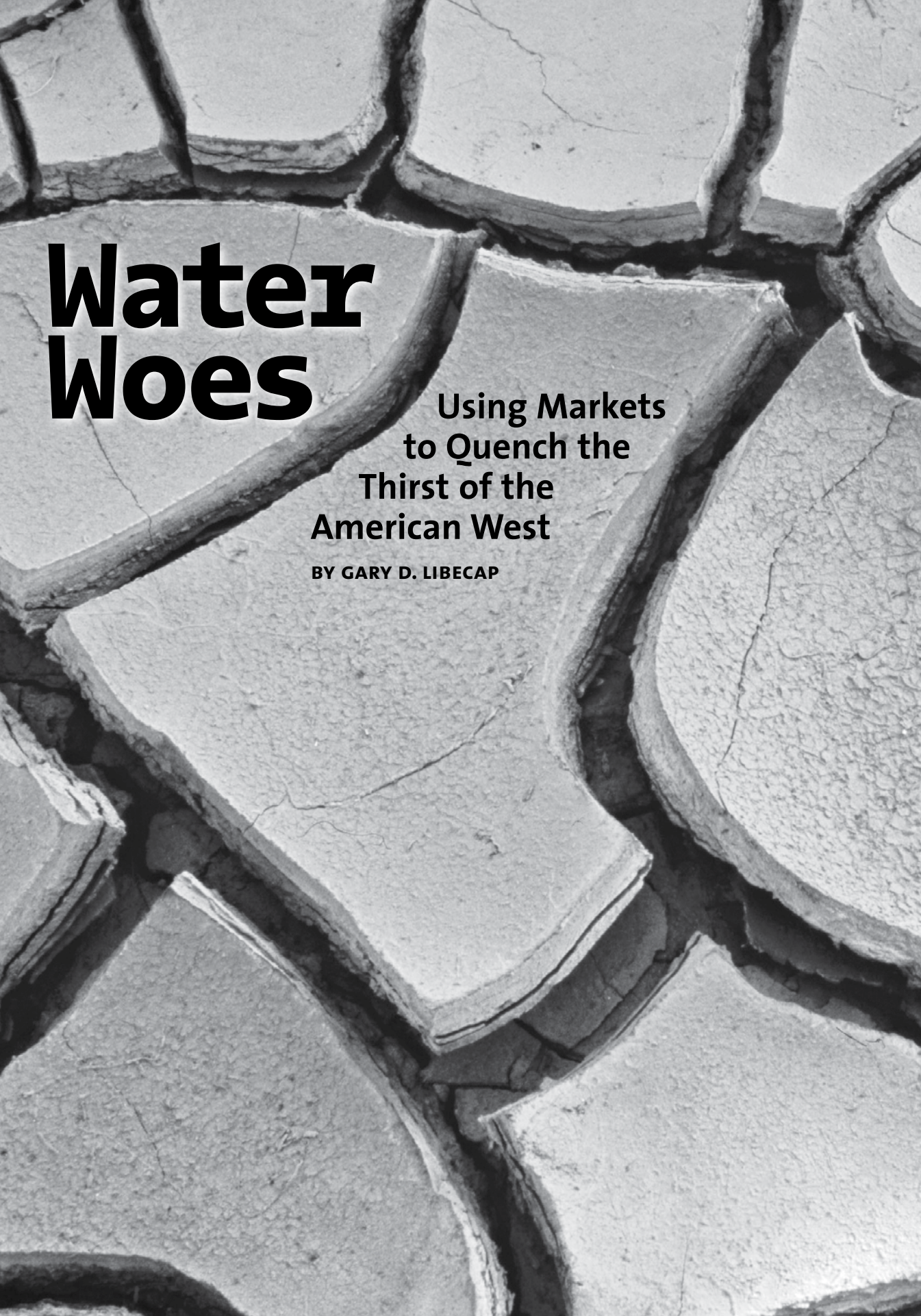

Water Woes

Using Markets to Quench the Thirst of the American West

BY GARY D. LIBECAP

It goes without saying that modern civilization turns on the availability of clean, fresh water at reasonable cost. So it is not surprising that in the semi-arid American West, complex institutions evolved to determine who got access. And while these rights were often vaguely defined, until the 1990s there was enough water available through government infrastructure that had been bought and paid for decades earlier to satisfy burgeoning demand.

Those halcyon days are over. Rapid population growth and expanded economic activity have pushed existing capacity to the limit. Meanwhile, the region's notorious drought cycles, which many believe will be exacerbated by climate change, have made supply more problematic. Now add to that picture two other concerns – evidence that more water is needed to protect the environment and a scarcity of capital for expanded storage and transport capacity – and it has become clear to almost all the stakeholders that muddling through has become a very high-risk option.

In an economic culture that generally bows to the goddess of property rights, one might have expected that excess claims on existing water would have forced a clarification of rights to that water, followed by the use of market pricing both to encourage conservation and to reallocate water to those who value it most. Indeed, just this sort of institutional evolution took place in the West with hard-rock minerals, oil and gas, timber and land. And there is every reason to believe that markets would narrow price differences between uses and among localities, freeing water for higher-value uses. Yet that process is only beginning, and it is by no means certain that the market

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will come to the rescue. Here, I explore why water is such a tough case and what might be done to speed the process.

THE WATER-RIGHTS MAZE

For a whole host of reasons – everything from the fact that it is both a private and public good, to the reality that it can be consumed by multiple parties simultaneously – water fits uneasily in textbook models of market allocation. Indeed, the interconnected, overlapping nature of water demands and uses explains in part why various stakeholders have resisted letting markets work their magic. I ask your forbearance in sitting still for a brief (as possible) enumeration of the arcana that stand between business-as-usual and rational allocation that would effectively solve the region's water problems for decades to come.

Appropriative Surface-Water Rights

In Western states, rights to flowing water (i.e., surface water) are largely based on the prior-appropriation doctrine, which allows rightsholders to withdraw specific amounts from a natural water course to use where they choose to – in some cases, places far from the source. The prior-appropriation doctrine emerged in the 19th century in response to the opening of rich opportunities in mining and agriculture far from rivers and streams, and the need to support the people arriving to exploit those opportunities. The appropriative system opened the door to using infrastructure – everything from ditches to massive dams to aqueducts – to create great wealth.

By law, earlier claimants to appropriative rights have priority over later ones. Rights are retained in perpetuity unless claimants fail to put the water to "beneficial" use. And in what amounts to a use-it-or-lose-it mandate, rights revert to the state and can be claimed by others after a specified period of nonuse. Appropriative rights can be traded and, during droughts, senior rightsholders can (and often do) lease water to junior parties. Because lower-priority claims carry greater risk that water won't be available when it is needed most, they are, of course, of less value.

Appropriative rights are measured in terms of quantities diverted from the source. And in many Western watersheds, water has been overallocated because diversions have not been carefully measured and because rights were granted in times of unusually large stream flows. Overallocation can be addressed through mediation or court action. But, not surprisingly, the process can be contentious.

Typically, much of the water used by a senior rightsholder seeps back to the stream or percolates down to an aquifer, creating access for junior rightsholders. Thus, market transfers that change the point of diversion, the timing of diversion or the way the water is used – and thereby threaten access for other rightsholders – are regulated to minimize the effects on third parties.

Riparian Surface-Water Rights

In the Eastern states, by contrast, water rights are attached to the land through which the water naturally runs, and cannot be separated from it. "Riparian" landowners have rights to this water for reasonable use, including fishing and navigation, and can utilize it as long as doing so does not harm riparian claimants downstream. In cases of drought, all parties share in the reduced flow.

Only a handful of the wettest states in the West recognize riparian rights. But when

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prior-appropriation and riparian systems do function in the same place, there can be questions of the priority of claims if diversion under the appropriative system reduces access for riparian owners.

Groundwater Rights

Groundwater rights vary across the West and are generally not as well defined as surface rights are. They are also assigned via prior appropriation, granting landowners access to "reasonable use." With multiple landowners sitting on top of the same pool, many groundwater basins are subject to competitive withdrawal and classic tragedy-of-the-commons conditions in which users bear only a fraction of the full cost of their pumping decisions in terms of land subsidence, saltwater intrusion, quality degradation and higher lifting costs – and thereby have inadequate incentive to conserve.

Some states (notably Arizona) that depend heavily on groundwater have enacted legislation to define groundwater rights more clearly and to manage its sources better. Others, notably California, are far behind. Indeed, even though about 30 percent of California's water comes from wells, of the 431 groundwater basins in the state, only 22 have had their water rights clearly defined.

Rights definition is a costly process, and it should be no surprise that most of the places where the legal and technical issues have been thrashed out are in the arid southern part of

the state. But as groundwater becomes more important throughout the West, it is likely that linkages between surface and groundwater will be defined more precisely.

Beneficial Use, Diversion Requirements, Preferential Uses

Appropriative rights are legally conditioned on placing the water into beneficial use without undue waste. Most Western states define beneficial uses fairly clearly as agriculture, industry, municipal supply, power generation and navigation. But the definition is flexible. For example, leaving water in streams for habitat preservation has recently been accepted as a beneficial use – though the rules vary from state to state. Typically, one can see a symbiosis at work here: private owners shift water rights into instream rights that are nonappropriative in order to protect their own rights from loss due to nonuse.

Historically, the requirement to use or lose water motivated farmers to irrigate low-value water-intensive crops, like alfalfa for cattle feed. Indeed, the failure to dump water on growing plants of one sort or another could be interpreted as evidence of a lack of beneficial use, opening it to claims by others.

No Injury Rules

If a senior rightsholder sells water or increases consumption, the amount available for subsequent users may drop. The prospect of such third-party impairments has led Western states to create procedures that must be followed before water use can be altered or rights transferred. Although these procedures vary, they typically allow changes in use or transfers only if there is no harm to other rightsholders – i.e., those states effectively created a no-injury rule.

Before water can be sold or leased, the owner must get permission from the relevant state agency, with the burden of proof of no injury usually resting on the applicant. Objections from users down the line may be resolved by adjustments in the amount of water, timing or allowable uses in the exchange – or

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with cash. But the resolution of other third-party complaints may not be so straightforward. If, for example, substantial amounts of land are taken out of agriculture when water is diverted, all the stakeholders in local farm economies may be affected. And here, figuring out who owes what to whom is no easy matter. Moreover, the uncertainty created by such claims undermines the potential for using markets to allocate water to its highest-valued use.

One way to finesse these claims is to shift the burden of proof of harm to those who protest water transfers. But that does not address fairness concerns in rural communities where equity issues loom large in local politics. Nor does it offer a way to win over other stakeholders – everybody from farm-equipment dealers to tax collectors – whose interests are indirectly linked to agricultural output. Luckily, though, only modest amounts of water (the proverbial low-hanging fruit) need be traded to generate major gains in efficiency.

Regulation overseeing trading varies. California has an especially tortuous system, with the state's Water Resources Control Board and Department of Water Resources, as well as the Federal Bureau of Reclamation, getting in on the act. The control board has legal authority to veto transfers that would "unreasonably affect the overall economy of the area from which the water is being transferred."

Further, 22 of California's 58 counties have asserted rights to restrict the extraction and export of groundwater. These county ordinances also can limit surface-water transactions if they appear to diminish groundwater resources. Indeed, there is little doubt that the whole point of the ordinances is to preserve the status quo, to prevent reallocation to urban or environmental uses.

Ironically, California (unlike many other states) already has an elaborate physical infrastructure in place for transferring water from wetter places (in the north) to drier, more populous areas. However, the north-south flow goes through the Sacramento-San Joaquin Delta, home to the endangered delta

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smelt and other species protected by federal law. And the courts have not looked kindly on trades through the delta.

Public Resource, Public Interest, Public Trust

Some people argue that water is too important to be left to markets – that it should be owned and allocated by public agencies. But the record of government involvement is problematic at best. In the case of ocean fisheries, for example, public ownership and management has generally led to overuse, while privatization through the creation of tradable catch permits has resulted in both lower fishing costs and significant rebounds of stocks.

A less extreme means of second-guessing private allocation is to require that water be used in the "public interest." But that notion is vague. And the broader the interpretation, the more difficult it is to use market incentives to encourage conservation or to channel the resource to higher-valued uses.

It is true that some societal values are not reflected in market prices freely determined by private contract. But these values can be incorporated by allowing markets to price water and then acquiring the water needed for public purposes with government funds or charitable contributions. This approach has been used in purchases and leases of water for instream flows by organizations that

include the Oregon Water Trust, the Montana Water Trust and Trout Unlimited. Such transactions make the real value of water more transparent, creating incentives for more efficient use.

Consider, too, the related doctrine of "public trust," which is a common law principle giving the public a claim on certain lands and waters, like tidewaters, navigable rivers and other natural resources with high amenity or public-goods values. It was applied in a far-reaching ruling by the California Supreme Court in 1983 involving Los Angeles' claims to the water in streams leading to Mono Lake. And it may be applied retroactively to roll back existing appropriative rights that are deemed inconsistent with the public trust.

There need be no compensation under the public-trust doctrine. Accordingly, compromise is difficult. In the Mono Lake case, the litigants battled for 20 years before Los Angeles was forced to relinquish its rights to bring water down the Los Angeles Aqueduct. A negotiated purchase of the rights, perhaps under the threat of condemnation, would likely have been timelier and much less costly.

THE DECISION MAKERS

As noted above, numerous third parties can play key decision-making roles, adding perplexing complexity to this stew of interest groups.

State Regulators and Water-Supply Organizations

Some 1,100 water-supply organizations, ranging from irrigation districts to municipal water districts to private water companies, may have leverage over trading decisions, and their incentives to facilitate market transfers vary widely. For example, the governing boards of irrigation districts may effectively be controlled by farmers who could make a lot of money selling water, or the boards may be elected by the whole community, which has nothing to gain and much to lose from sales that take land out of farming.

The experiences of the Palo Verde and Imperial Irrigation Districts in California illustrate the differences. The Palo Verde district's board is elected by property owners. It reached agreement quickly and smoothly in 2004 to let between 7 and 29 percent of its members' land lie fallow on a rotating basis in return for cash from the Metropolitan Water District, the huge agency that delivers most of the water to Southern California.

By contrast, the board of the Imperial Irrigation District, which has a claim to about two-thirds of all the Colorado River water diverted to California, is elected by all registered voters. Beginning in the 1990s, there were efforts to transfer some of that water to San Diego and other cities. A tentative agreement was reached in 2002, but it collapsed when local officials protested the likely losses in jobs and taxes. The deal was only resurrected after the U.S. Department of the Interior (which administers Colorado River water) intervened – and only after more money was included for community compensation.

The Bureau of Reclamation

The Federal Bureau of Reclamation is the largest wholesaler of water in the country, capturing water in some 600 dams and reservoirs, and selling it to 140,000 farms covering millions of acres in 17 states – often at far below market value. And its policies with regard to transfer, official and unofficial, have varied greatly with time and place. One consequence: it reduces farmers' incentives to resell water because they fear they may lose access to federal largesse.

This maze of institutional barriers suggests that selling water is hardly like selling

WATER TRANSFER PRICES BY SECTOR, 1987–2008
(2008 DOLLARS PER ACRE-FOOT)

	AGRICULTURE-TO-URBAN LEASES	AGRICULTURE-TO-AGRICULTURE LEASES	AGRICULTURE-TO-URBAN SALES	AGRICULTURE-TO-AGRICULTURE SALES
Median Price	$74	$19	$295	$144
Average Price	$190	$56	$437	$246
Number of Trades	204	207	1,140	215

SOURCE: author's calculations

other real property. And the resulting inefficiency is reflected in the low level of transactions and seemingly permanent price differentials between localities and among uses.

Water Price Differentials, 1987-2008

Few Western states keep systematic records of water transactions. My own analysis is based on 4,220 transactions from a 22-year period from 1987 through 2008, as compiled at the Bren School at the University of California, Santa Barbara from reports in the trade journal *Water Strategist*.

The table above shows average and median prices per acre-foot (the amount of water it takes to cover one acre a foot deep, or approximately 325,000 gallons) for the 12 Western states. The prices for sales and multiyear leases are given as the value per acre-foot of the committed flow of water. Where multiyear contracts are involved, the quantities are discounted in a process analogous to determining the present value of a bond. Because most water has been consumed in agriculture (at prices set by historical cost) but most new demand is for urban and environmental uses, the trades reported are mostly for transfers out of agriculture.

The findings confirm the obvious: agriculture-to-urban prices are far above those for agriculture-to-agriculture trades. A bit of the difference may be associated with the higher costs of moving water to cities, but not much: the market for water is grossly inefficient, implying there is much opportunity to increase the value of water through trading. Because sales (as opposed to leases) create a perpetual (and therefore more valuable) claim on water flows, sales prices are naturally higher.

Prices also differ sharply by state, with averages for one-year leases ranging from $8 per acre-foot in Idaho to $87 in Arizona and averages for sales ranging from $113 acre-foot in Idaho to $6,592 (!!!) in Colorado. These price gaps underscore the inefficient segmentation of water markets.

In theory, one could get a clear sense of the potential gains from unimpaired water trading from these price differences. Unfortunately, water markets are too thin to make this easy. But one example is illustrative. Groundwater for farming cotton near Marana, Ariz., costs approximately $27 per acre-foot. The same water supplied to Tucson, which is about 25 miles away, will cost urban customers $479 to $3,267 per acre-foot.

WestWater Research, a water broker, offers more illustrations. Nevada's Truckee River Basin has been one of the most active markets in the Western United States, thanks largely to urban growth in the Reno-Sparks area. Between 2002 and 2008, there were 1,025 water sales to urban users, with a median price of $17,685 per acre-foot, as compared to only 13 sales to agricultural users, with a median price of $1,500.

By contrast, the market built around the Colorado-Big Thompson project in northern Colorado yielded much narrower differences. And no wonder. Within this large water-supply project, each user has an identically defined claim to water units that are tradable, and there are no return-flow considerations that could lead to third-party impairments. Water trades occur smoothly and frequently.

For example, in October 2008, an agriculture-to-agriculture trade took place at $9,152 an acre-foot, just $53 less than an agriculture-to-urban trade that same month. Unfortunately, the Colorado-Big Thompson market is a very unusual one. But it provides a template for what might be possible elsewhere.

Welfare Gains from Greater Trading

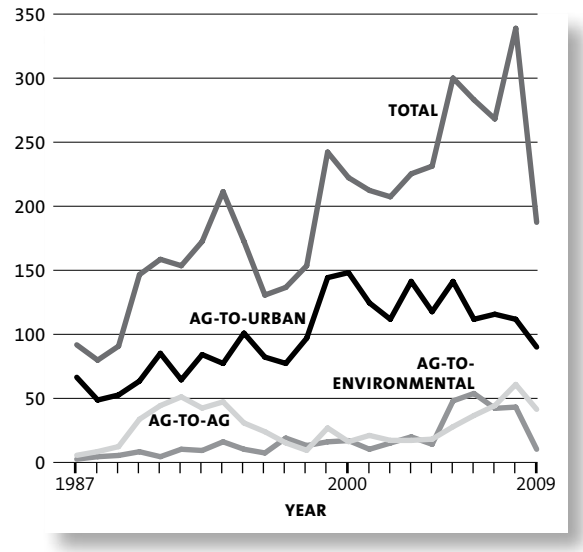
Differences in water values across sectors indicate that moving water from agriculture to urban and industrial uses can yield enormous returns. As I have noted, the calculation of the benefit is complicated. Nevertheless, we can use price data for different types of trades and United States Geological Survey estimates of the amount of water applied in irrigation to perform a simple exercise that illustrates the potential for trading. Transferring a relatively small amount of Western water – 3 percent of water currently used for surface irrigation – from agriculture to urban use would generate $98 million per year in net benefits.

Patterns of Water Trading, 1987-2008

All Western states allow for transfers of water under terms ranging from short (one-year) leases to long (35-year) ones. Some are simple transfers between agricultural users in the same locality. Some involve transfers among uses from a common source, while others involve long-distance exchanges. As the figure at right shows, volumes in agricultural-to-urban and agricultural-to-environmental transfers are increasing, while ag-to-ag trades suggest no discernable trend.

But the pattern varies greatly by state. Colorado dominates in terms of total market transactions, reflecting the institutional advantages of the Northern Colorado Conservancy District and the Colorado-Big Thompson Project, where the costs of trading are low

NUMBER OF TRANSFERS IN 12 WESTERN STATES



SOURCE: author's calculations

and most involve sales of relatively small amounts of water. Other active-market states are California, Texas, Arizona and Nevada. California's institutional and regulatory environments explain the focus on short-term leases. In Arizona and Nevada – both rapidly urbanizing, dry states – sales are common, But – not surprisingly – Montana and Wyoming, the least urban of the 12 Western states, have the fewest water sales.

There are also important differences in the parties involved in the transactions. In Colorado, Nevada and Washington, agriculture-to-urban trades account for most of the water, reflecting rapid urbanization. In California, single-year leases within agriculture dominate, with a few large multiyear leases from ag-to-urban use in Southern California.

Most transfers are within states, limiting the potential gains associated with transfer to higher-value uses. Even so, the numbers are fairly impressive, offering a hint of the opportunities for addressing growing problems of regional scarcity.

WATER WOES

Farmers are often eager to engage in water trades; the financial benefits can be quite a lure. For example, consider a sale of 1,200 acre-feet of groundwater in California from agriculture-to-urban use. At a sale price of $275 an acre-foot, plus a processing fee of $20,000, the total revenue to the farmer was $350,000. In spite of pumping costs of $50 to $75 per acre-foot, consulting fees of $25,000 to gather needed hydrological information for regulatory review and $70,000 in legal fees for the regulatory process, the net income was still $165,000. A bonanza, compared to, say, the economics of growing alfalfa to feed animals. The big question, then, is how to remove unreasonable hurdles from the process.

THE WAY FORWARD

To create reasonably efficient markets with low transactions costs, a variety of changes are needed:

Surface-water rights must be better defined and quantified, and recorded in state registries. Groundwater rights must be similarly defined, with withdrawals monitored by local water masters. Meanwhile, the links between ground- and surface water need to be recognized in defining rights.

Private water rights need to be endorsed as a basis for use and exchange by state legislatures. And the ownership of water within supply organizations like irrigation districts needs to be clarified, with decision-making assigned to owners – not boards controlled by ancillary groups.

Private water banks need to be encouraged. These would involve virtual deposits of excess water, whereby owners could offer specific amounts for sale or lease at specified prices. These banks would standardize terms of transfer, like other commodity exchanges do. Such banks have been used in the past, but the prices have been heavily regulated and the administrative fees imposed have exceeded real costs.

The no-injury harm rule for assessing water trades should be defined precisely and the range of objectors limited to those with a direct stake in the process. "The public interest" should be defined clearly and narrowly to reduce uncertainty. Similarly, area-of-origin restrictions on trading should be limited to actual hydrological effects of trading – and not used to mitigate pecuniary effects of transfers.

The public-trust doctrine should be invoked only as a last resort. Instead, water should be purchased for environmental use by state agencies or nonprofit groups, and the possibility of condemnation of water for public uses employed as a lever in bargaining. This threat would work much the way it works in land condemnation to overcome the holdout problem in public infrastructure investments.

Retail urban water pricing needs to be reformed to promote efficiency. Some cities, including Sacramento, do not meter water use at all; others charge flat unit prices that don't reflect the high cost of adding new supplies. Consider two Arizona desert cities. Tucson's water rates rise steeply with consumption, and in 2007, annual use per capita was 140,800 gallons. By contrast, Phoenix has flat rates, and consumption was 75 percent greater.

* * *

The West's water policy is a minefield in which policymakers and politicians are inclined to step gingerly – or not at all. But with urban and environmental demand for water growing at a prodigious rate and supply growth constrained by a host of factors, the path of least resistance is no longer an option. The region's fabled quality of life turns on easy access to water, and only well-functioning markets can offer the prospect of delivering that water at reasonable cost.