The Takeaway

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Texas Groundwater

Dispelling Some Common Misconceptions

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Like politics and religion, water is an emotionally charged topic about which reasonable people vehemently disagree. Some of those disagreements arise from three common misconceptions about groundwater:

1) *A drop in artesian pressure implies an equally large drop in an aquifer's storage.*
2) *Sustainability requires that pumping equal recharge.*
3) *Dewatering an aquifer impoverishes future generations.*

Together these three misconceptions lead adherents to conclude that since the loss in artesian pressure has been quite marked in many of Texas' key aquifers, these aquifers are facing imminent depletion and the only reasonable policy prescriptions are to limit pumping to recharge and then let regulators decide who gets to pump. Before embracing these policy prescriptions, let's consider

WHAT'S THE TAKEAWAY?

Regulations need to be based on loss in aquifer storage, not artesian pressure.

Dewatering aquifers is okay if limited and water markets are available to signal scarcity.

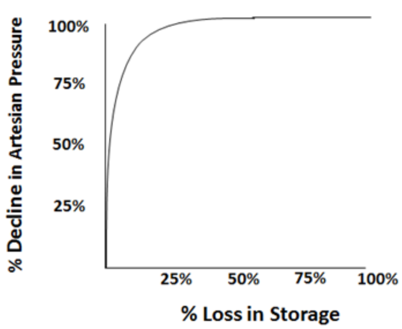
Viable water markets require a correlative rights system and ending discrimination among users and uses.

the empirical basis for these three misconceptions.

MISCONCEPTION 1: Does the loss in artesian pressure lead to an equally large loss in aquifer storage?

Suppose as in Central Texas, the Trinity Aquifer lays 1,000 feet below the surface. While originally, the well naturally flowed to the surface without a pump, now there has been a 50% loss in artesian pressure, requiring pumps to be set at 500 feet. Does a 50% loss in artesian pressure imply a 50% loss in aquifer storage? No, the relationship between the two is highly non-linear.[1] A 50% loss in artesian pressure may entail only a loss of a few percent of storage (as in Figure 1). However, even after all artesian pressure is lost, pumpers can still continue to dewater the aquifer, albeit at increased costs.

Figure 1: Artesian Pressure vs. Loss in Storage



MISCONCEPTION 2: Does sustainability require that pumping equal recharge?

On the face of it, by pumping only the recharge going into the aquifer, storage can be maintained indefinitely, treating equally all future generations. To many, this is the only morally responsible policy prescription.

Before accepting this prescription, consider the following thought experiment: *Imagine a huge aquifer with no recharge. If pumping were limited to recharge, there would be zero pumping both now and forever. Zero pumping would confer no benefits to any generation!*

Shouldn't dewatering an aquifer depend on the size of the aquifer's storage relative to the rate of recharge? For example, in the Trinity Aquifer, storage is about 14,800 times annual recharge. Pumping could be twice recharge for 3,700 years before depleting even half of storage. For other key Texas aquifers, like the Carizzo-Wilcox and Gulf Coast, storage is 520 and 4,000 times recharge, respectively.[2] But eventually, won't complete dewatering leave the aquifer dry? What happens then?

MISCONCEPTION 3: Will dewatering an aquifer really condemn future generations to poverty?

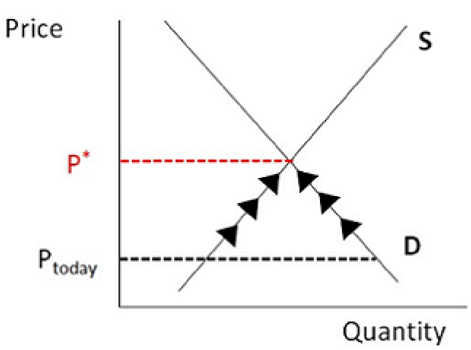
Curiously, if these big three aquifers had no recharge, they would be *treated like any other non-renewable resource*. Society shows no qualms about depleting oil and gas fields, phosphate mines, uranium mines, etc. To date, cost and resource saving technological change have in most instances offset the depletion effect, so that prices have either fallen in real terms or risen moderately.[3]

There are good reasons why these same factors would apply to water. There are two basic reasons—the Law of Demand and the Law of Supply. In Figure 2, line D shows the familiar demand curve from Econ 101. The Law of Demand states that ceteris paribus (i.e., holding constant things like population and per-capita income) as the price rises consumers will conserve by using less. Lots of economic research shows that this curve slopes downward to the right and is not vertical. A recent survey of the literature suggests that the average elasticity estimates is -0.48 — implying that a doubling of the price of water would lead to a 48% reduction in usage.[4] Examples of conservation in response to rising prices include installing more efficient irrigation pivots, planting less water-intensive crops, and installing a host of conservation devices by homeowners and industrial users.

The Law of Supply is yet another powerful force to expand supplies. The long run version of the Law of Supply tells us that rising prices will stimulate investment in relatively underutilized aquifers and encourage desalination technology to access Texas' enormous brackish water supplies.

Putting the two laws together, Figure 2 shows that at today's artificially low water prices, P_{today}, (due to the current rationing system) it appears there is a water crisis because the quantity of water demanded far exceeds available supplies. But if the market is allowed to function properly, prices will rise to P* forcing consumers to conserve and suppliers to develop new supplies.

Figure 2: Laws of Supply and Demand



In sum, the same market forces of supply and demand apply to water as they do for non-renewable resources in general. There is little evidence that the current generation has been victimized by previous generations' profligate use of these resources. There is one important feature of markets—they will provide price signals of impending shortage giving regulators and the market time to make necessary adjustments.

NECESSARY CONDITIONS FOR A PROPERLY FUNCTIONING MARKET

If markets are to provide this valuable signaling device, groundwater must be actively traded. This means that water must move both geographically (so that water from one aquifer can be pumped to customers in another) and functionally (so that water can be switched to alternative, higher-valued uses). The Edwards Aquifer boasts a viable water market. But, the big three aquifers serving the most populous parts of the state—the Trinity, Carizzo-Wilcox, and Gulf Coast Aquifers—lack active water markets.

Regulatory hurdles by local groundwater conservation districts (GCDs) prevent groundwater from moving to higher-valued uses. Even though the Courts have identified a number of beneficial uses of water, GCDs can make it difficult to change the use of groundwater,[5] and to export outside a GCD. In 2016, of 97 GCDs surveyed, only 6 exported more than 1% of quantity pumped.[6] Additionally, Desired Future Conditions (DFCs) based on loss of artesian pressure instead of loss in storage artificially limits overall pumping. New permits may be denied while historical pumpers with large, grandfathered pumping rights continue to pump unhindered.[7] For areas outside of a GCD, which fall under the Rule of Capture, there is the opposite problem—a built in incentive to over-pump and under-price groundwater.[8]

The necessary changes to enable a groundwater market in the Trinity, Carizzo-Wilcox, and Gulf Coast Aquifers would require the following three conditions:

1) Set DFCs based on loss of storage and not on artesian pressure.

2) Prohibit GCD policies that have the effect of discriminating among uses and users.

3) Assure equal access by instituting some type of Correlative Rights System both within GCDs and non-GCD areas, whereby all pumpers would share and share alike. I strongly prefer the groundwater bank system vis-à-vis other correlative rights systems which I outlined in the *Texas Water Journal*.[9] With bank accounts, landowners would have incentives to leave groundwater in the ground.

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Notes:

[1] See http://www.twdb.texas.gov/groundwater/docs/GAMruns/Task13-035_v2.pdf?d=14021.621169119096

[2] For storage, see http://www.twdb.texas.gov/groundwater/management_areas/TERS.asp

For Recharge, see TWDB unpublished excel file.

[3] Simpson, R.D., Toman, M.A., & Ayres, R.U. (Eds). (2005). Scarcity and Growth in the New Millenium: Summary, in *Scarcity and Growth Revisited: Resources for the Future*, Washington, DC: Resources for the Future.

[4] Scheierling, S.M., Loomis, J.B., & Young, R.A., (2006). Irrigation water demand: A meta-analysis of price elasticities. *Water Resources Research,* 42(1). doi:10.1029/2005WR004009

[5] Beckermann, W., Brady, R., Capps, A., Kennedy, B., McGee, P., Northcutt, K., Parish, M., Qadeer, A., & Shan, S. (2016, January), *An Assessment of Groundwater Regulation in Texas*, *A Bush School Capstone Report*, pp. 51-52.

[6] Beckermann et al. (2016), Appendix B.

[7] Griffin, J.M. (2017). Interjecting economics into the groundwater policy dialogue, *Texas Water Journal*, 8(1), pp. 97-112.

[8] Griffin (2017).

[9] Griffin (2017).

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