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DO MISSING INSTITUTIONAL ARRANGEMENTS BLOCK ENLARGEMENT OF WATER MARKETS?

by
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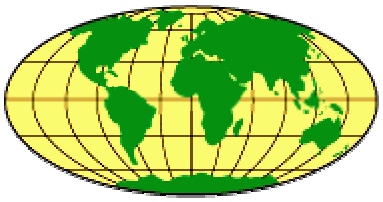

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K. William Easter* and Rodney Smith**

INTRODUCTION

As should be expected there has been a growth in water markets as water has become increasingly scarce in many parts of the world (Easter et al., 1998). Yet the increase has been confined to trading internal to the local water districts with a few exceptions, such as California's Water Bank during the 1990s droughts. Only limited trade has occurred among water districts or river basins. Several hypotheses have been suggested concerning why this has been the case. One is that the necessary infrastructure is not in place to move water between districts and watersheds and it is expensive to construct the canals. A second possibility is the strong belief, that water is a basic local resource and important for local development. A third reason may be the concern that water transfers to users outside of the local area (region) or to other types of use will cause adverse environmental impacts and hurt downstream water users. These concerns about third party impacts may act as catalysts to simulate development of institutional arrangements which effectively block trades to outside regions.

Constraints to market expansion can also be explained in terms of potential market failures that involve technological and pecuniary externalities as well as the public goods characteristics of infrastructure including irrigation canal maintenance and the provision of joint

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water-services (table 1). The pecuniary source of externalities involves the decrease in local business caused by a number of farmers decreasing irrigation and reducing agricultural production through land fallowing or even land retirement. These farmers can earn higher rates

Table 1. Types of Market Failure

A.	Pecuniary Externality	
	1.	Reduction in land cultivated that causes drop in local economy
B.	Technological Externality	
	1.	Higher pumping cost
	2.	Reduced return flows
	3.	Reduced stream flows and dried up wetlands
C.	Public Good Issues	
	1.	Drop in joint provision of water services
	2.	Higher farmer cost of maintaining infrastructure

of return by selling water to urban users or to irrigators outsides the local district. The resulting drop in production can cause a decrease in local demand for inputs and processing services, which reduces demand for local businesses (table 2). There may also be a decline in demand for labor by agriculture, local businesses and possibly the irrigation agency. Offsetting the drop in local sales could be the increased income farmers gain from the water sales. The increased income could expand local sales of goods and services especially new irrigation (water saving) technology. If this happens it is possible that the income effect will offset the negative impact on local service demands of the fallowed or retired land.

The technological externalities disturb a different set of stakeholders than do pecuniary externalities and will vary depending on the source of water being traded. For groundwater, the externality involves well interference and higher pumping costs due to declining watertables caused by increased pumping which is exacerbated by those expanding their water sales. This problem can exist with just local trading but expanding the market to include urban users and outside areas mean a greater water demand and increased pumping by water sellers who impose higher pumping costs on neighboring pumpers (table 3). If recharge is high, cost increases may

Table 2. Potential Market Failure: Pecuniary Externality

A.	Activity Causing Externality	
	1.	Land fallowing
B.	Negative Impacts	
	1.	Drop in local business
	2.	Drop in local employment
C.	Principal Stakeholders Damaged	
	1.	Local businesses
	2.	Irrigation agency

be small and only temporary, such as in Bangladesh, but in other cases the watertable will recover slowly, if at all, and the pumping cost will increase for all irrigators in the area overtime.

A different type of technical externality arises because of changes in return flows when water is traded between areas or uses. This is primarily a problem with surface water irrigation, but it can be a problem with groundwater. In many surface water irrigation systems as much as 50% or more of the water delivered to a farmer will become return flow and be used by farmers downstream--which is why many irrigation specialists have argued that one needs to look at basin water use efficiency and not worry as much about farm level water use efficiency. If all the water or a significant amount of the water in a district is traded to another district, or type of use, those farmers dependent on the return flow will receive little or no water (table 3). Offsetting this loss (externality), somewhat, is the fact that the water buyers may well provide return flows to a new set of downstream users so that the net loss to society as a whole may be quite small or nonexistent. Still it is the local users that are adversely affected by any one of these several externalities who will be catalysts for establishing institutions to block any water trades which may reduce return flows, raise pumping costs, or reduce local business activity.

The final class of technological externalities is one that results from environmental damages caused by changes in water use. We will characterize this as damage to in-stream water services such as wildlife and fish habitat (table 3). Here again water trading outside the local

area may only increase the damages that already exist due to local use of water for irrigation. However, the attempt to expand water markets can act as a catalyst to organize environmental groups to try to stop further water trading.

The public good characteristics of infrastructure and the joint provision of services are primarily of concern to individuals in the district who are using water services. The irrigators who do not want to sell water are concerned that they may have to pay a larger part of the canal

Table 3. Potential Market Failure: Technological Externality

A.	Event Causing Externality	
	1.	Drop in groundwater table
	2.	Reduced return flows
	3.	Reduced stream flows and loss of wetlands
B.	Negative Impacts	
	1.	Increase in pumping costs
	2.	Drop in downstream irrigation
	3.	Drop in environmental services and nonirrigation water services
C.	Principal Stakeholders Damaged	
	1.	Irrigators not selling water and rural domestic water users
	2.	Downstream irrigators not selling water
	3.	Nonirrigation water users and environmental groups

maintenance costs (table 4). If most of the farmers served by one canal sell their water, the few remaining farmers may have difficulty maintaining the canal and not receive adequate water flows due to overall reduced water deliveries.

The joint provision of water services is important for those families and individuals who make use of the water before it reaches the farmers fields. In developing countries this means a long list of uses including: bathing, livestock water, fishing, recreation, and local business and domestic water uses. Meinzen-Dick and Bakker (2000) point out how many of these different uses would be affected if water was transferred from irrigation to urban uses in the Kirindi Oya

Table 4. Potential Market Failure: Public Good Characteristics

A.	Type of Activity	
	1.	Joint provision of water services
	2.	Maintaining canal infrastructure
B.	Negative Impact	
	1.	Drop in services to nonirrigation water uses (fishing, livestock, bathing, etc.)
	2.	Increased costs to remaining irrigators
C.	Principal Stakeholders Damaged	
	1.	Nonirrigation water users
	2.	Irrigators not selling water

irrigation system in Sri Lanka (Figure 1). They go on to suggest that most of the nonirrigation water users have very weak or nonexistent water rights except for domestic water uses and possibly fishing. Even in developed countries, livestock water, recreation and fishing are likely to be important water uses but their water rights are likely to be uncertain.

These nonirrigation water users would be adversely affected primarily when a significant share of the water was sold to another district or for different type of use (table 4). Thus the impacts of water sales on these users of joint water-services and their concerns may be quite similar to those of farmers who receive return flows. When sales are large enough to have significant impacts on return flows, they are likely to have an impact on these nonirrigation water uses.

COMPETING STAKEHOLDERS

Given the different classes of externalities listed above, there are four to seven stakeholder groups that are likely to be important in future expansion of water markets (table 5).

Table 5. Primary Stakeholder Groups

1. Irrigators selling water
2. Users purchasing water
3. Irrigators not selling water
4. Environmental groups
5. Nonirrigation water users
6. Local businesses
7. Irrigation agency

Yet as already suggested, these different stakeholder groups are likely to have conflicting objectives. The first two groups include those irrigators who can profit from and want to sell water outside the district or basin and the users purchasing the water. A third group involves those irrigators who might be damaged by increased water sales either due to reduced return flows or higher pumping costs. Also we could include in this group those farmers who might have higher infrastructure (canal) maintenance costs if other farmers sell their water and do not continue to assist with canal maintenance.[1] The impact on canal maintenance is primarily the result of how many irrigation systems are organized with canal maintenance the responsibility of farmers using the canals. Part of the problem is that canal maintenance has strong, local, public good characteristics. For example, all farmers using a canal benefit from the maintenance efforts of farmers particularly those at the head of the canal.

A fourth group of stakeholders would be those who are concerned about the environmental damage caused by reduced stream flows, dropping groundwater tables or fallowed

[1] To deal with maintenance problems, some contracts for water sales require the water sellers to continue expenditures for canal maintenance even after they have sold their water and stopped irrigating.

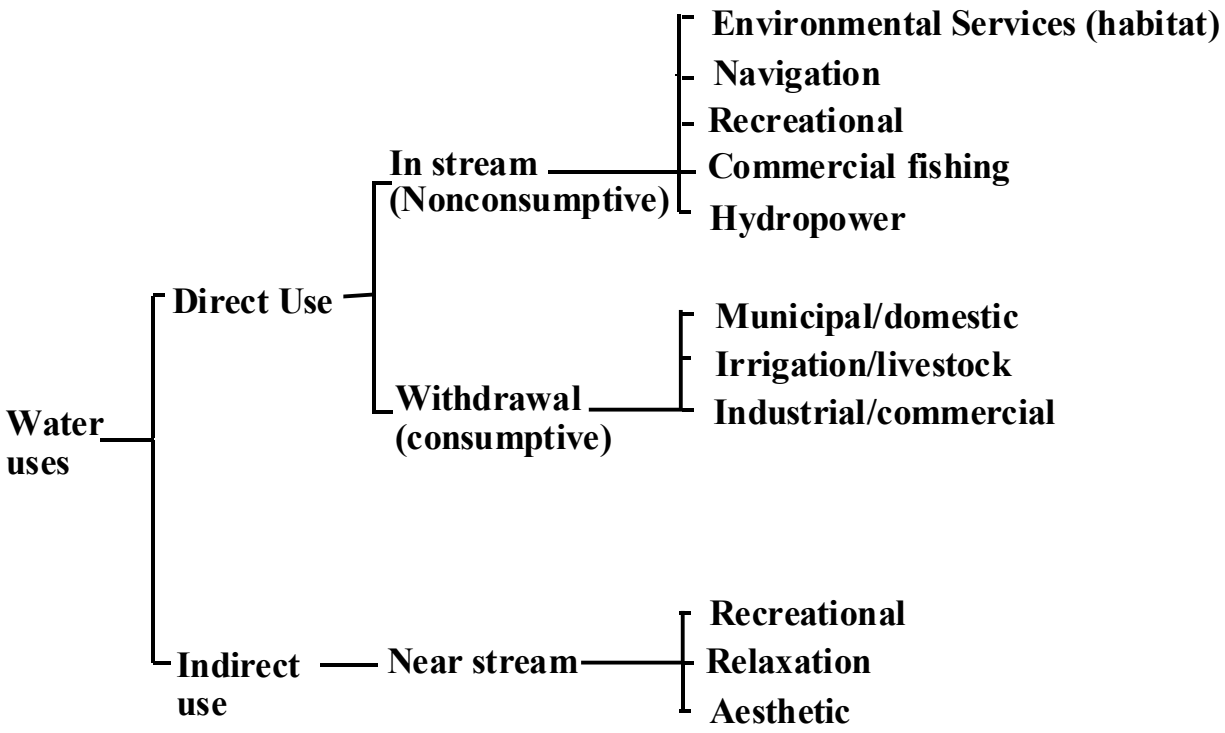

Figure 1. Direct and Indirect Water Uses

land.[2] Dropping groundwater tables can cause wetland and/or nearby streams to dry up or decline significantly. Reduced stream flows can mean loss of species dependent on cold running water while fallowed land may cause dust storms. Closely aligned with environmentalists is a fifth group, the nonirrigation users of the canal water (livestock water, recreation, etc.). The sixth group would be the local business interests that will oppose transfer to other areas but not necessarily to other users, particularly if the other users are local businesses.

In some government owned and/or managed irrigation systems there is a seventh stakeholder's group, the irrigation agency, which must be considered. The irrigation agency might feel threatened by water sales. If sales are large, this could mean loss of their jobs. The concern would be much greater if the change also involved privatization of a government irrigation system. In this case there would be a high probability of job losses and the agency staff would work against such a change.

Of these seven groups, the latter five may have quite similar objectives and may form coalitions to oppose water trades (table 6). At other times, they may not work together since some environmental groups oppose all water trades while other groups would be willing to allow trading under the right restrictions. In fact, some of the farmers, who at first may lose due to expanded water trading, may want the option to become sellers in the future. Most nonirrigation water users are likely to have weak or no water rights and will, generally, not benefit from trades outside the region. This means their interest may be more closely aligned with environmental groups. In contrast, local business interests and the irrigation agency may be willing to support

[2] If fallow land is not managed carefully, soil erosion and weeds can be a problem for neighboring farms. Also if large areas are fallowed, local dust storms can result. Again water sales contracts can include provisions that require farmers, who are selling their water, to control their weeds and take measures to prevent wind erosion. Such contracts will require increased monitoring and enforcement efforts by the community.

some water sales outside the region as long as it does not damage the farming base they serve.[3] In fact, local businesses might look favorably at water sales in which the profits are reinvested in new irrigation water-saving technology and farming practices, e.g., drip or sprinkler irrigation. This would be particularly true if much of the new equipment is purchased locally.

Table 6. Stakeholders Groups Likely to Form Coalitions to Support or Oppose Regional Water Trading

	Likely Coalitions[a]	
Competing Stakeholders	Support Trades	Oppose Trades
1. Irrigators selling water	x	
2. Users purchasing water	xx	
3. Environmental groups		xx
4. Local businesses		x
5. Irrigators not selling water		x
6. Nonirrigation water users		xx
7. Irrigation agency		x

[a]Those with a double x are likely to take a strong position for or against regional water trading.

INSTITUTIONAL ARRANGEMENTS

Several different types of institutional arrangements have been used to prevent water trading while others have been developed to promote trading by providing protection against some of the externalities created by trades. One of the institutions in place that restricts water trading in U.S. states, such as California, is the reasonable and beneficial use requirement. If water rights owners do not use their water beneficially and reasonably as specified in their water rights, they can lose their water rights. The courts may interpret the sale of water as not making reasonable and beneficial use of the water. This can mean the loss of water rights by those who

[3] However, some have argued that, in a number of areas, because of the inelastic demand for water in the urban sector, it may only be the first water sellers who benefit from higher prices. After the urban market is satisfied, water prices will drop and so may agricultural land prices that are based on the initial high water prices (Haddad, 2000).

buy or sell water rights. The uncertainty created by such laws has been enough to help prevent potential sales of permanent water rights in states such as California (Archibald and Renwick, 1998).

A second group of institutions that have restricted water trading are laws that tie water rights to land ownership. In such cases, the buyer must purchase the land to get the water rights. This is typical for groundwater as well as some surface waters rights. Keeping water rights tied to land is based on the "old" riparian water law and the belief that water is a local resource and should be saved for local use, primarily for agriculture production.

A third type of institutional restriction, that has been used more recently, is to introduce laws or change laws to make the water seller liable for any damages caused because of water sales. Since ex ante it is difficult to determine what (or if) water sales damage any third parties or the environment, many potential sellers are afraid to sell water because of the potential liability (Archibald and Renwick, 1998).

These types of restrictions tend to be supported by the stakeholders groups who are likely to work to block water market expansion. The important question is what institutional arrangements might be developed to deal with the concerns of these groups so that water trading can be expanded? If one looks at the conditions for effective water markets, two institutional arrangements appear to be critical, particularly for those farmers not selling water, local businesses, and nonirrigation water users (Easter and Archibald, 2001). They are: (1) mechanisms that provide "reasonable" protection, against damages caused by water sales, for those (third parties) not directly involved in water sales, and (2) mechanisms for resolving conflicts over water rights and changes in water use. The first of these mechanisms is particularly important for environmental groups, nonirrigation water users and local businesses, while the second is critical for water rights holders and not as important for the other groups.

These two arrangements can be informal and handled by water users organizations if water trades are local and transparent. A formal but nonlegalistic approach might also work such as a state commission that would have to review and decide on any sales that were contested as

in New Mexico, for example. More elaborate and formal mechanisms may be necessary, such as Colorado's water courts, when water trading expands. To protect those farmers receiving return flows and nonirrigation water uses, some surface-water irrigated areas restrict sales to only the consumptive use part of the water right. One typical solution has been to restrict sales to only 50% of the water right (table 7). The problem with such rules is that 50% represents an average for existing technology. If there are different irrigation technologies used in an area, there may be large differences in return flows among farmers. Imposing the 50% rule on all farmers would be considered unfair by those farmers using water saving technology such as sprinklers or drip irrigation. Consequently, a more flexible institutional arrangement (restriction on sales) may be necessary to facilitate trades among uses and regions.

Table 7. Primary Stakeholder Group Benefiting from New Institutional Arrangement

Competing Stakeholders Adversely Affected	Institutional Arrangements					
	A[a] Consumptive	B Permits	C Limits	D Compensation	E Districts	F Flow
Environmental groups			x	x	x	x
Local businesses			x		x	
Irrigators not selling water	x	x	x	x	x	
Nonirrigation water users	x	x	x	x	x	x
Irrigation agency			x			

[a]Institutional arrangements for placating different stakeholder groups.
A = Limit water sales to consumptive use
B = Well permits
C = Limits on local water sales (10%)
D = Fund to compensate for third-party losses
E = Ground district with volumetric water rights
F = Limits on stream flow reductions

Many states in the U.S., irrigating with groundwater, require permits before a well can be installed. As part of the application for a well permit, the firm or person requesting a permit may also have to show that their pumping will not interfere with any other wells already in the area. There also may be a waiting period during which time anyone can contest a permit request. If done correctly, the use of permits can effectively deal with the well-interference problem but it will not solve the larger problem of dropping groundwater tables and higher pumping costs over time when pumping exceeds recharge rates. This is, partly, because of our limited knowledge concerning the recharge of many of our aquifers and the difficulty of quantifying volumetric groundwater rights. In a few of the areas where overpumping and declining groundwater tables are causing serious problems, such as salt water intrusion or land compaction, pumping districts have been established that actually limit pumping rates and invest in groundwater recharge. This essentially involves establishing water rights in volumetric terms at the district level. Both establishing districts and requiring permits are promising ways to limit the adverse effects of water trades on other farmers and domestic water users in a pumping area. However, not many effective pumping districts have ever been established while permits cannot deal with pumping that already significantly exceeds recharge rates.[4]

Another difficult question is how to address local business and environmental concerns? Howitt and Vaux (1995) have suggested that because of the impacts of water trades on local business, California may want to limit water sold from each county. This would prevent sales from being concentrated in just a few counties. The State of California took the suggestion somewhat further and banned all water sales based on land fallowing which appeared to satisfy many of the local business concerns.

[4] Currently much of California's groundwater is allocated based on correlative rights. Landowners overlying a common aquifer can use the water and are entitled to a reasonable share of the water during times of shortage. If one wants to export this groundwater, these sales are likely to be restricted to surpluses. Only under special conditions (no objections from other users) can one get a prescriptive right to this exported groundwater. Therefore, because of high transaction costs, export sales can occur only when a few users are involved (Kanazawa, 1999).

The issue of potential environmental impacts is more difficult to deal with because of the lack of information particularly about the likely future impacts of changes in water use on the environment. One suggestion made in California was to establish a fund from taxes on interbasin water sales to compensate for third-party losses (Howitt, 1998). Such a fund would be used to mitigate environmental damages and compensate stakeholders damaged by water trading.

The next step is to determine if these or other institutional arrangements, when effectively administered, would allow water markets to expand and develop in countries facing increased water scarcity. What has been the experience within areas identified as having water market activity? Equally important is the need to better understand the likely impact different proposed water institutions might have on the different stakeholder groups.

COUNTRY EXPERIENCE

Some of the countries and states that have been cited as examples of active water markets include California and Colorado in the United States, Chile, and India. As mentioned earlier, only the California Water Bank has moved large quantities of water over long distances and among different uses (Easter and Archibald, 2001). In Chile water markets have been restricted to select areas in the north and within small river basins (Bauer, 1998). Here trading has been mostly among irrigators with only limited trades between irrigators and the urban sector and these have not involved fallowing significant amounts of land. For India trades have been primarily with groundwater and mostly among farmers in the same village. The main concerns in India have been declining watertables, in some areas, and in others, monopoly pricing. Northern Colorado has an active market but most of the trading is in the same water district or basin.

Only in the case of water sales from the Colorado/Big Thompson project do you see an active water market between different types of users and across districts in Colorado. Other than this source of water, most water is being traded within water companies or districts. In fact, it has been difficult for cities to buy water from these districts or companies. For example, Thorton

(near Denver) tried to transfer water rights, that it had "secretly" purchased from a water supply and storage company, but faced strong resistance and litigation. "This litigation lasted for many years and resulted in the city eventually receiving the right to transfer about 50 percent of the historic water supply that it had purchased" (Simpson and Ringskog, 1997, p. 23). The city was also required to prevent wind erosion and noxious weed growth if it transfers the water.

The reason why the Colorado/Big Thompson project water is traded quite freely has to do with the water rights. These rights do not allow for any compensation for injuries to third-party water users. In other words, return-flow users cannot obtain any water rights for the return flows. Chile's water law also does not appear to allow for return-flow water rights. Owners of water-use rights in Chile can sell all their water right and not just the consumptive part. However, "water rights owners affected by someone else's change or transfer of use can protest either to the canal association involved or to the civil courts" (Bauer, 1998, p. 63). The potential for a protest creates enough uncertainty so that most Chilean irrigators have not wanted to test the law by selling outside their association. Thus in Chile, water markets have not developed across river basins because of the high transaction costs due to infrastructure constraints, multiple water uses, and uncertainty regarding water rights as well as other institutional limitations (Bauer, 1998). So far Chile has not established effective mechanisms to resolve problems associated with competing multiple water uses and third party damages caused by water trading, particularly those involving environmental damages and nonconsumptive uses. For example, nonconsumptive (hydropower) uses have proven to be more competitive with consumptive uses than originally expected because timing of nonconsumptive use (hydropower) and their location on the river have made them competitive with irrigation (figure 1). When the water law was written, little or no competition was expected between consumptive and nonconsumptive uses.

Concerns about external impacts appear to have limited interregional trades in California. Haddad (2000) finds that "great public energy over the past two decades has gone into creating water markets, but few results have been realized in terms of long-term interregional rural-to-

urban transfers" (p. 134). He goes on to say that "market-based rural-to-urban reallocation of water is likely to be a slow, limited process for many years to come" (p. 149). Yet his conclusion would likely change with institutional innovation.

Kanazawa (1999) thinks that California may be ready for some significant changes in water rights, which will make water trading outside water districts much easier. He argues that changes in water law go through three stages and that California is entering the third stage. In the first stage when water is in surplus, there are few restrictions on water trading. However, in stage two when shortages are experienced, water trading outside the district or basin is restricted. Finally, in stage three when shortages really hurt urban areas, the restrictions on trading are modified and markets can move water across regions and uses.

Kanazawa's three stages are not too different from the three stages discussed by Saleth and Dinar (2002): 1) mind changes, 2) political articulation, and 3) operationalization. Clearly, developing and establishing new institutional arrangements is a key part of the operationalization of water markets and would occur in Kanazawa's third stage.

EVALUATION OF ALTERNATIVE INSTITUTIONAL ARRANGEMENTS

The above country experience suggests that changes in institutional arrangements are not only possible but necessary if water markets are to be an important tool for transferring water among different types of users and regions. Two of the more difficult problems involve concerns about the impacts of water trading (1) on local businesses and (2) on the environmental quality. Of these two concerns the one that appears to be growing worldwide is the concern about environmental impacts, although local business and employment impacts may be just as big a concern in many countries. Can we develop institutional arrangements that allow water to be traded across regions and uses while still protecting key environmental services and not overly harm local business? How can local interests and other concerned citizens be given assurance that water trading will not deprive them of environmental services or that local businesses and workers will be left high and dry?

For a new institutional arrangement to be effective it would need to meet four criteria. First, it should allow some expanded water trading among different uses and/or between regions. Second, net social benefits from the expanded water trading should be positive. Third, the major stakeholder groups should feel that the new institutional arrangement is "fair." Finally, the same stakeholder groups should have assurances that local water managers and/or government officials will effectively implement the new institutional arrangement.

The first two criteria are very straightforward. If they cannot be achieved, then there is no reason for the new institutional arrangement. The third and fourth criteria are about whether or not the new arrangement will be effective. With a strong central government some of the stakeholder groups may be ignored but in most democracies this is difficult and usually counterproductive. Thus the stakeholder groups need to feel that the trades will be "fair." In this case "fairness" would be based on the idea that the expanded trading involves no envy by any group of stakeholders (Baumol, 1982). In an irrigation system this would mean that the farmers irrigating with return flows would not envy those who had used the water up stream. "Fairness" is similar to Rawls' principles of compatible liberty and justice, which preclude "an individual or group from enjoying undue influence over water receipts, system maintenance or system enforcement" (Bromley et al., 1980, p. 377).

The need for assurance regarding implementation and enforcement of the institutional arrangement is just as important as fairness. If one stakeholder group thinks that another group will take advantage of their political and/or economic power and distort implementation of the new arrangement, then they will work to block its enactment. A water system with a good record of effectively reallocating water during drought periods combined with a government regulatory agency that has been effective in protecting third party interest (local business and environmental interests) would provide such assurance.

To determine if a new institutional arrangement meets the above criteria, we first need to think of the optimum use of irrigation water that can be achieved through trading given alternative third party (environmental or business) safeguards. One possible safeguard might be

to allow water trading as long as in-stream water flows are not drawn below a certain level. Once water flows drop below this level, water transfers would be reduced until the level of water flows is restored. The cutback of transfers could be based on the time of the water sales much like "seniority" in appropriative water rights. The last transfer or sale would be cut back first. Another option would be to have proportionate cuts in all out-of-region sales. A safeguard like the above would also address many of the concerns of nonirrigation water users and appears to meet their "fairness" criteria. Withdrawal limits based on stream flow levels and other possible safeguards still need to be evaluated to determine how much is given up in the purchasing region from loss in water sales due to the safeguards, compared to the gains in the environmental services and/or returns to local businesses. (Net social benefits are positive.) For example, in evaluating the flow limit, it might involve the comparison between the income foregone in the purchasing region and the gain from fish catch and/or local service industry profits in the region limiting sales.

For local business and many of the farmers using return flows, absolute limits on water transfers may be the critical issue and pass their "fairness" test. Both of these groups are more concerned about the current irrigators continuing to farm at about the same level. They are less concerned about in-stream flows and more concerned that irrigation does not drop by more than 5 or 10%. A good example of this was found in the 2001 Klamath River conflict between irrigators and environmentalists. Farmers had their water turned off by the federal government to maintain stream flow and protect two endangered fish species as required by the U.S. Endangered Species Act. In this case almost all the local people were against cutting off irrigation water to protect the fish and supported the farmers' efforts to legally and illegally open up canal headgates. It illustrates how environmental stakeholders are not likely to obtain much support from local businesses and farm groups unless they are protecting environmental services that local people also value highly and the action will not seriously damage the local economy.

In a few cases these types of water allocation trade-offs can be found within the same groups of stakeholders. For example, in some projects the irrigators may also do the fishing.

Such a case was found in the Kirindi Oya project in Sri Lanka where the fisher persons also own agricultural land (Meinzen-Dick and Bakker, 2000). In other projects there may be farmers using both hydropower and irrigation water. Furthermore, there will be systems where some of the irrigators also own local businesses.

For these types of stakeholder groups the decisions concerning the value of water in different uses involves a trade-off within their own optimization framework. Their question is whether they want more hydropower and less irrigation water, or more irrigation water and less hydropower. In the case of the Kirindi Oya project during drought periods, farmer/fisher persons appeared to favor irrigation over fishing in the water allocation decisions (Meinzen-Dick and Bakker, 2000). For a more affluent population the decision might be different. The interesting point is that in such trade-offs one does not get the fishing or environmental benefits for nothing. The farmer/fisher persons must give up crop output to obtain more fishing. The benefits and costs do not fall on different stakeholders. Unfortunately this is usually not the case when you are selling water between regions. Someone is benefiting from the water purchase in one region while others may lose as well as benefit (seller) in the region from which the water is sold.

Thus there is a clear need for institutional safeguards to assure potential losers that the negative impact on them will be small or that they will be compensated for their losses. Unfortunately, there are currently few institutional arrangements that provided means for the traders to compensate potential losers or assure third parties that they will not be big losers.

If Kanazawa (1999) is right, regions facing increasing water scarcity, such as the western U.S. and North Africa, may be moving into stage three where the trading of water rights is less restricted. If this is the case, what safeguards should be recommended so the damage to third parties is limited and trading will be facilitated? One basic safeguard follows from the Owens Valley purchase that southern California made which could have dried up the valley as well as the Thorton Colorado purchase discussed earlier. This rule would read something like: make the transaction transparent and, at least, partially compensate third parties that are damaged by the water sales. Such a rule would, most likely, put a constraint on how much water was taken out

of an area. If too many people might be damaged by the sales, then the transaction costs of the trade would be too high since the cost borne by third parties gets translated into higher transaction costs. To hold down transaction costs there would also need to be some political mechanism to facilitate the process of determining who needs to be compensated and by how much. Such mechanisms would complement the compensation rule and, ideally, keep water trading out of the courts.

Other safeguards for the environment may be needed to facilitate regional water trading particularly in developed countries. As suggested earlier, this might mean simple stream flow requirements in any water right that was traded to users outside the region. Where reservoirs water supplies are available, the safeguard could involve rules for water releases that favor the environment as opposed to irrigation or hydropower production.

CONCLUSION

It will take innovations in institutional arrangements to help move water markets to the next level. At this level water markets will become a more effective tool for moving water between regions and/or among different types of use (irrigation to urban use). The California Water Bank is only one model, and not necessarily the best model since no market clearing mechanisms were allowed to work, and the bank was designed only for temporary water transfers.

The next step in this work will be to develop a more formal model to help ascertain the likely impact and effectiveness of different institutional arrangements. For instance, would the trading of water rights conditional on water flow levels in a river be an effective arrangement? Clearly, institutional arrangements need to be developed that consider water users, both consumptive and nonconsumptive, and other stakeholders who may face changes in their water supply or business activity because of water trades. Thus, another part of our future research agenda is to develop alternative institutional arrangements that will reduce the uncertainty that different stakeholders may perceive with water trading. If stakeholders can be given assurance

of compensation for losses caused by water trading, or shown that no losses will occur, then they are not as likely oppose water trading just because they "think" they may be damaged.

The latter appears to have happened in Westlands Water District in central California. Irrigators first tended to oppose interdistrict water transfers but as their local market expanded and they better understood the potential benefits from water trading, their resistance turned to support (Easter and Archibald, 2001). Hopeful future analysis will help provide a much clearer picture of what real gains and losses can be expected from expanded water trading under alternative institutional arrangements and thus facilitate future trading.

REFERENCES

Archibald, Sandra O. and M. E. Renwick. "Expected Transaction Costs and Incentives for Water Market Development." *Markets for Water: Potential and Performance,* K. William Easter, M.W. Rosegrant and Ariel Dinar, eds. Boston, MA: Kluwer Academic Publishers, 1998, pp. 95-117.

Bauer, Carl J. *Against the Current: Privatization, Water Markets and the State in Chile*. Norwell, MA: Kluwer Academic Publishers, 1998.

Baumol, W. J. "Applied Fairness Theory and National Policy." *American Economic Review* 72 (4) (1982):639-51.

Bromley, D. W., D. C. Taylor and D. E. Parker. "Water Reform and Economic Development: Institutional Aspects of Water Management in the Developing Countries." *Economic Cultural Change* 28(2):1980)365-87.

Easter, K. William, M. W. Rosegrant and Ariel Dinar, eds. *Markets for Water: Potential and Performance*. Boston, MA: Kluwer Academic Publishers, 1998.

Easter, K. William and Sandra O. Archibald. "What Is delaying Privatization and Water Markets in the U.S. West." Presented at the 7th Conference of the International Water and Resources Economics consortium and 4th Seminar on Environmental and Resource Economics, Angels Llinus University de Girona, Spain, June 3-5, 2001.

Easter, K. William and Sandra O. Archibald. "Water Markets: The Global Perspective." *Water Resources Impacts* 4(1) (January 2002):23-25.

Haddad, Brent M. *Rivers of Gold, Designing Markets to Allocate Water in California*. Washington, D.C.: Island Press, 2000.

Howitt, Richard E. "Spot Prices, Option Prices and Water Markets: An Analysis of Emerging Markets in California." *Markets for Water: Potential and Performance*, K. William Easter, R. W. Rosegrant, and Ariel Dinar, eds. Boston, MA: Kluwer Academic Publishers, 1998.

Howitt, Richard E. and Henry Vaux. "Competing Demands for California Scarce Water." Ch. 22, *Water Quantity/Quality Management and Conflict Resolution: Institutions, Processes and Economic Analysis*, Ariel Dinar and Edna T. Loehman, eds. CT: Glenwood Press, pp. 271-88.

Kanazawa, Mark. "*Institutions and Institutional Change: The Evolution of Groundwater Law in Early California*." Northfield, MN: Carlton College, Sept. 1999.

Meinzen-Dick, Ruth and Margaretha Bakker. "Water Rights and Multiple Water Uses: Framework and Application to Kirindi Oya Irrigation System, Sri Lanka." EPTD discussion paper #59, Washington, D.C.: International Food Policy Research Institute, March 2000.

Saleth, R. Maria and Arial Dinar. *Water Institutions and Sector Performance: A Quantitative Analysis with Cross-Country Data*. Draft book, Washington, D.C.: World Bank and Delhi, India: Institute of Economic Growth, 2002.

Simpson, Larry and Klas Ringskog. *Water Markets in the Americas*. Washington, D.C.: Directions in Development, The World Bank, 1997.