and away from the poor.

Recent experience in the urban sector has shown that with commitment and imagination, the poor can be much better off when water is managed as an economic resource. Three examples illustrate this.

In Santiago, Chile, the government realized that it was inherently contradictory to require that an urban water utility (EMOS) function as a commercial entity and provide subsidized services to the poor, since each subsidized person served would represent a loss of revenue to the utility. Accordingly, the government decided to institute a targeted, means-tested, government-administered "water stamps" program, whereby poor people would get "stamps" which would cover part of their water bill. The utility then not only strengthened its focus (getting out of the welfare business and focusing on becoming the most efficient utility it could), but it now had a clear incentive to serve the poor, who became revenue-generating customers like all others. The system works very well [27].

In Conakry, Guinea, the performance of the water utility in the late 1980s was catastrophic -- water for only a few hours a day, with the poor, as always "at the end of the line". The familiar "low-level equilibrium" prevailed -- service was poor, people were not willing to pay, revenues were inadequate, service got worse and so on. The government made creative use of a World Bank credit to get to a "high-level equilibrium". The assets were leased to a private operator who was paid a fee which reflected the full cost of the service. Users initially paid only about a quarter of this fee, with three quarters of the operator's fee covered by the World Bank credit. Users were informed that service would improve, and that as it did tariffs would be increased to cover costs over a five-year period. Although problems remain [28], this innovative approach worked well for the poor -- coverage increased from 15% in the 1980s to 52% in 1994.

In Buenos Aires, Argentina, the public water company performed poorly for years -- coverage was low, water was rationed every summer, and prices were high. The Government gave a concession contract to a private operator in 1993. At the end of 1995 the water tariff was 27% lower than it was when the utility was publicly run, 650,000 new water connections and 340,000 new sewerage connections had been made.

The experience of the urban water sector is clear and well-documented -- the poor are much better off when water is managed as an economic good. What of irrigation?

The inequities of existing command-and-control mechanisms for water allocation in irrigated agriculture have been widely documented (for instance by Wade [29] in South Asia). Because water has rarely been formally managed as an economic good in developing countries, however, there is little information on the equity effects of a market-oriented management system.

In the case of Chile, there are differing positions on the equity implications of water markets. As always, the counterfactual is of central importance and debatable! Proponents of the Chilean water markets [24] argue that the counterfactual is of subsidized infrastructure which inevitably (just as in the case of urban water) differentially favors the well-connected. They further argue that it is the poor that suffer disproportionately from the fiscal deficits and inflation to which such subsidies contribute. Critics of the Chilean markets [30], focus on the fact that no effort was made to address the specific problems which faced the poor when the market system was introduced: "In the 1980s the government undertook no campaign of public information or education about the Code's new features, not offered legal or technical advice about how to apply for new rights or regularize old ones". What is striking in Chile today is that post-Pinochet social democratic governments (who have a strong commitment to equity) have remained firmly committed to the use of water markets, while being equally committed to addressing the informational deficiencies which disproportionately affect the poor [23].

A rare empirical assessment of the equity impacts of water markets was done for Spanish and Western US irrigation in the 1970s. The authors [31] concluded: "although it is a doctrine of many welfare economists that procedures that rank high in efficiency will do poorly in distributing income equally among beneficiaries, while procedures that do well in distributive terms will be inefficient... this conventional wisdom does not apply to a wide variety of conditions in irrigated agriculture".

3.2.4. *Concerns that the environment will be neglected or damaged*

In the past there was a widespread perception that there is some inherent contradiction between "the capitalist economy" and the environment, and, therefore, concern with the environmental effects of treating water as an economic good. After the devastating effects of command-and-control policies on the environment became clear in the Soviet Union and elsewhere, perceptions have changed dramatically. It is now widely understood that it market mechanisms induce efficient resource use, and that inefficiency is the enemy of the environment. And it is equally widely understood [18,32] that this is particularly true of water.

Many sophisticated environmental groups have, accordingly, become vigorous advocates of the concept of water as an economic good. In the case of some of these groups, such as the World Resources Institute [32] and the Environmental Defense Fund [33], the principal issue is that treatment of water as an economic good per se will mean much more efficiency, and far fewer environmentally-destructive investments. For others, the purchase of water rights becomes a cost-effective and practical method through which environmental requirements can be handled without expropriation. The Nature Conservancy, for instance, has spent $1.5 million to purchase water from farmers to leave instream in the Carson River in Nevada [34]. The US EPA is also starting to follow the same path -- Federal Clean Water Act funds now being used to buy water rights from irrigators in the Truckee River area (near Reno, Nevada), to increase river flow in dry summer months [35].

3.2.5. *The "exceptionalism syndrome" -- "markets may work for selling cars, but they don't work for water; water markets may work in California, but they can't work in India....."*

Institutional change has always been resisted, precisely because it involves change. A universal argument against change is that "water is different" or "India is different". It is, however, becoming increasingly clear that there is a remarkable degree of commonality between the ingredients of successful reforms in quite different contexts, ranging from Taco Bell, to General Electric, to the New York Police Department, to the NGO Aravind Eye Hospital in Tamil Nadu [36], to the state government of Ceara in Brazil [37]. The "uniqueness" idea is not standing the test of time!

In the water sector there is a remarkable degree of similarity in the nature of "the problem" throughout the world. The political economy of contemporary public irrigation systems in, say, India [29], is remarkably similar in many respects to the political economy of public irrigation systems in the Western United States [38]. And there is much in common between the groundwater markets of Gujarat [17] and those of New Mexico [39]. And there is little distinction between the reform recipes for urban water supply in Adelaide and Abidjan. It is this very convergence which underlies the consensus around the Dublin principles!

This does not imply that the instruments used in different cases will not be strikingly different. The institutional arrangements are not the same in short, unregulated river basins in Chile as they are in continent-wide rivers like the Murray-Darling, but the underlying principles are similar.

What is striking in the contemporary water management arena is how a few hegemonic ideas are becoming universalized very rapidly. The Ruhr-French model (of participatory management, with the use of user and pollution charges) is proving

to be well adapted to quality problems in the Paraiba do Sul river in Southeast Brazil [21] and for the management of coastal wastewaters in the United States [40]. And the water market/water bank model is finding wide application where there is scarcity -- in Chile, Argentina, Mexico and South Africa, just as in Australia and the Western United States.

3.2.6. *Discussion, debate and development of a consensus for reform*

There are, essentially, two reform paths. Either a dictatorial government can simply declare that the resource will, henceforth, be managed differently. Or there is a process of open debate, with different stakeholders expressing their concerns and views. There are important examples of water reform which have taken place via the former mode (notably Chile), and there are certainly some countries which could follow that route today. But, happily, in the vast majority of countries of the world today, changes require the consent of the people. In these circumstances a vigorous, open debate is necessary for reform to take place. Three contemporary examples are illustrative of "good practice" in this regard.

The first example is Australia. As in every other situation of scarcity, informal water markets existed for many years. Starting in 1983, the government formalized and legalized this practice, simply by removing legal obstacles to transferability. These markets have worked well in many respects, and have become a fixture of the institutional landscape, supported by both sides of the political spectrum [9]. The markets have, however, been limited because there have been restrictions on inter-sectoral and inter-state trade. In recent years the Coalition of Australian Governments (COAG, comprising the Prime Ministers of the Federal and State Governments) has looked carefully at Australia's overall economic and trade policies, and concluded that economic growth requires that water (and other factor) markets operate efficiently. Accordingly, COAG has decreed that "the major goal of water resources management is to achieve the highest and best value of the limited resource... (and that)... the move towards property right regimes is intended to link the responsibilities and accountabilities for decisions on water use with the incentives and sanctions for achieving highest value use" [41]. A central element in achieving this goal is to ensure that the geographic and sectoral reach of water markets is much broader, with inter-state, inter-sectoral trade a prime objective. What was clearly understood was that high-level commitment was a necessary but not sufficient condition -- it was vital that there be a broad-based discussion of the why and how. And in this discussion it was vital to identify different stakeholders and their interests and concerns and address these specifically and systematically in a consultation process. The work of the "Murray Darling Basin Commission's Water Market Reform Working Group" [42] is a model of how this stakeholder identification and information/consultation process should be done.

The other two examples are developing countries which are now embarking on similar reforms. When Peru initiated discussions of "following the Chilean model", there was concern that the Pinochet dictatorship was a necessary condition for such radical reforms. The (as yet incomplete) expérience in Peru showed that, on the contrary, broad-based discussions with interested parties strengthened rather than weakened the support for market-based reforms in water management [2]. South Africa is also undergoing a major reform in its water management practices, with the management of water as an economic resource a major objective. The debate on this policy issue is very broad and very open and is making use of a variety of traditional (public meetings) and modern (internet-based) instruments [43].

Finally, it is imperative that this debate be conducted in the appropriate language. As noted elsewhere: "Above all else, policy-makers need to demystify the academic literature, to strip away the jargon and explain to politicians, public servants and private stakeholders the advantages and disadvantages of market solutions to natural resource allocation" [9].

RULE #2:
There are many concerns about the possible effects of treating water as an economic good: Many of these fears are misconceived, and some are fanned for nefarious purposes! All concerns must be recognized and addressed openly and clearly.

3.3. Tailor the reforms to the reality of the problem

While there are clear and universal principles on what constitutes effective water management, the details of what can and should be done are enormously variable. It is obvious that context -- historical, cultural, legal, institutional, political, economic and hydrologic -- matter a great deal, and that the particulars of appropriate solutions require careful and ongoing adaptation to particular circumstances. A couple of examples illustrate this general point.

Within the Ruhr basin, pollution charges are the major economic instrument for managing point sources. But as non-point source pollution has become a more important and recognized problem, different and creative approaches (such as subsidies for changed land-use practices) have been invented, and used successfully [44].

Within most water markets, a mix of different instruments are used. Short-term leases are effective for addressing the needs for higher reliability, but long-term sales are more appropriate when there are structural shifts (in the location of agriculture, or from agriculture to industry) [4]. And as water markets mature, other niches are emerging -- with options and futures contracts now coming onto the scene in the Western United States, Australia and Chile.

In urban areas, there is a similar need for inventiveness and adaptation. Thus there is innovation in how to direct subsidies to the poor (see the Santiago example discussed earlier), and innovation [26] in how to charge for water from public standpipes.

RULE #3:
Context matters (a lot!)
Basic principles apply, but details require adaptation of these principles to the institutional, political, economic and hydrological context

3.4. Keep expectations reasonable

Treating water as an economic resource is desirable for a wide variety of economic, equity and environmental reasons. And the benefits of this approach are substantial. But precisely because context matters so much, there are no ready solutions which can simply be plucked off the shelf and no "final solutions".

Reform requires a complex mixture of impatience and patience. Impatience is required to make paradigm shifts, but then it must be realized that implementation is a very long-term process, which requires persistence, patience and adjustment. This is well illustrated by the contemporary processes in Australia and Chile. In both places formal water markets have existed since the early 1980s and in both places these have

been relatively successful. But both countries are now in the process of major adjustments -- in Australia to extend and deepen what were initially relatively timid reforms [9]; in Chile to adjust the framework to account for some distortions (hoarding of rights by hydroelectric companies) and to embed the markets in a more effective river basin management framework [2,23].

There is a further, very clear lesson from all efforts to deal with water as an economic resource, whether it be through pricing or marketing mechanisms. In all cases where economic instruments for water management work well -- such as the Ruhr, the French River Basin Financing Agencies, the Northern Colorado Water Conservancy District, the New Mexico water markets, the Murray-Darling Basin, the Elqui Basin in Chile -- this happens in the framework of an effective overall river basin management system. The issues of governance and technical management of the resources are at least as important as, and essential complements to, the use of economic instruments [45].

Experience shows that blind advocacy of, say, water markets as "the silver bullet which will solve all problems" is not only misguided but actually counterproductive (as has been apparent in the debate over water markets in Chile). Acknowledging broader issues and keeping expectations realistic is not a recipe for inaction, but essential if there is to be effective reform.

RULE #4:
There are no silver bullets:
Economic instruments work well only when they are part of an effective overall water resource management system.

3.5. Nothing succeeds like success-- start where the chances of success are highest

Reforming water management systems is never easy. Early successes are vital in demonstrating that change is possible and in building a broader constituency for reform. The strategy being followed in introducing inter-state water trading in Australia is a good example.

The background to this stage of the Australian reform process is recognition of the gains to be had from broadening and deepening water markets. As has been pointed out in the Western United States "since localized markets such as those within water conservancy districts and small river basins have been active for many years, some of the greatest opportunities for increased efficiency lie in interdistrict and interstate markets"[46]. In the lower Sevier River in Utah, for example, the actual gains in efficiency were measured following a relaxation of exchange restrictions -- exchanges were allowed between four irrigation districts (rather than just within a particular district). The average real rental price in the period after the free inter-district exchanges was more than three times that in the exchange-restricted period [47].

The practice of water trading in Australia is now well established and supported by all major stakeholders, and all political parties. However, the water markets in Australia are relatively restricted (to sales within agriculture, and to sales within specific states). High-level commitment to inter-state trading has been made; the question is where to start. The Murray Darling Water Market Reform Working Group [42] is clear and strategic:

"Initial community consultation on permanent interstate trade focused on the Mallee region for three reasons:

- Mallee irrigation enterprises in each state (New South Wales, South Australia and Victoria) are similar enough for a high degree of commonality in understanding of water entitlements;

- Since Mildura (the main town in the Mallee region) acts as a regional transport and processing hub for integrated produce from each state, many traditional interstate economic rivalries are relatively subdued in the Mallee;
- The Mallee is a likely net importer of water entitlements under each of the existing separate intrastate water markets. Consequently it is possible for a variety of community interests to discuss interstate trade as a potential win-win exercise."

The message is clear -- start with the relatively easy problems, get success there and then move on with the momentum of success to address the more difficult problems.

Similar strategies are evident in other parts of the world. In Brazil, for example, the establishment of tradable water rights in being undertaken on a pilot basis on a single-state basin, in a state (Ceara) where water is scarce and where there is a recent track record of effective, modernizing government [37]. In India the establishment of the first formal water market has been proposed as a method for effecting the voluntary transfer of water from low-value agriculture to high-value urban uses in the Madras Metropolitan area. The chances of success are increased by the fact that it is a classic "win-win" situation (in which the city could buy water at a fraction of the cost of alternatives, and farmers could get paid much more than the value of the water in irrigation) [48].

RULE #5:
Pick the low-hanging fruits first -- nothing succeeds like success.

3.6. Don't let the best become the enemy of the good

There is no such thing as the perfect water management system. Insisting on perfection is a recipe for inaction -- the best can become the enemy of the good.

All water management systems have to face many difficult issues -- systems which manage water as an economic resource are no exception. Consider, for instance, the thorny issue of allocation of initial rights in publicly-financed irrigation systems. In virtually every country in the world, these systems have been heavily subsidized, with (as always) the privileged getting disproportionate benefit from these subsidies. One legitimate perspective on the allocation of permanent rights is thus: "these people have had a privileged position for long enough; now is the time to allocate the rights on a more equitable basis." However, those who enjoy those rights never see it like this. Their generic position is most persuasively argued by a recent purchaser of land in the irrigation district: "When I bought my land, I implicitly paid for the right to water at the historic (subsidized) price. To take this right away from me now -- either by pricing or by re-allocation -- is expropriation, which I will resist fiercely and honorably."

There is reason (and often commitment) on both sides of this debate, and thus no elegant "perfect" solution which will be just, efficient and politically acceptable to all. A practical outcome to the solution will be different in different places. In New South Wales, for example, there has been considerable controversy regarding one-off capital gains some water-entitlement holders have been able to make on the sale at market prices of water rights acquired under government-financed and subsidized projects. After much debate, the government approach been to accept a one-off imperfection in return for continuing future improvements in efficiency [9].

A similar debate is under way in South Africa, complicated greatly by the fact that it was whites who were the beneficiaries of apartheid-era pork barrel politics. Sanctification of these past inequities is out of the question, yet a policy of

confiscation, as in other parts of the world, would meet with serious political opposition. While this debate is far from over, the task is clear -- try to "start playing the right ball game" (perhaps by buying out initial rights at the opportunity cost of water in irrigation, and then auctioning off all rights). This would probably mean, as in Northern Colorado [25], that high-value urban users would buy the rights, and then lease them back to farmers until such time as they were needed by the cities.

Finally, it should be recognized that these difficulties are not created by a water market system -- it is simply that a market system brings these issues to the surface. The bottom line is that there is no perfect solution -- the challenge is to find a reasonable, practical second-best solution which will start the vital process of treating water as an economic resource.

RULE #6:
Keep your eye on the ball, and don't let the best become the enemy of the good.

3.7. Ensure that legitimate third party interests are addressed, but that transactions costs are minimized

3.7.1. Concerns with economic and employment effects in "areas of origin"

The rationale for tradable water rights has been clearly articulated by the Water Science and Technology Board of the US National Academy of Sciences: "The classic rationale for all economic activity -- gains from trade - motivates most water transfers. Buyers perceive that the cost of purchasing existing water rights and transferring water to new locations, seasons, or purposes of use is less than the cost of alternative means of securing needed supplies. Conversely, sellers -- generally farmers -- sell when the price offered is greater than the economic value of the crops or livestock they produce. The net result is that the new use generates higher economic returns than the old use" [15].

Where they have been established, water markets have performed this re-allocation function well. In the State of Victoria in Australia, for example "water is tending to move away from badly-salinized mixed-farming land to dairying and horticultural areas where the returns are higher" [49]. In California the Water Bank has meant the transfer of water from low-value fodder and foodgrain crops to high-value fruit, vegetable and nut agriculture, and to municipal uses [4]. A study of trades in the Arkansas River Valley illustrates the typical imbalance between costs and benefits well -- net income losses in the area of origin were about $53 per acre foot (4.4 cents per cubic meter), and the market value of water in the urban areas $1,000 per acre foot (80 cents per cubic meter) [50].

Precisely because of these imbalances and shifts, the economic benefits from trades is substantial -- an estimated $104 million in 1991 alone from the California Water Bank [4]; about $5 million per year in the (presently-restricted) market in New South Wales [9] and an estimated $100 million per year in additional agricultural production in the southern part of the Murray-Darling Basin in Australia once inter-state trading becomes a reality [42]. In Chile, the gains-from-trade in the (small) Limari Valley are about $2 million per year [51]. The impacts on employment follow a similar pattern -- in the case of the 1991 California Water Bank about 1600 jobs lost in the area of origin, offset by 5,400 jobs gained in the importing regions [4].

These large net benefits notwithstanding, there are losers in water trades (as there are whenever there is an adjustment in any market). Naturally these third parties would like protection, usually by way of legislation on "area-of-origin restrictions". As has become evident in the case of Australia "advocates of restrictions on transfers ... argue that unrestricted transfers impoverish less-productive regions. Yet this should, in fact, be viewed as a vindication on the transferability of water -- it shows

the resource moving to higher-valued use"[9]. Whatever the conceptual shortcomings of the area-of-origin claims, they remain a fact of life [45] and a potentially serious impediment to managing water as an economic resource because of the way in which they can increase transactions costs.

3.7.2. Minimizing transactions costs

While externalities are (as the above discussion suggests) too often the "first refuge of scoundrels", the very nature of water means that real externalities are, in fact, pervasive. Accordingly, "the main administrative problem in water markets is the existence of 'third-party' effects that take the forms of changed return flows, changed groundwater levels and water quality changes, and the main issue in making markets work more efficiently is to identify and quantify these effects accurately and quickly and to get agreement on their magnitudes so that compensation and/or adjustments to the original property rights can be carried out without excessive transactions costs" [46].

Because transactions costs are so important, the choice of institutional arrangements for dealing with these is critical. Detailed empirical investigations of transactions costs in the Western US are revealing. Policy-induced transactions costs (include attorneys' fees, engineering and hydrological studies, court costs and costs paid to state agencies) range from about $50 per acre foot (4 cents per cubic meter) in New Mexico (where the State engineer adjudicates these issues) to nearly $200 per acre ft in Colorado (where they are adjudicated by the courts). The delays follow a similar pattern -- an average of 4 months in New Mexico, and 30 months in Colorado [52].

The issue of transactions costs is particularly vital where short-term markets are dominant (as with the California Water Bank), since the problem is a rapid response to drought conditions [4]. Accordingly, much attention is now given to streamlining the systems that impose superfluous restrictions, costs and delays on the transfer process, and, at the same time, to devise new ways to account for the important interests that are now left out. For example, in California, "one mechanism being considered would decouple transactions and compensation by establishing a compensation fund from which third party claims would be paid. The fund would be kept solvent by a standard charge on all inter-basin water sales. While the system is open to aggregation inefficiencies and moral hazard costs, it is hypothesized that the reduction in transaction risk will more than compensate for these costs" [4].

A related, important issue for third parties is whether trades deal with consumptive use or withdrawals. One way of reducing transactions costs is to tie transfers to consumptive use [15]. While there is no perfect solution to the problem of determining consumptive use, the problem can be addressed effectively where there is a will. In New Mexico, for instance, all rights are consumptive, with a typical description of the water right as follows: "This dedication is for 6.82 acres of irrigated land having a diversion right of 20.46 acre feet of water per annum and having a consumptive use of 1.5 acre feet per irrigated acre for a total of 10.23 acre feet per annum of consumptive use" [34]. The consumptive use is estimated by the State Engineer, who considers the type of crops cultivated, soil type, climate and other factors that affect water consumption [15]. Protests are rare. In California, where farmers are paid not to use water, "(aerial) photography used by the US soil conservation service to verify and monitor crop areas for subsidy payments were used to establish the past cropping pattern of an area, and to verify that irrigation was discontinued once the fallowing agreement was in force. Using this data base, the Water Bank was monitored at low cost ($4 per acre ft, or 03. cents per cubic meter)" [4].

RULE #8:
Transactions cost matter (a lot) – institutions should be designed to minimize transactions costs while providing protection for legitimate third-party claims.

4. Conclusions

This paper extends a previously-developed framework [1] for thinking about management of water as an economic resource, by showing how positive and negative externalities can be taken into account. The main focus of the paper, however, is on assessing the lessons of experience which emerge from successful reforms.

The conclusions of this review are that strategy is vital in implementing a market-oriented water reform. More specifically, the following emerge as a tentative set of "rules for reformers":

- initiate change only when there is a powerful, articulated need for reform;
- have a clear strategy for involving all interested parties in the discussions of reform, and for addressing fears seriously, with effective, understandable information;
- pay attention to general principles, but be sensitive and innovative in adapting these in different institutional and environmental contexts;
- do not advertise water markets as a silver bullet or a panacea, but ensure that they are part of an effective water resource management system;
- start with the relatively easy problems to get experience and build momentum for reform;
- acknowledge that there are no perfect solutions, and don't let the best become the enemy of the good;
- pay close attention to prescribing institutional arrangements which will address legitimate third-party issues, but which will simultaneously minimize transactions costs.

Finally, it is important to acknowledge that the idea of "water as an economic good" is but one of a triad of related ideas which will increasingly shape the way in which societies are organized (and water managed) in the latter part of the twentieth century. These ideas are:

- broad-based participation by civil society in decisions (including those on water management) which were previously often treated as the province of technocrats alone;
- the hegemony of the market model of development, and the corresponding move to using market-like and market-friendly instruments for managing all elements of the economy (including water);
- the emergence of the environment as a major focus of concern.

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