Water Scarcity a Potential Drain on the Texas Economy

By Keith Phillips, Edward Rodrigue and Mine Yücel

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Texas has abundant natural resources, but water scarcity has the potential to impede the state's economic growth. Protracted drought in Texas has renewed awareness of water availability as one of the most pressing economic issues facing the state.

As water supplies shrink, demand is projected to rise, with Texas' population doubling to 52 million residents by 2047, according to the Texas State Data Center. Farming consumes the lion's share of the water supply. With the state's metropolitan areas expanding, however, urban demand for water has intensified.

Historically, users drew water freely from nearby streams or from groundwater aquifers—subterranean bodies of water replenished by rain seeping through the soil and rock. But as Texas' growing population has strained its limited water resources, the allocation of water has become increasingly important. Property rights and markets can play a significant role in allocating water efficiently by establishing ownership and setting prices to reflect water's scarcity.

Running Dry

In 2011, Texas suffered its worst single year of drought since records began in 1895, and the state's climatologist anticipates the region will remain drier than normal for another 15 years. Texas has a long history of regular and severe droughts.[1]

The stakes are particularly high for farmers, especially in the arid western half of the state, where low-margin, high-acreage crops such as alfalfa and cotton are harvested.

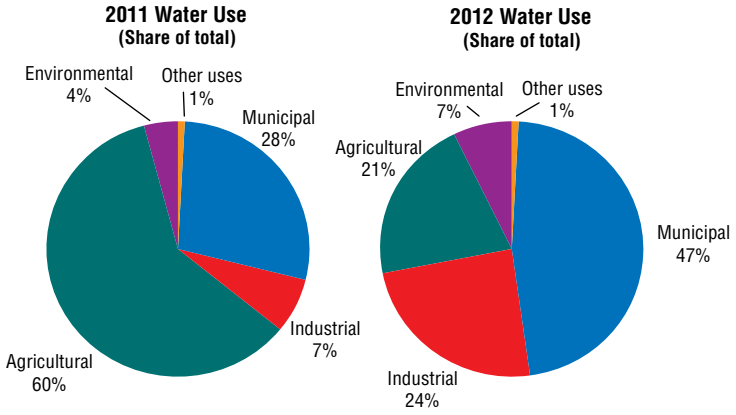
Along the Coastal Bend, where drought reduced water availability in 2012 and 2013, the Lower Colorado River Authority (LCRA) cut off most rice farmers' water to limit curtailment in Austin. The action reduced agriculture's share of water from the LCRA—one of 16 water authorities in the state—to 21 percent in 2012 from 60 percent the year before (*Chart 1*).

The farm sector uses the most water statewide, 61 percent, followed by municipalities at 27 percent (*Chart 2*). Manufacturing uses 6 percent, power generation 3 percent and livestock 2 percent, while oil and gas drilling accounts for about 1 percent.[2]

As Texas cities grow, water demand expands. Farmers, whose water rights are traditionally allocated based on historical use, can't benefit from selling their water to cities without developed markets. Municipalities, whose water prices often don't reflect scarcity and thus discourage conservation, are forced to ration supplies during dry spells.

Bolstering supply with new reservoirs is becoming more difficult. Dallas

Chart 1 Lower Colorado River Authority Drought Curtailment Cuts Into Agricultural Use



SOURCE: Lower Colorado River Authority.

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needed three lakes to meet its water needs in 1970; now it draws from eight lakes up to 90 miles away, with plans to go more than 200 miles to the Texas–Louisiana border.

Texas water comes from aquifers (groundwater) and rivers, lakes and reservoirs (surface water). Panhandle farmers pumping the Ogallala Aquifer account for 60 percent of state groundwater use (*Chart 3*). Aquifers decline when pumping outpaces replenishment.[3]

The Ogallala typifies the state's thirst for water. It has fallen several feet per year in some areas, while its average recharge rate is a half-inch per year.

If current allocation methods remain unchanged, overall Texas water supplies could contract 3.3 percent by 2020 as demand rises 5.4 percent.[4] The 2012 State Water Plan, derived from 16 regional water plans, suggests a mix of novel supply-and-demand strategies to meet urban needs.

Conservation, reuse and redistribution of existing supplies account for more than a third of proposed projects. Development of additional surface water supplies makes up another third, and new reservoirs account for about a fifth. The state plan suggests that demand for agricultural irrigation water will decrease from 10 million acre-feet in 2010 to 8.4 million in 2060 because of more efficient irrigation systems, reduced groundwater supplies and the transfer of water rights from agricultural to municipal uses.

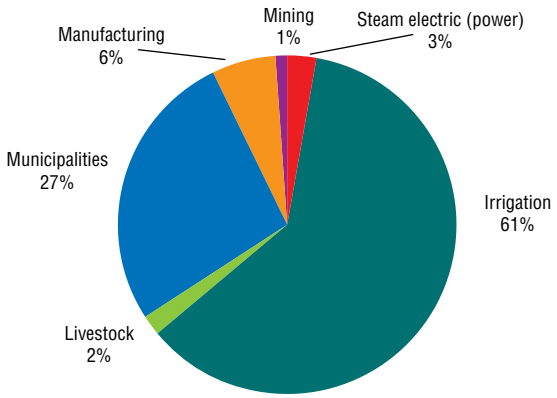
The plan also relies on water markets. How far market solutions can go toward distributing water depends on the location of supplies, the ability to monitor usage, and the legal and regulatory frameworks governing water allocation. Both surface and groundwater lack true market pricing, although the most severe challenges are in groundwater use because property rights do not exist.[5]

Groundwater Allocation Challenges

Sixty percent of Texas' water comes from groundwater aquifers, and farmers rely on groundwater for 80 percent of their irrigation use. Several problems plague Texas' groundwater management, endangering local economies and wildlife.

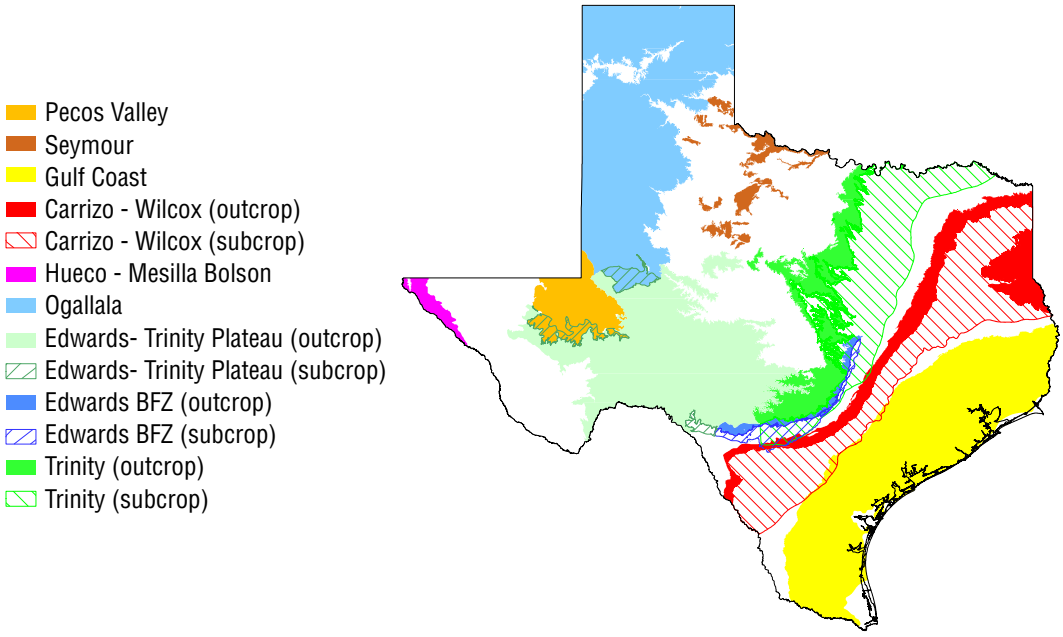
Texas does not assign ownership rights to groundwater. A legal doctrine—the "rule of capture"—allows any landowner to drill a well and, in many parts of the state, pump almost unlimited amounts of water. Because water becomes private property only after a landowner draws it from the ground, there is a strong incentive to

Chart 2 Most of Texas' Water Used for Irrigation
(2011 consumption shares)



SOURCE: Texas Water Development Board.

Chart 3 Texas' Major Aquifers Provide Groundwater Supplies



NOTES: Outcrop refers to that portion of the aquifer in which water passes through a permeable layer of surface rock, allowing relatively quicker recharging. In the subcrop portion, water passes through an underground layer of rock, creating a slow recharge process. BFZ stands for Balcones Fault Zone, a region of the Edwards Aquifer.
SOURCE: Texas Water Development Board.

be the first to pump. Economists call this the "tragedy of the commons." Groundwater pumping from an aquifer has negative spillovers because one person's actions leave less for everyone else. The system sends users exactly the wrong message: Pump faster as water becomes scarcer.

Groundwater conservation districts, the government bodies formed to address this issue, are made up of local users who decide how best to use the water in their county-sized jurisdictions. Because district borders follow county lines, several districts may overlay the same aquifer. Hence, the rule of capture extends the negative spillover from the individual to the district level.

One market-based solution, applied successfully in Australia and to surface water in the Lower Rio Grande Valley, is cap and trade. In this system, the state allocates—or caps—pumping rights and turns water into private property. Users are given well-defined deeds to water, in terms of the amount of water they can pump. These can be traded, leading to a market for water, facilitating efficiency and conservation. Prices that arise from this system are closer to market prices than rate schedules set by agencies.

Texas House Bill 1763, passed in September 2005, recognized the "common pool resource" problem associated with competing groundwater districts. This legislation shifted decision-making toward larger entities that encompass entire aquifers, called Groundwater Management Areas (GMAs), which are overseen by the Texas Commission on Environmental Quality.[6]

With GMA oversight, an aquifer's constituent districts agree on "desired future conditions," a 50-year objective for groundwater levels. They outline how much each district will take, in essence assigning ownership to fixed quantities of water. GMAs could begin to facilitate markets by overseeing trade among districts. To measure groundwater allotments, however, wells need meters. Most groundwater conservation districts do not require farmers to install meters; most cities do not regulate "domestic" wells, which can pump up to 25,000 gallons a day. The High Plains Water District in Northwest Texas, whose area includes Lubbock, is an exception, requiring meters on all wells by 2016.[7]

The cap level on withdrawals is also critical. The cap can be set to sustain the aquifer, which means drawing only on the average annual recharge.

The Edwards Aquifer Authority in Central Texas, which serves San Antonio, oversees a cap-and-trade system. The current cap of 572,000 acre-feet is equal to the current permitted usage authorized for municipal, industrial and irrigation purposes. However, this amount does not include withdrawals from exempt wells, which can draw up to 25,000 gallons per day. During periods of drought, the authority issues mandatory curtailments rather than buy back the permits, and some users exploit the loophole by drilling exempt wells.[8]

Despite an array of challenges, groundwater often lends itself well to market trading. This is particularly true for aquifers similar to the Edwards that serve both agricultural and urban areas. To complete a local transaction, users rarely need to physically move the water; they can sell pumping rights to each other, with one user simply pumping less while the other pumps more.

When property rights to a resource are not allocated, it can be overused. Establishing groundwater rights would help end Texas' pumping free-for-all and create a more efficient distribution of aquifer resources. But as long as the rule of capture remains in place, property rights assigned by GMAs and aquifer authorities face frequent challenges. In recent rulings involving the Edwards Aquifer Authority, the Texas Supreme Court suggested that a formula taking into account land acreage above an aquifer as well as historical usage may be a better and legally defensible way to allocate water rights.[9]

Surface Water Supply Issues

Forty percent of Texas water supply comes from surface water, found in rivers and reservoirs. Surface water is particularly important to cities, supplying 62 percent of their water.

Texas' surface water management institutions are more developed than their groundwater counterparts. The state owns surface water, holding it in trust for the public. Property ownership is defined: Residents and river authorities apply for the right to use the water or buy existing rights from others. Twenty-three state-chartered wholesalers (river authorities) own 70 percent of these rights (*Chart 4*).

River authorities manage reservoirs and sell water to cities and farmers. Their policies—rather than supply and demand—dictate prices. Typically, water is priced to reflect purification and transportation costs but not its opportunity costs (reflecting scarcity), leading to overuse and consumption rationing.

"Take or pay contracts," requiring municipalities to pay for river authority water whether they use it or not, further encourage water consumption even during periods of scarcity. The state also issues too many rights, causing existing rivers to be oversubscribed during droughts. Users need not buy water when they can obtain cheap new water rights from the state or exceed their current allotment.[10] Low prices and inflexible contracts both promote water use.

Texas has the legal and regulatory framework needed for efficient surface water use, but small changes in implementation could improve outcomes. When water is scarce, capping total diversion rights and monitoring them carefully would allow Texans to adapt through water markets. Water rights have traditionally been allocated by historical use and land access. The key is to provide users with certainty about the rules of water sales and well-defined rights that are not over-allocated to make trading simpler and more profitable. Greater potential profits would encourage participants to finance infrastructure, such as pipelines, needed to move water.

Benefits of Water Markets

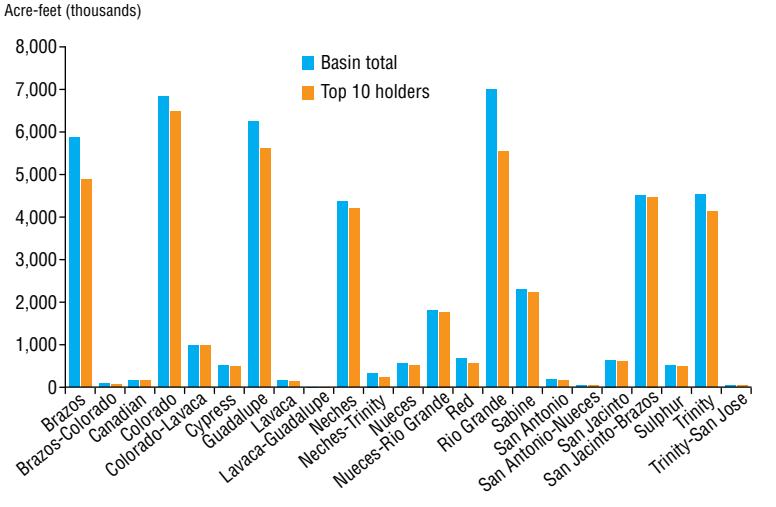
Water markets, which allow people to buy, sell or lease water rights, can allocate water to its most productive uses and help alleviate shortages. Prices are not set by an agency but are negotiated in the market process—rising in periods of relative scarcity and falling during times of relative abundance. This adjustment mechanism balances the quantities demanded and supplied, minimizing shortages.

Given that river authorities and municipalities will remain major players, how can surface water be priced so that it is allocated efficiently? In lieu of fully competitive markets, innovative contracts between big buyers and sellers can replicate market outcomes. The Edwards Aquifer Authority, before opening its cap-and-trade system, experimented with an irrigation-suspension program. Participating farmers left their land fallow for cash and cities received water.

To ensure every household has access to a base level of affordable water, households in municipal systems could receive a basic amount of water at a low price but pay more as their consumption increased, reflecting the marginal cost of the additional water. Some researchers have even suggested market mechanisms that allow households to sell some of their basic allocation if they choose to conserve.[11]

Because agriculture represents a small fraction of the state's economy but uses most of the water, cities and

Chart 4 River Authorities Control Most State Surface Water



SOURCE: "A Powerful Thirst: Water Marketing in Texas," by Mary Kelly, Environmental Defense, 2004.

industries would have the opportunity to buy water from the agricultural sector as their demand increased. This is already happening in areas such as the Lower Rio Grande Valley, home to Texas' most active water market, where more than 90 percent of sales by volume go from farmers to cities.[12] Fewer than 300 rice farmers served by the Lower Colorado River Authority hold the rights to a majority of the water; Austin-area homeowners have offered $100 million for those rights.[13]

In the Lower Rio Grande Valley, water rights sell for nearly $2,000 per acre-foot. Despite the region's rapidly growing population, a new water supply project hasn't been built in 40 years. Farmers turn a profit selling their water to other farmers and cities, and businesses can trust they will always have water, for a price.

The demand for water is sensitive to price. Estimates suggest that for every 1 percent increase in the price of water, farmers use 1 to 3 percent less. Cities' water needs are somewhat less sensitive. A 1 percent price rise reduces their demand by only 0.3 to 0.7 percent.[14]

One study found that municipal and industrial buyers across the American West would pay three to four times what farmers would pay for an additional acre-foot of water, on average.[15] Rice farmers, for example, receive Colorado River water for $6 an acre-foot; Austin residents pay $151 per acre-foot.[16] If prices were set through a market rather than by a water authority, cities and farmers would trade; farmers would have an incentive to sell more water and use less by planting fewer crops, substituting crops that consume less water or investing in more efficient irrigation systems.

The realization of water's value as a scarce commodity, like oil, will also promote conservation. People will try to make money selling unused water, or save money by purchasing less. Through market prices, people discover for which "needs" they're willing to pay. Some may find that high prices preclude miles of irrigated cotton or lush St. Augustine lawns.

Water Markets' Promise

It is encouraging that some regions in the state are using market principles to manage water. Efforts include the cap-and-trade system governing the Edwards Aquifer and the water market in the Lower Rio Grande Valley. More widespread use of markets would ensure that Texans have enough water—and that it goes to its most productive uses. Many challenges to markets remain, including the rule of capture, which impedes groundwater markets, and "use it or lose it" laws, which hinder surface water markets.

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Notes

[1] See "The Impact of the 2011 Drought and Beyond," Texas Comptroller of Public Accounts, February 2012, www.window.state.tx.us/specialrpt/drought/pdf/96-1704-Drought.pdf.

[2] See "A Deeper Dive: Gross Domestic Product (GDP) by State," The Texas Economy: Economic Outlook, Texas Comptroller of Public Accounts, 2010, www.thetexaseconomy.org/economic-outlook/economy/articles/article.php?name=DD-GDPbyState, and Texas Water Development Board, Historic Water Use Estimates, August 2013, www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp.

[3] Aquifers suffer both local and regional declines. The Ogallala fell 9 percent, on average, from 1950 to 2005, according to the U.S. Geological Survey. But Texas experienced sharper drops, and local declines can be more acute. The aquifer serving parts of the Panhandle fell by half.

[4] Based on 2012 Texas State Water Plan, Texas Water Development Board, and authors' calculations.

[5] We refer to property rights as the ownership rights to a defined quantity or share of water, not the ownership rights to the land where the water resides.

[6] See "A Streetcar Named Desired Future Conditions: The New Groundwater Availability for Texas," Texas Water Development Board, prepared for The Changing Face Of Water Rights in Texas 2008, State Bar of Texas, May 8–9, 2008, www.pg-tim.com/files/TX_Summary_HouseBill36_Desired_Future_Conditions.pdf.

[7] See "Ogallala Aquifer in Texas Panhandle Suffers Big Drop," by Kate Galbraith, *Texas Tribune*, May 22, 2013, http://stateimpact.npr.org/texas/2013/05/22/ogallala-aquifer-in-texas-panhandle-suffers-big-drop.

[8] See "A Powerful Thirst: Water Marketing in Texas," by Mary Kelly, Environmental Defense, 2004.

[9] See *Edwards Aquifer Authority v. Day* and *Edwards Aquifer Authority v. Bragg*.

[10] Some river authorities use this disparity to sell more water than they own.

[11] For example, see "Transferable Rate Entitlements: The Overlooked Opportunity in Municipal Water Pricing," by Robert A. Collinge, *Public Finance Review*, vol. 22, no. 1, 1994, pp. 46–64.

[12] A substantial number of water contracts take place between farmers. See "Water Marketing as a Reallocative Institution in Texas," by C. Chang and Ron Griffin, *Water Resources Research*, vol. 28, no. 3, 1992, pp. 879–90.

[13] See "Central Texas Coalition Urges Buyout of Rice Farmers," by Asher Price, *Austin American-Statesman*, March 3, 2013, www.statesman.com/news/news/state-regional-govt-politics/central-texas-coalition-urges-buyout-of-rice-farme/nWf6J.

[14] See "Reducing Institutional Barriers to Water Conservation," by Frank A. Ward and J. Phillip King, Water Policy, vol. 1, no. 4, 1998, pp. 411–20, http://agecon.nmsu.edu/fward/natural%20resource%20news/wc_wpolicy_ward_king.pdf.

[15] "Emerging Markets in Water: A Comparative Institutional Analysis of the Central Valley and Colorado–Big Thompson Projects," by Janis M. Carey and David L. Sunding, *Natural Resources Journal*, vol. 41, no. 2, 2001, pp. 283–328.

[16] See "Central Texas Water Conflict Heats Up Again," by Terrence Henry, StateImpact Texas, Dec. 13, 2012, http://stateimpact.npr.org/texas/2012/12/13/central-texas-water-conflict-heats-up-again.