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University of Minnesota
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Universita degli Studi di Padova
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Agricultural Development Agency – Veneto Region

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SESSION VI: AGRICULTURAL POLICY AND SUSTAINABLE DEVELOPMENT - II

PAPER 1: MARKET APPROACHES TO WATER ALLOCATION: WHAT HAVE WE LEARNED?

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Market Approaches to Water Allocation: What Have We Learned?

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Market Approaches to Water Allocation: What Have We Learned?

K. William Easter*

There is growing evidence that water markets can be an effective mechanism for allocating water resources (Hearne and Easter, 1995; Chang and Griffin, 1992). In areas with limited water supplies and inefficient water allocation, markets are being evaluated as an alternative mechanism for improving water use and its allocation. One advantage of water markets over administrative pricing and allocation is that market prices are based on individual user assessments of the value of water. These assessments are made with information that is available to water users but expensive for government agencies to collect. Without markets, it is expensive for government agencies to determine the value of water to individual water users and to allocate water to those with the highest net return.

Not only do water markets provide a mechanism to address the water misallocation problem, they give water owners an incentive to move water to its highest valued uses (Rosegrant and Binswager, 1994). Because sellers are compensated, they have an incentive to sell their water whenever the market price minus transaction costs exceeds the net marginal value in its existing use. The market introduces an opportunity cost which encourages users to transfer water to its highest valued uses and make long-term investments that improve water use efficiency. By adopting new technology such as drip irrigation, farmers can either expand their irrigated area or sell the water saved to the highest bidder.

Water markets involve the sale of a specified volume or share of water for a set period of time, or the permanent transfer of a water right. The former occurs when the owner of a legal or prescriptive right to a certain volume or flow of water sells a portion of that water, sometimes

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outside of legal sanctions, to a neighbor in a simple transaction. These exchanges are usually for a short period of time — sometimes only one irrigation turn, or possibly a season. Although the unit sold may not be metered volumetrically, both the buyer and seller have good information on the volume transferred. A permanent transaction involves the exchange of the water right itself. This generally requires legal sanction to maintain security of the right after the transfer (Easter and Hearne, 1995).

Experience with Water Trading

Informal markets have developed in the large surface water systems of Pakistan and northern India among farmers along a given water course or canal (Easter, 1986). Farmers have a use right for a certain time period to irrigate from the watercourse that serves their area. The actual volume of water received will vary depending on the water flow but whatever the flow is during the farmer's allotted time is his to use. The trades are made of all or part of an individual irrigation time allotment. Yet, even on an individual watercourse, the coordination required among farmers can make it difficult to implement trades because of the high transaction costs. If there are other farmers on the watercourse in between the two farmers who want to trade, then the intervening farmers must also agree to the change in irrigation time. The fact that such water trades are illegal makes it difficult if not impossible for government officials to help coordinate trades and reduce their transaction costs.

Also in India, where private well development has proven to be the most productive form of irrigation, groundwater markets have made water available to even the poorest farmers. "Up to half or more of the land served by private modern well extraction mechanisms in many parts of India is likely to be owned and operated by the buyers of water," (Shah, 1993, pp. 48-49). This practice is encouraged by the pricing policies of State Electric Boards which charge a flat fee for each pump

but charge little or nothing for the power used. With a marginal pumping cost close to zero, water prices are kept low as long as there is competition among well owners (Palanisami and Easter, 1991 and Shah, 1993). In areas with salt water intrusion, rapidly declining groundwater tables or aquifer compaction, market prices fail to reflect the externalities caused by pumping and increase the rate at which the aquifers are damaged (Shah, 1993).

A very different community-based water market developed several centuries ago in Alicante, Spain, just south of Valencia. The market evolved based on a system of tradable water rights which were partly separated from ownership of the irrigated land. Both irrigators and non-irrigators own these rights. Although the water rights were based on allotted irrigation time from a canal, the rights were translated into volumetric units. This was possible because of the control and storage that existed in the system. In contrast to the uncertain flows in the large Pakistan and Indian systems, the Alicante system generally maintains a constant flow in the canals. The water market is based on an auction every Sunday morning in the village of San Juan. Buyers purchase tickets for a particular irrigation time during a particular cycle of canal flows. An analysis of the market exchanges and water allocation by Maass and Anderson (1971) found it to produce higher net returns than two alternate rotation systems used elsewhere in Spain.

A more centralized system of transferring finite quantities of water was established in California. This "Water Bank," started in 1991, takes advantage of the state's extensive system of canals, and allows high valued users of water to buy finite quantities of water from low valued sellers. Despite the fact that actual purchases were limited, municipal areas were able to ensure future supplies of water during the last stage of a severe drought. Because transfers of water were volumetric and temporal, sellers were not threatened with forfeiting their permanent water rights. However, concentration of the sales in several counties in the northern part of California's Central

Valley raised concerns about possible third party impacts due to large areas being left fallow. This prompted a number of politicians to suggest restrictions on the total quantity of water that could be sold from any one area. Howitt, 1993, estimated the losses in county income because of the water sales at 5% in Yolo County and 3.2% in Solano County. He also estimated that if sales were restricted to 15% of the past surface water supply, the losses in county income would be cut in half.

Permanent transfers of water-use rights are common in other parts of the western U.S. where water is allocated through priority rights based on time of appropriation (Colby, 1990). Much has been written about water markets in this area where water scarcity and an evolving economy have encouraged the development of physical and institutional infrastructure for efficient water management. Transfers are well regulated and although the legal system and other mechanisms for conflict resolution are utilized, conflicts continue to occur, especially over instream uses and Native-American traditional water rights.

Chile is one of the few developing countries that has taken steps to encourage the development of water markets. Market allocation in Chile is feasible because a system of transferable water-use rights separate from land was established under the National Water Code of 1981. Although the law stipulates that rights are to be specified by volume of flow per unit of time, in reality, rights are defined as a share of stream flow. Water use rights are specified for consumptive and non-consumptive use. Non-consumptive rights obliges users to return the water in a form that does not damage the rights of other users. Consumptive use rights are granted for the full use of all the water stipulated in the right. Thus, downstream users do not have rights to return flows generated by upstream users.

The Water Code stipulates that individuals can petition the DGA for water-use rights. However, most rivers in the arid north and fertile central valley of Chile were completely claimed

and divided before the 1981 law. The government did, however, grant large quantities of non-consumptive rights, mostly to developers of hydroelectric projects in southern Chile. Although these non-consumptive rights were not supposed to interfere with established consumptive rights, conflicts have occurred (Bauer, 1993). Conflicts between water users are generally resolved within water user associations. The DGA does have limited powers to regulate natural channels and can intervene in disputes when water user associations (WUAs) misuse their power. During times of drought, the DGA can impound water with compensation to water rights holders. The ultimate arbiter in water conflicts is the judiciary.

Active water markets are found in areas where water is scarce and transactions costs are low. Transactions costs are minimized by effective WUAs and maneuverable physical infrastructure. The presence of fixed flow dividers can make it too costly to move water from some locations. But in the Elqui and Limarí valleys of Chile where gates are used to regulate flows, WUAs can easily execute water transfers. One of the most important benefits of this system of transferable water-use rights is the security brought to rights holders. For example, Chilean farmers in the Limarí Valley have invested heavily in irrigated fruit crops and taken advantage of their favorable location and growing season to obtain high international market prices for their crops. As the opportunity cost of water increases, farmers invest more in efficient irrigation technology while water companies serving urban areas, such as in La Serena, purchase water-use rights and manage their water supplies more efficiently.

In Mexico, leases and sales of water among farmers for seasonal water use have existed for many years, even when such sales were not encouraged or were even illegal. However, this situation changed in 1992 when a new water law was promulgated. The new water law makes it legal to lease or sell water use rights and establishes water concessions or use rights of 5 to 50 years in length on

a volumetric basis separate from land rights. In theory, the actual water rights are held by the Comision Nacional de Agua (CNA) for the Mexican people. These water concessions or use rights will, generally, be renewed by CNA if the use and discharge have not changed. The CNA has an incentive to facilitate the registration of these rights since concession owners must pay a water use fee that will help finance CNA. The use fee is in two parts, one for the volume extracted, and the other for the volume and quality of the discharge.

These water concessions are based on consumptive use which essentially grants downstream water users the right to return flows. To maintain ownership of a water concession, the water must be used every three years. In practice, this means the owner of the water concession must pay the extraction fee. This requirement was included to prevent speculators from holding water free of charge. However, if instream uses do not qualify as use, then this three year limit could pose serious problems for those trying to purchase concessions to protect fisheries and aquatic ecosystems. It is also unclear how CNA will determine if irrigators are using their concession, given the zero extraction price for irrigation water.

Requirements for Efficient Water Markets

Unfortunately, efficient water markets do not occur naturally. The mobility and liquidity of water makes it difficult to establish secure water rights without collective action. In addition, the bulky nature of water makes it difficult to move large quantities upstream or outside the river basin without large infrastructure investments. These characteristics, combined with some of the market factors discussed above, mean that a number of institutional and organizational arrangements, and investments are needed before local or regional water markets can function efficiently.

Past experience indicates that there are, at least, five arrangements that should be in place if water markets are to be efficient, equitable, and sustainable. First, institutional arrangements must

be created that establish tradable water rights that are separate from land. A second important ingredient is an organization or management unit to implement the trades. A third component for an effective water market, particularly for irrigation, is a flexible infrastructure (control gates and interconnecting canals) that allows sellers to transfer water (at a reasonable cost) to the buyers. This may be less of an issue if large quantities of water are being transferred to high valued urban uses that can pay for a new pipeline or canal. Fourth, institutional arrangements need to be in place that help resolve conflicts over water rights and protect third parties, who may be damaged by water trades because of the interdependent nature of water uses. Finally, if equity is important in water allocation or transaction costs are high, then the initial distribution of water rights should be based on an assessment of society's basic water demands.

Establish water rights

Once a decision is made to allow markets to allocate water, the first step is to determine how water rights will be defined.[1] Rights can be defined in terms of a share of an uncertain stream flow or a share of an aquifer or reservoir. Alternatively, rights can be defined in actual quantity terms for a given time period, e.g., 20 thousand m^3 annually. If water rights are denoted in quantity terms, some agreed upon method will be needed for sharing water during periods when not enough water is available to fully supply all the rights. Two alternatives are generally used. First, each right can be given a priority based on some characteristic such as the date the right was issued or appropriated, the location of the right, or the type of water use (irrigation vs domestic consumption). When water is in short supply, only high priority water rights would be fully served (Becker, Zeitouni and Shechter, 1994). In the western U.S., this is done by dating each water right based on when it was

[1]These rights can be granted as either the actual water right or as a use-right. The use-right allows government to maintain the fiction that water belongs to all its citizens.

first established or appropriated. Under these "appropriated water rights," the oldest or most senior water rights holders receive their full share before the more junior rights holders receive water.

The other approach is to reduce all rights proportionately based on the size of the shortage. Sometimes a combination of the two approaches is used. In this case, certain priority uses such as domestic supplies are reduced less or not at all while others, such as industrial or agricultural uses have their deliveries reduced the most. These priorities will vary among countries depending on what they determine are their most critical water uses. Generally, in Chile, the total quantity of shares available for allocation are based on a river's flow that is estimated to be available 85 percent of the time. Thus in 15 percent of the years, there will be a shortage and the shares will be reduced proportionately to make up the difference. In streams where water rights have been established for urban areas, these rights, in most cases, are not subject to the same proportional reduction during times of shortage as are agricultural water rights.

The advantage of the appropriative water rights in the western U.S. is that one does not need as much historical information concerning water availability. During times of drought, only senior water rights holders receive water while in time of surplus flows, even the most junior rights holders will receive water. Granting another junior water right does not reduce the amount available for other more senior water rights holders. In Chile, they created a special class of water rights for water that is available when the supply exceeds the normal flows (which have already been allocated to permanent water rights holders, based on the 85% availability rule). These water rights are called "contingent water rights," and are contingent on high stream flows (Hearne, 1995). This was done because granting additional permanent water rights would have reduced the flows available to all other permanent rights holders during times of shortages.

To establish rights based on shares or volumes without establishing priorities requires

historical information concerning the probabilities that certain quantities or flows of water will be available at different times during a year. Without this information, it is difficult to determine how many water rights can be distributed. Information such as the probability of different levels of water availability will also improve the efficiency of the water market by reducing the uncertainty regarding how much water will be received under a given water right. Storage capacity, either in a reservoir or an aquifer, will further reduce uncertainty and improve market efficiency. In fact, water rights can be established in terms of a share of reservoir capacity as has been done in Australia, or as a share of aquifer storage (Dudley and Musgrave, 1988, and Dudley and Musgrave, 1991). In Australia, a water rights holder receives a percentage of whatever volume of water is in the reservoir during a given time period depending on how much of the reservoir capacity (s)he purchased. For an aquifer, the rights could be based on the average annual recharge or on the stock of water in the aquifer (Smith, 1977). Defining water rights in this manner would allow use of the aquifer stock during drought periods that would be recharged in high rainfall years or to efficiently allocate a fixed quantity of water overtime. Where possible, users should be allowed to bank water rights during surplus periods and use them during droughts. In cases where there is little or no recharge, then the user must be limited to the withdrawal of a fixed quantity.

It is important to establish water rights for both surface and groundwater. In many cases, surface and groundwater supplies are directly interconnected. In such cases, establishing only surface water rights may leave out much of the water supply. Furthermore, the surface water rights are not secure if anyone can install a well next to a canal or river and withdraw water that actually "belongs" to the owners of surface water rights. The lack of compatible surface and groundwater rights has caused serious water management problems in a number of areas including Arizona, and is likely to cause problems in other areas such as northern Chile and south Asia (Charney and

Woodard, 1990; Hearne, 1995). In addition, if groundwater rights are not clearly defined, the user will undervalue its future use by ignoring the user cost and buffer stock values.

Once the water rights are established, independent of land, they need to be recorded and enforced. This is generally an important role for government but strong water user associations can record and help enforce water rights. Having the rights recorded should improve water market efficiency by reducing uncertainty and making information about the supply of water rights more accessible to potential buyers.

Management of the system

For efficient water exchanges beyond one's neighbors, some management unit is required to change gates and assure the interested parties that the correct amount of water reaches the buyer. In some countries, this can be the organizations currently operating the water system such as a government water agency, a WUA, or some form of water utility (public or private). In other cases, managers who have been hired by the water users to manage the water system can implement the transfers. However, an active water market will require more effective management than most system operators have exercised in the past, particularly for government managed irrigation systems. Thus, at a minimum, the management staff may need training to improve their management skills and their responsiveness to user requests.

An effective management unit, such as the water users association in the Limarí Valley of Chile, can implement trades as well as provide information regarding who wants to buy or sell water. By improving the flow of information about water availability, demand, and water prices, the association improves the market efficiency. In the Limarí Valley, water users are well informed about the prices of water and how much is available for a given season. Thus, they have an active water market (Hearne and Easter, 1995).

Infrastructure investments

The other component necessary to actually implement a trade includes the canals, pipes and gates that allow operators to change the water flows. The more flexible the system, the easier it is to make the necessary changes and the lower will be the transaction costs for making a trade. In fact, if the infrastructure is inflexible and the transaction costs are too high (i.e., if new canals or gates are required) many trades will be blocked. These costs appear to be an important constraint for canals with fixed regulators. The cost of alternating the canals and regulators reduces the price of the water offered to the seller and raises the cost to the buyer (assuming the buyer pays for changing the structures as is the case in Chile). Thus, few trades have been consummated in areas of Chile with fixed canal regulators while frequent trading occurs where adjustable regulators exist (Hearne, 1995).

A water system that includes reservoir storage also appears to facilitate water trades, particularly if water rights can be translated into a volume of water in the reservoir. This, then, allows anyone in the system to buy from anyone else, assuming that the reservoir services the whole irrigated area. In a water system with storage and a large number of water users, there is the potential to have a very efficient market with numerous buyers and sellers.

Third party impacts and conflict resolution

Institutional arrangements are generally needed to protect third parties who may be damaged by trades. Because of return flows, withdrawals or sales upstream can reduce the quantity and quality of water availability downstream. Even changing the type of water use may change the return flow. To mitigate this problem, most water sales in the western U.S. are for the consumptive portion of the water right. In addition, water sales outside a water district or basin are highly regulated (Colby, *et al.*, 1993). Similarly, problems arise when groundwater use lowers the water

table and raises the cost of pumping to other users. Pumping licences, well spacing and the regulation of pumping rates have all been used to try to reduce or eliminate this externality.

An equally serious issue is the discharge of pollutants into water bodies that effects other users of the same water source. "In addition to pollution that is visible and degradable, new types of pollution have arisen involving small quantities of nondegradable synthetic chemicals that are invisible, toxic, persistent, and difficult and costly to treat" (World Bank, 1993, p. 32). These pollutants can have a negative impact on all downstream users. Since most water rights have been specified only in quantity terms, this means that governments must establish overall water quality regulations or impose emission charges on polluters. If this is not done, water markets will be constrained because of the uncertainty concerning water quality. Reductions in water quality can essentially make water unfit for certain water uses and decrease the value of water rights.

Another possible third party impact may arise from changes in economic activities and jobs. For areas that are buying the water, these economic impacts will be positive. However, when water is transferred to another region or river basin and agricultural land goes out of production or into dry farming, input suppliers, processors and farm workers are likely to see a drop in their business, income, and employment. These are primarily local impacts and from a national perspective, the gains in the area receiving the water are likely to be as large, or larger than the losses in the exporting area.

Formal mechanisms must be developed to bring these third party concerns into the decision-making process and to help resolve water right disputes. A commission could be established to act as a clearing house for water sales. They would receive complaints regarding proposed sales and have the authority to block or delay sales if large negative third party impacts are likely. In some countries, this could be done by a government water agency and the court system, while in others

with strong WUOs, the water users working through their WUO, may be able to resolve many of the disputes. In the western U.S., the court system along with water agencies or the State Engineer have been effective in resolving most disputes. Colby (1990) argues that policy induced transaction costs in the western U.S. play an important role of accounting for the social costs of water trades.

The positive role of water policy is illustrated in Figure 1, where policy induced transaction costs reduce the size of a water transfer and move the water allocation closer to the social optimum. Assume that Q_1 is the initial allocation of water to the urban sector, while the rest is used by agriculture. Once water becomes tradable, farmers begin to sell water to urban users. The farmers' supply curve, PSC, measures the benefits farmers forego when they sell water. In the new market allocation, without transaction costs, the urban demand D_1 equals PSC at Q_2. Under this market allocation, the urban sector obtains an additional $Q_2 - Q_1$ units of water. Yet this is not optimum for

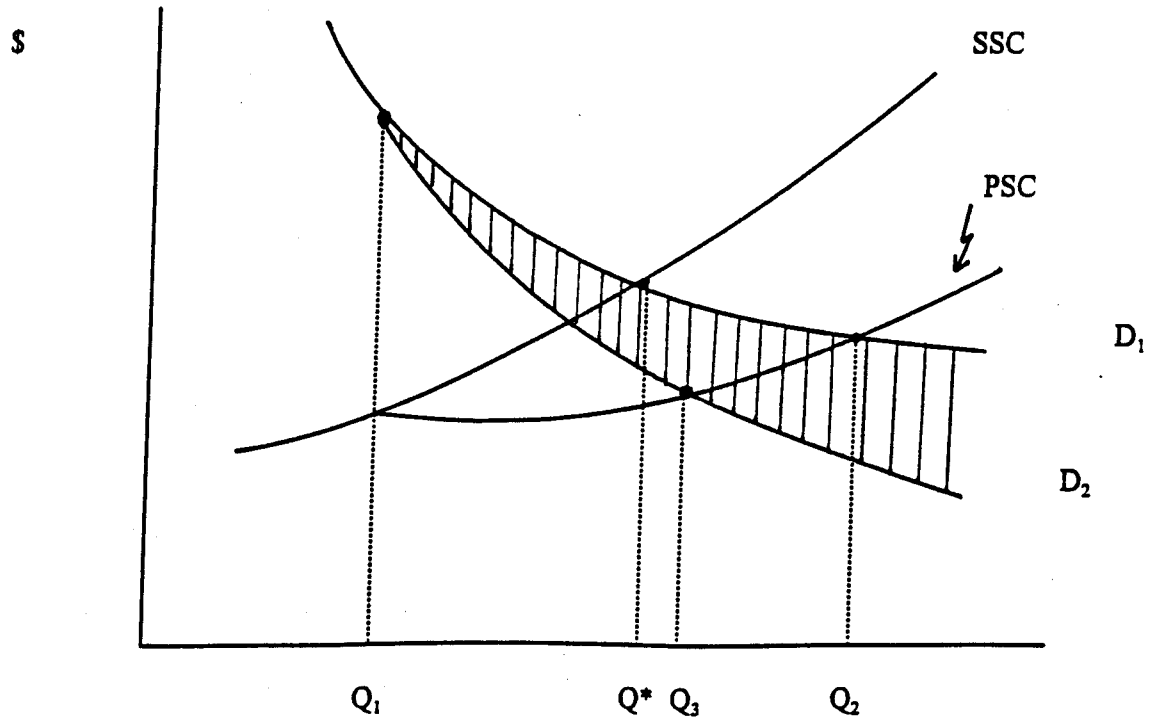

Figure 1 - Transaction Costs and the Market Allocation of Water Between Sectors
Source: Adopted from Colby, 1990.

"Transaction costs generated by state policies are a reasonable means to account for social costs of water transfers, given the immense centralized information requirements for an optimal tax on transfers. The present institutional structure gives affected parties, each weighing their own costs and benefits, an incentive to generate information on transfer impacts and to negotiate transfer conditions and mitigation of externalities. State water transfer criteria are not arbitrary hindrances imposed upon the marketplace. These policies protect existing investments by water rights holders and, as they are broadened to include other interests, they can reflect public good values affected by water use and transfer" (Colby, 1990, p.1191).

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society since third party impacts are not included. When the third party impacts are included, the supply curve becomes SSC. The difference between PSC and SSC measures the negative impact of the transfer on third parties. The social optimum allocation is, therefore, Q*, where SSC equals D_1 which is less than private optimum Q_2.

If the transaction costs of negotiating and implementing trades are included, the urban demand drops to D_2 which is the urban demand minus all transaction costs (this assumes the buyer pays the transaction costs). The private allocation, with transaction costs included, becomes Q_3 where PSC equals D_2. In this example, transaction costs move the private market solution closer to the social optimum Q*. It is also quite possible that transaction costs could by high enough to move the urban sector's share to less than the social optimum (to the left of Q*) and even close to the starting allocation Q_1. In such cases, government should take steps to reduce transaction costs and encourage more trades.

The distribution of water rights

The key equity issue involved with water markets is deciding on who gets the initial rights. From an economic efficiency standpoint, the distribution is not important as long as the rights are freely tradable and transaction costs are low. When trading is allowed, water will move to its highest valued uses unless transaction costs are high (Stavins, 1995). However, the distribution of the benefits from such trades and the initial use of the water will be directly dependent on who initially

receives the water rights which raises important equity questions. When the water has been used in the past, this past use will need to be given some weight in the allocation of water rights. If there is additional water available after water has been allocated to past users, it can be sold by auction.

If there is a plan to redistribute land resources within a country, then the water rights can be redistributed in a similar manner. Where the land resources on which most of the water is used are held by a few individuals and there is no plan for land redistribution, then the water rights should be sold at an auction. This will create an efficient allocation of the water and allow some of the economic rents created by public water projects to be recovered and used to pay for the projects. Yet attempts to reallocate water without compensation will likely elicit the same types of resistance that land reform efforts have provoked in the past.

Another alternative, which puts greater weight on equity considerations, would be to allocate the water rights to all families (landowners and landless) in the irrigated area, as was done in a small irrigation project in northern India (Joshi and Seckler, 1982). After the water rights were allocated, a water market was used to reallocate water rights since some water rights owners had surplus water. The end result was that even landless families received direct benefits from the sale of water rights or through the use of their rights on rented land. Thus, all families shared the economic rents created by the irrigation project and there were strong incentives to use the water efficiently. A complementary alternative would be to allocate some of rights to the WUA and use the revenue from the sale of these rights to help fund improvements in the irrigation system (Easter and Hearne, 1995).

Closely related to the issue of who gets the economic rents from the water rights is the allocation of water rights for "societal water uses" (uses with significant public goods characteristics). This involves instream water uses to preserve fisheries and aquatic ecosystems and to prevent salt water intrusion. For example, during low flow periods, California irrigation has dried

up several rivers with drastic impacts on fisheries and aquatic ecosystems. At the time water rights were allocated in these rivers, the state government failed to recognize that instream water flows provide numerous social benefits. They took the position, with the support of farmers and community leaders, that all water should be used and none should be allowed to flow into the ocean. The state is now faced with legal requirements under the "Public Trust Doctrine"[2] to set aside water for these instream uses. This means that California has to take back or reduce water rights that have already been allocated to and used by farmers. Other countries can learn from this experience and remember that it is important to consider instream uses when allocating water rights.

Government action and water rights

Establishing water markets necessitates taking concrete actions. Many governments fail to take the necessary steps either because they are loathe to give up their control over the water resource, particularly if it has been developed with public funds, or they are concerned about the potential for monopoly control over water and possible third party impacts. Countries seem to overcome these fears when either they are restructuring the role of government in the economy (Chile, Mexico, and Peru), or when water scarcity and water misallocation become too severe (California and Texas). Yet even after markets are introduced, these concerns still remain. For example, Chile and Mexico are granting water use rights for a set period of time. This allows the country to retain the actual water right and the rights to reallocate water during times of drought or major economic changes.

Establishing water rights and determining their distribution are likely to be the most important issues facing countries that want to introduce water markets. The distribution issue is

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[2]Public Trust Doctrine requires the government to hold certain water rights in public trust to protect instream uses.

particularly contentious when farmers are currently using water that has been provided by government at highly subsidized rates. Many will argue that it is not "fair" to let the subsidized users receive most of the economic gain from selling "society's" water. Yet this may the only way we can efficiently reallocate the water to higher valued uses. If users cannot benefit from the transfer, they will strongly resist any attempts to change the allocation rules. Thus, the question becomes, "what should water users give up, if anything, to be able to trade the water?" Should some of these rents accrue to government to help pay for projects? Yet, it will be difficult for most governments to capture much of the rents generated by the water sales, without eliminating the incentives for trading water.

As the recognized uses for water expand, it will become more difficult to agree on who is entitled to an initial water allocation. There will also be issues concerning how much flexibility a water rights owner should be given to move the water or change its use. Further, as rights are expanded to include the infrastructure such as dams and canals, who will own the excess capacity in these structures? Can markets for water options be used to help reduce the need for excess capacity in the system? Finally, the introduction of water markets can result in some lumpy changes, particularly if large amounts of water are traded between sectors or regions. Are there more effective ways to smooth out these changes and reduce the third party impacts?

Conclusions

As new sources of water supply become difficult to find and expensive to develop, economic mechanisms for managing water resources will come to the fore. Water markets can improve water allocation and give users a stronger incentive to conserve water. As the electric utilities in the U.S. have already learned, conservation can be a cheaper source of supply than building a new power plant. The same is true for water resources where many countries have already developed their low

cost sources of water supply and new sources of supply are much more expensive to develop (World Bank, 1993).

It is clear that water markets can allocate water more efficiently than top-down administrative allocations. Yet to establish efficient water markets requires a number of institutional and organizational investments, including a procedure for formalizing water rights and one for resolving water disputes. These investments will pay off in areas where water is scarce and the opportunities for water use have been changing. If water is not scarce, then the pay off from those institutional and organizational investments will be low.

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