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# Water Markets

## Implications for Rural Areas of the West

*Market transfers of water from irrigated agriculture are viewed as one of the most likely ways to accommodate new demands for water supplies. Market transfers generally improve statewide economic efficiency by shifting water to higher valued uses. However, case studies find the impact of these transfers on agriculturally dependent rural communities to be significant because the costs accrue to the area of origin and the benefits to the area of new water use.*

Water is one of the West's most important and limiting resources. Historically, areas with limited water supplies built dams and other supply-enhancing infrastructure, often with willing Federal assistance. However, the strategy of expanding available water supplies is increasingly less tenable since it is unlikely that society (from local communities to Federal agencies) will incur the increasing monetary and environmental costs of major new storage and conveyance facilities. Thus, current unmet demands and future needs for water will need to be accommodated within the existing supply system. Some demand may be met with unclaimed water reserves, but most will require transfers from existing uses. Since agriculture is the dominant water user, water transfers have important implications for irrigated production and agriculture-based rural communities.

Much attention has focused on development of a compensated transfer system for water or water rights termed a "water market." This transfer process involves a market transaction in which water use or ownership rights are exchanged for money. Water market exchanges are increasingly being used to adjust water allocations in the West. While some transfers involve water moving to agriculture, most involve a substantial and growing net outflow of water from agriculture. The few studies that examine the rural community impacts of water market transfers show that income lost to rural farming communities can be as much as 20 percent at the completion of the water transfer. The negative impacts are local since water transfers almost always increase economic activity in the area receiving water. This article focuses on current market activities and the potential impacts of water markets on rural communities in the West.

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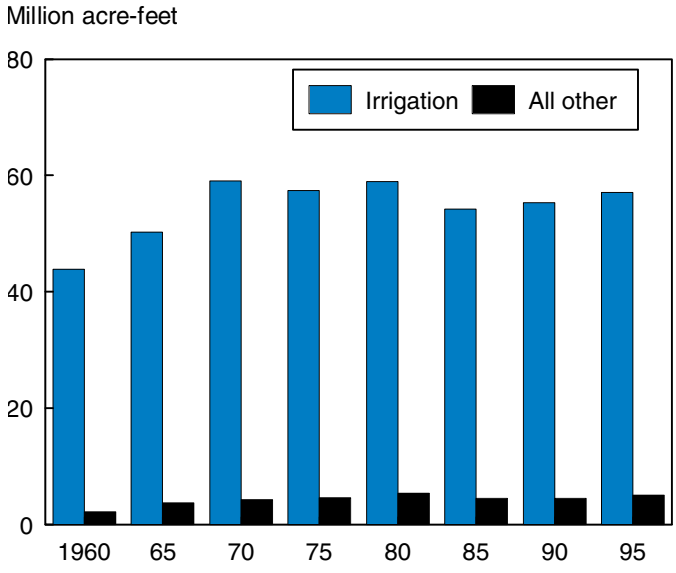
### Recent Water Transfers Usually Involve a Temporary Shift from Agriculture

Irrigation is the major use of most of the current water supplies in the 11 Western States (Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Utah, Colorado, Arizona, and New Mexico). Agricultural irrigation accounted for 92 percent of total consumptive water use in these States in 1995 (fig. 1), down from 95 percent in 1960. The simple fact that agriculture is the dominant out-of-stream water user means that most transfers will involve water used for irrigated production.

Additionally, water transfers will involve agriculture because irrigation is a "lower valued" water user in many locations. While irrigation may be used to produce the most profitable crops for the area, the last units of water applied will rarely return more than $30 per acre-foot, and in most cases, much less. Industrial, commercial, domestic, and environmental restoration applications can, in most cases, pay much more.

Urban and industrial users may also seek transfers from agriculture due to the relatively stable allocation of many irrigation water supplies. In almost all cases, water users do not own the water they use. (States generally maintain ownership of their waters.) What irrigators own is the right to withdraw a specified water quantity, at a specific location, for a specified use. This water right is conditional upon withdrawals not infringing on the water rights of

Figure 1
**Consumptive water use in the West**
*Irrigation dominates all other water uses in the West*




Source: Calculated by ERS based on U.S. Geological Survey, Water Use Program data.

a senior right holder. This system of rights based on "first in time, first in right" is termed the prior appropriation doctrine. Under this system, the most senior right has the greatest assurance of receiving water in dry years and is the most valuable to seekers of stable water supplies. Irrigated agriculture holds many of the senior water rights in the West, making transfers from agriculture to other users more attractive to those seeking stable supplies.

There are two broad types of water market transfers. A water sale involves a temporary transfer of water, with the water seller continuing to hold the water right. This type of transfer takes many forms, including single-year rentals, multiyear leases, transfers contingent on water levels, and transfers involving water banks or marketing pools. A permanent transfer of annual water supplies occurs with the ownership change of the water right, whereby an irrigator gives up all future access to the water. (In some cases, water rights purchased by urban areas are leased back to the selling irrigators until the water conveyance infrastructure is built, which can take many years.)

In 1996 and 1997, 282 water-market transactions were recorded in Western States (Smith and Vaughan). The water volume associated with the market transfers over 2 years totaled 2.7 million acre-feet—virtually all from agriculture—almost 2.5 percent of the annual irrigation consumptive use shown in figure 1. Of the 282 transactions, permanent transfers accounted for 78 percent of reported transactions but only 7 percent of the total water quantity; the temporary transfers (22 percent of the contracts) accounted for 93 percent of the water movement.

Colorado had the most market activity with 194 transfers, most (189) being relatively small (average of 135 acre-feet) permanent water sales from agriculture to urban areas. California moved the greatest amount of water with 33 transfers, most being relatively large (average of 57,000 acre-feet) temporary water sales from agriculture to environmental purposes. Average water prices depend on the type of transfer. Permanent transfer prices averaged $1,360 per acre-foot, ranging from $77 (ID) to $4,950 (NV) per acre-foot. Temporary transfer prices averaged $233 per acre-foot, from $3 (MT) to $979 (UT) per acre-foot (table 1).

Since water rights usually represent a use right and not an absolute ownership right, most water transfers are generally subject to State approval. Most States have a water management authority to solicit and evaluate comments from other water-right holders on the proposed transfer, and will allow the transfer only if the impact on other water-right holders, both junior and senior, is insignificant. The major protection offered to downstream water right holders involves limiting the quantity of water transferred to the amount actually consumed (lost to system), not the amount diverted. Water diversion quantities contain return flow—water lost to individual irrigators but retained in the regional hydrologic system. Return flow water is available to downstream diverters and may be important to many uses (instream flow, wetlands, hydropower, aquifer recharge) as it moves through the basin. If the amount transferred was based on the entire diversion—including runoff to water channels and seepage to aquifers—downstream water-right holders would contest that too much water was removed from the hydrologic system. For example, if the water right specifies a withdrawal of 3 acre-feet per acre, only the portion of the withdrawal that is actually consumed can be transferred, say 2 acre-feet per acre. The portion of the right that is actually consumed, and spatial and temporal adjustments in return flows, are often contentious issues that result in appeals of State rulings through the court system.

Most water transfers involve surface-water resources (fig. 2), although transfers of both groundwater and groundwater rights do occur. Surface water is easily conveyed through existing natural channels and existing infrastructure, as long as the destination is downstream. Surface waters are renewable, which is consistent with the long planning horizons of urban areas.

### Water Allocations Affect More Than Just Buyers and Sellers

Several parties are affected by water transfers. The most obvious are the buyer and seller of water or water rights. These parties have direct control over the outcome of the transaction and would presumably not enter into a transfer if it were not mutually beneficial.

Table 1

**Water market activity in Western States, 1996 and 1997**

*While most contracts were for permanent sales, most water moved on annual contracts*

| State | Total contracts | Water-right sales (permanent) | | | Water sales (temporary) | | |
|---|---|---|---|---|---|---|---|
| | | Contracts | Water quantity | Average price | Contracts | Water quantity | Average price |
| | Number | Number | Acre-feet | Dollars per acre-foot | Number | Acre-feet | Dollars per acre-foot |
| Arizona | 10 | 6 | 23,212 | 2,753[1] | 4 | 83,821 | 463 |
| California | 33 | 3 | 38,260 | 1,947 | 30 | 1,715,532 | 319[1] |
| Colorado | 194 | 189 | 25,517 | 4,395 | 5 | 93,360 | 20 |
| Idaho | 7 | 2 | 41,500 | 77 | 5 | 504,100 | 20 |
| Montana | 2 | 0 | 0 | 0 | 2 | 25,392 | 3 |
| Nevada | 2 | 2 | 1,928 | 4,950 | 0 | 0 | 0 |
| New Mexico | 7 | 6 | 1,621 | 3,462 | 1 | 44,760 | 50 |
| Oregon | 13 | 4 | 18,018 | 130 | 9 | 24,350 | 42[1] |
| Utah | 8 | 6 | 3,409 | 1,270[1] | 2 | 20,791 | 979 |
| Washington | 3 | 1 | 40,320 | 32 | 2 | 202 | 11[1] |
| Wyoming | 3 | 1 | 253 | 0 | 2 | 1,484 | 45[1] |
| Total | 282 | 220 | 194,037 | 1,360 | 62 | 2,513,792 | 233 |
| | | | | Percent | | | |
| Percent of total | 100 | 78.0 | 7.2 | NA | 22.0 | 92.8 | NA |

NA = Not applicable

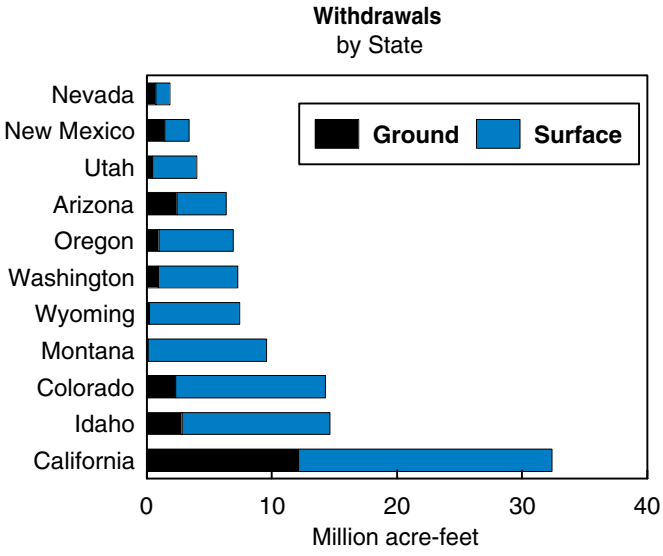
[1]Values based on a reduced number of observations due to missing data.

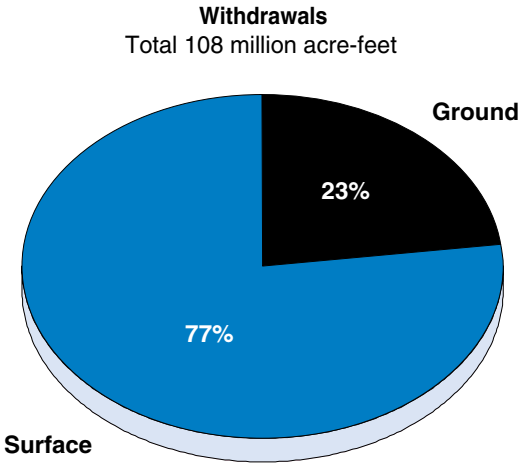
Source: USDA, ERS based on *Water Strategist* data.

Figure 2

**Sources of irrigation water in the West, by State, 1995**

*California withdrawals are more than those of Idaho and Colorado combined*




Source: Calculated by ERS from U.S. Geological Survey, Water Use Program data.

Other (nontransferring) water-right holders may also be affected. Most States allow other water-right holders to protest the transfer because their rights are protected from adverse impacts. The State authority may cancel or modify protested transfers. In some cases, the water buyer may pay compensation to prevent a protest from being filed.

Other parties that may be affected by water transfers include many elements of a rural community—agricultural supply and processing industries and local businesses, nonagricultural local businesses and communities, environmental protection groups, local government officials, and taxpayers. Most States do not have a formal process to consider the impacts (both benefits and costs) imposed on this broader segment of society within the transfer review process.

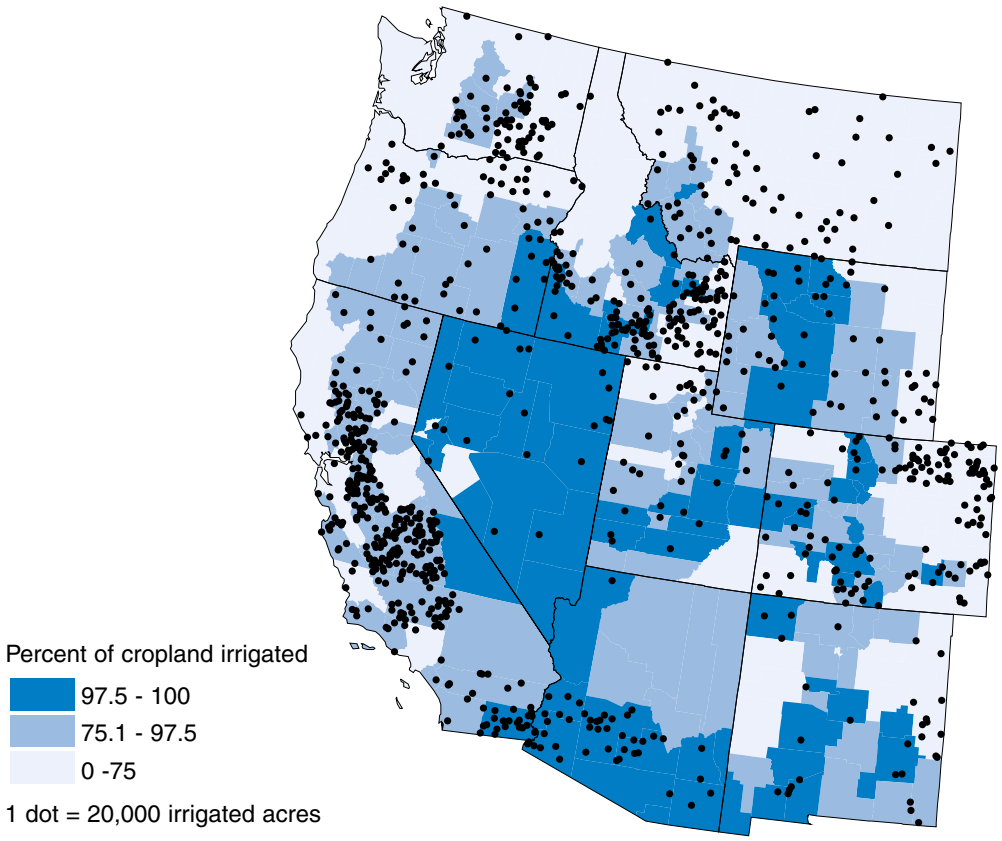
Clearly, transfers of water from irrigated agriculture have impacts beyond the farmgate in rural communities. For 1992, the average sales per irrigated acre was estimated at $740 per cropped acre in the 11 Western States. For nonirrigated cropped agriculture in the same region, estimates averaged only about 25 percent of the irrigated value, as irrigated yields are higher and most high-valued crops grown in the West require irrigation. The increased crop sales associated with irrigation translate into increased input use and output processing requirements that benefit the broader agricultural service economy and rural economies in general. Figure 3 shows the location of irrigated land and the dependence on irrigation by counties in the West. Some areas are wholly dependent on irrigation, while other areas' irrigation water only supplements natural precipitation. In general, the share of cropland irrigated shows the suitability of land to remain in cultivation if water is not available for irrigated agriculture. Areas with few nonirrigated crop options provide even less in terms of sales to support rural communities.

Water transfers may also benefit irrigated agriculture and the rural communities that depend on high-valued irrigated production. In many cases, surface-water rights are held by the irrigation district providing the water. Water may be freely exchanged among farmers in that district as long as the diversion point or total use do not change. There is virtually no published record of these transfers, but they may occur often in some agricultural districts. Agriculture is also a major water purchaser from other irrigators in the water market. Water transfers for 1996 and 1997 indicate that about 19 percent of the purchases were for irrigation purposes, 72 percent for urban uses, 10

Figure 3

**Location of Western irrigated croplands and their dependence on irrigation, 1992**

*The West's harvested cropland depends heavily on irrigation*




Source: USDA, ERS, based on USDC 1992 Census of Agriculture data.

percent for environmental purposes, and 3 percent for other purposes. (Sum totals to more than 100 percent due to multi-use transfers.)

### Water Transfers Show Losses in Rural Communities

While water transfers within agriculture are important, the net outflow of water from irrigated agriculture to other uses is substantial and increasing. The cumulative impact on agriculture and rural communities of water transfers to meet urban and environmental uses is an important policy question. Several studies have addressed elements of this question, but only a few studies comprehensively estimate the impacts of water transfers on agriculture and rural communities considering the direct (agricultural), indirect (related agricultural service industries), and induced impacts (broader economic activity associated with the direct and indirect impacts, including income and consumption effects). Studies that have examined the issue indicate that overall economic efficiency is improved at the State level. The benefits of providing relatively low-cost water to major population centers far exceed the monetary cost to agriculture and the rural areas. However, the benefits and costs usually fall on different populations, and environmental impacts are typically not documented. For example, the compensated sellers of the water often cease irrigation and the input- and output-related industries that serviced those formerly irrigated acres may lose that income.

Case studies are the usual approach used to examine the impacts of water transfers on rural areas, due to the difficulty of isolating hydrologic and economic consequences of transfers across a broad region. The complexity of water use and hydrologic links makes it difficult to measure impacts of water transfers on instream flow, habitat, aquifer recharge, and downstream supplies. And, if the hydrologic impact is predicted accurately, the amount of time required to negotiate and execute a water transfer makes it difficult to attribute changes in economic activity to the water transfer. Water transfers generally occur with multi-year advance notice, which may signal a several-year decline in the economic activity in the rural communities servicing that region. Many rural communities have been in economic decline for some time, and attributing the reduced economic activity to the water transfer may be difficult. Finally, transfers may limit economic development since new agriculturally related businesses may locate in areas where there is less uncertainty about water supplies for irrigation. In a few regions, the timing and measurement problems have been overcome to provide case studies of water transfers on rural communities.

**Arizona.** One well-documented case study examined by Charney and Woodward involves large transfers of water from Arizona "water farms." Arizona passed a comprehensive Groundwater Management Act in 1980 that required municipal areas in "groundwater management areas" to have a 100-year assured water supply in order for new development to occur. While not all urban areas are included, greater Phoenix and Tucson are in designated groundwater management areas. The act set off a round of water acquisitions in Arizona. While conditions that prompted the series of Arizona transfers are unique, impacts are instructive.

In Arizona, because of the regional nature of groundwater management areas and lack of available surface-water supplies, groundwater supplies located some distance from urban areas became the preferred source of water to meet the 100-year supply requirement. Urban areas sought large quantities of high-quality water located close to the main Central Arizona Project (CAP) canal. The CAP canal provides a reliable means of transporting water through existing facilities, lowering the final cost relative to water supplies that were closer but required new infrastructure. Urban areas concentrated purchases of irrigated land for the associated water rights—hence, the "water farms" term—in rural areas along the CAP canal in La Paz County. These purchases of land and associated water did not follow an orderly, staged retirement of the least productive land first, with the better quality land continuing in production. Most of the water purchased was groundwater, and since most groundwater pumped in Arizona is recharged very slowly, the incentive of the purchasing urban areas was to conserve water by immediately ceasing irrigation. In this case, the usual long timeframe of water transfers was compressed. The impacts were also spatially concentrated, since purchases were dictated by proximity to the water conveyance infrastructure.

The water farm purchases in the late 1980's totaled about 450,000 acres, including over 48,000 acres of irrigated farmland (most land was nonirrigated, grazing land). The analysis assumed that about 40,000 acres of irrigated land would soon be idled by the water purchases. (The remaining 8,000 acres continue to operate with surface water until needed by the urban areas.) One key assumption of the analysis was that all crops were retired in proportion (higher valued crops were not transferred to the remaining acreage). This assumption is important because (1) about half the land produced higher valued crops, and (2) impacts are greater with declines in high-valued crops relative to forage-type crops. The analysis estimated a decline in employment by 17 jobs and personal income by $363,000 for each 1,000 acres of farmland retired. This translates into a total employment loss of 340 jobs, about 14 percent of La Paz County's 1987 employment. The personal income loss was about 10 percent of the county's income. But even these significant numbers understate the impact, because the loss is concentrated on one side of the 4,400-square-mile county. In addition, the county government lost an estimated 5 percent of its tax revenue base as a result of the water transfer.

Beyond the revenue, income, and jobs lost from the water transfers, a greater loss may be the loss of the region's character, as well as future development options for La Paz County. The study cites a survey wherein almost all of the La Paz County residents interviewed agreed with the statement, "The losses to the community associated with the transfer of water are of such a nature that they cannot be compensated."

**Colorado.** Colorado has a well-developed, if relatively expensive, water-transfer system. Transaction costs of water transfers in Colorado are significantly more than in other States because no State authority reviews proposed transfers; all transfers go through the court system. Colorado's front-range urban areas have grown significantly and have actively pursued water for continued growth despite the transaction costs. One of the renewable water sources tapped by urban areas is irrigated agriculture in the Arkansas River Valley. A case study by Howe and others examined the impacts of water transfers in a seven-county area of the Arkansas River Valley in southeastern Colorado. This area of Colorado has over 300,000 acres of irrigated crops and 700,000 acres of nonirrigated field crops, despite the dry, variable climate. Only about 3 percent of the irrigated acres are devoted to specialty crops (melons, onions, tomatoes, and flower seeds), but these crops have strong links to the agricultural processing sector. Irrigated feed grains and forage also support a regional cattle-feedlot industry.

Prior to 1990, surface-water transfers from the Arkansas Valley to urban areas had totaled almost 100,000 acre-feet of consumptive use from about 48,000 acres of irrigated land. In addition, transfer applications on file but not yet approved totaled over 320,000 acre-feet of consumptive use from about 130,000 acres of irrigated land. While all the proposed transfers have not occurred on schedule, the approved and pending transfers account for over 60 percent of the study area's water, with an associated idling of almost 60 percent of the irrigated land in the study area.

Howe and others estimated the impact of the historic water transfers, considering only the retirement of the land idled by 1990. They assumed that the relatively small acreage of high-valued crops would not be affected by the loss of irrigated area. The high-valued crops were assumed to be produced on other farms in the area with continued water supplies. They found that each 1,000 acres of farmland retired reduces employment by 3.2 jobs and personal income by $100,000.

To bracket the range of potential impacts of the current plus proposed transfers, the analysis provides two scenarios of impacts on the local economy based on agriculture sector adjustments to the transfers. The less extreme scenario assumes that the high-value crops remain on the shrinking irrigated area until water is no longer provided. This scenario estimates a 10-percent reduction in both farm employment and value added by the agriculture sector in 2020, when compared with 1982 levels. Regional employment and personal income loss estimates were a modest 1 percent. The more extreme scenario assumes that, in addition to the high-value crop loss, there would be an 80-percent decline in feedlots in the area from increased feed and forage costs due to the reduction in irrigated production. This scenario posits a 20-percent or greater reduction in both farm employment and value added by the agriculture sector in 2020, when compared with 1982 levels. Regional employment and personal income would decline 2 to 3 percent. The impacts of both scenarios on the economy of Colorado were also estimated and found to be insignificant.

These studies from Arizona and Colorado lead to similar conclusions. Both recognize the economic gain to the State as a whole, given the much higher costs of water supply alternatives. In both cases, the impacts of water transfers are severe on local agricultural economies and the related agricultural support and processing industries. The impact on related industries is sensitive to the rate at which high-value crops move to areas outside the region. Both studies conclude that impacts measured over a larger area or at the State level are insignificant, but that local impacts fall heavily on small rural areas. In both cases, the costs accrue to the area of origin and the benefits go to the area of new water use.

### Challenges for Markets in the Future

Water transfers will continue in the West, perhaps at an accelerated rate as population growth continues and efforts are made to address environmental issues through increased instream water flows. In the larger regional and State economy, water transfers are almost always economically efficient, given the relatively high willingness to pay for urban and environmental water supplies. Unfortunately, the costs and benefits usually accrue to different populations. Agriculture will be the source of most water that is transferred to urban and instream flow uses.

The impacts of water transfers on agriculture and rural communities tend to be very concentrated, often within subcounty areas. Impacts are difficult to measure because of the complexity of hydrologic and economic interactions, the long-term gradual nature of transfers, and the lead time involved in transfers. Long lead times allow capital and population migration in anticipation of income losses associated with water transfers. In addition to hastening population loss, water transfers make it increasingly difficult to justify capital improvements in irrigation technology, farming operations, and agriculture-related industries, thus accelerating declines in farming-dependent rural communities. While water transfers from irrigation usually have a negative impact in these rural areas, there may be a positive impact when water is purchased by other agricultural producers growing more

valuable crops or when the rural economy has recreation-based industries dependent on instream flow levels.

Policies and institutions that regulate water transfers tend to evolve slowly unless there is a severe water shortfall. As transfer pressures increase, there is a need to be more creative in providing for both rural-based economies and urban demands. Several concepts need more evaluation, for example, dry-year transfers (temporary transfers to meet drought needs), transfers of water conserved through technology adoption, and public/private financing of transfers. The institutions governing transfers need to develop a framework that considers costs and benefits of all stakeholders. This would recognize (1) that water has value to segments of society beyond just those holding water rights, and (2) that transfers need to be structured to minimize the costs on economic, environmental, and community stakeholders. While the issue of water marketing remains contentious, most agree that expanding water markets represent a largely positive development in western water management. Operating water markets provides an opportunity to affect the allocation of water within the existing water supply system through improved management. Given the difficulty in meeting future water needs in other ways, water markets may be the best option available.

**For Further Reading . . .**

Alberta H. Charney and Gary C. Woodward, "Socioeconomic Impacts of Water Farming on Rural Areas of Origin in Arizona," *American Journal of Agricultural Economics*, Vol. 72, No. 5, Dec. 1990, pp. 1193-99.

Charles W. Howe, Jeffrey K. Lazo, and Kenneth R. Weber, "The Economic Impacts of Agriculture-to-Urban Water Transfers on the Area of Origin: A Case Study of the Arkansas River Valley in Colorado," *American Journal of Agricultural Economics*, Vol. 72, No. 5, Dec. 1990, pp. 1200-6.

National Research Council, Water Science and Technology Board, *Water Transfers in the West: Efficiency, Equity, and the Environment*, Washington DC: National Academy Press, 1992.

Benjamin M. Simon, "Federal Acquisition of Water through Voluntary Transactions for Environmental Purposes," *Contemporary Economic Policy*, Vol. 16, Oct. 1998, pp. 422-32.

Rodney T. Smith and Roger Vaughan, eds., *Water Strategist*, Stratecon, Inc., Claremont, CA.