George Owen

The Exploitation of the Ogallala Aquifer

Abstract

The United States is becoming increasingly reliant on groundwater from aquifers. Water statistics from 2015 report that while surface-water withdrawals were down 14 percent, withdrawals from groundwater sources rose by as much as 9 percent. The Ogallala reservoir in particular has become a primary source of water in America. This aquifer, the largest in the world, lies underneath much of the High Plains in central America and spans 174,000 square miles across eight states. It provides drinking water to 82% of the people living in the High Plains,
and additionally supplies almost 30 percent of all the water used for irrigation in the United States. However, we need to find an alternative. The United States is withdrawing water from the Ogallala much faster than it is renewed. If we don't stop this trend, then much of the United States will not have a source of water after the aquifer is depleted. The most rapidly depleting areas of the Ogallala lie in Texas, whose lax groundwater regulations encourage competition and further withdrawals. One viable solution to this issue is increasing federal oversight of the Ogallala. This could mean the creation of a board and task force composed of representatives from all eight states the Ogallala lies beneath, which would be responsible for managing and conserving water use. However, alternative sources of water will also need to be found in addition to this.

Paper

The Ogallala aquifer, one of the main sources of water in the United States, is drying up in Texas due to overuse. Unless overly lax laws are changed or an alternative water source is found, most of the central United States will no longer have reliable access to water.

Groundwater sources form the largest single supply of freshwater which can be used by humans. In fact, there is nearly 30 times more groundwater than surface freshwater in all of the lakes and streams of the world combined! This water resides underground, primarily in rock formations called aquifers. An aquifer is an area of porous or otherwise permeable rock in which water can be stored. Water gradually percolates underground as a result of precipitation, and collects in aquifers to form large reservoirs. They can range from shallow to deep - some

aquifers have little more than a few feet of water-saturated thickness, while the largest reach depths of up to 1,200 feet. Additionally, aquifers are not uniform, and can vary in saturation and depth across their extent.

The largest aquifer in the United States, and likely the entire world, is the Ogallala aquifer. This giant aquifer spans eight states throughout the high plains and 174,000 square miles. While the Ogallala's most saturated areas reside under Nebraska, the aquifer also stretches across South Dakota, Wyoming, Colorado, Kansas, Oklahoma, New Mexico, and Texas. This aquifer contains as much water volume as Lake Huron. All together, 30% of all water used for irrigation in the United States comes directly from the Ogallala aquifer. Due to environmental conditions , this aquifer has an extremely slow rate of recharge. The great plains is a semiarid region, meaning that precipitation is limited. In addition to this, much of the aquifers' water is extremely ancient. In southern regions, the Ogallala lies underneath a nearly impermeable layer of rock. This sedimentary layer blocks almost all precipitation the Ogallala would receive in those regions. The slowest recharge rates are present in parts of Texas, where the aquifer refills at a rate of 0.024 inches per year.

While the Ogallala's slow recharge rate has not previously been an issue, it has recently become a major concern as America grows increasingly reliant on groundwater sources. According to a 2015 report by the US Geological Survey, even though overall water use in the United States was 9 percent less than in 2010, groundwater withdrawals were 8 percent greater. This means that America, especially in states like Texas, are getting more and more of their water supply from aquifers underground. According to a 2017 report by the Texas Water Development Board, 54 percent of all water used in Texas was from groundwater sources, totaling 7.4 million acre-feet of water. Figure One shows the percentage of total municipal water use by county in Texas. This chart reveals that while water-affulent communities like Dallas can

ignore groundwater, other places like San Antonio and Amarillo have an almost complete reliance on aquifers. Amarillo is especially of note, as it is situated in the Texas panhandle squarely above the Ogallala reservoir.

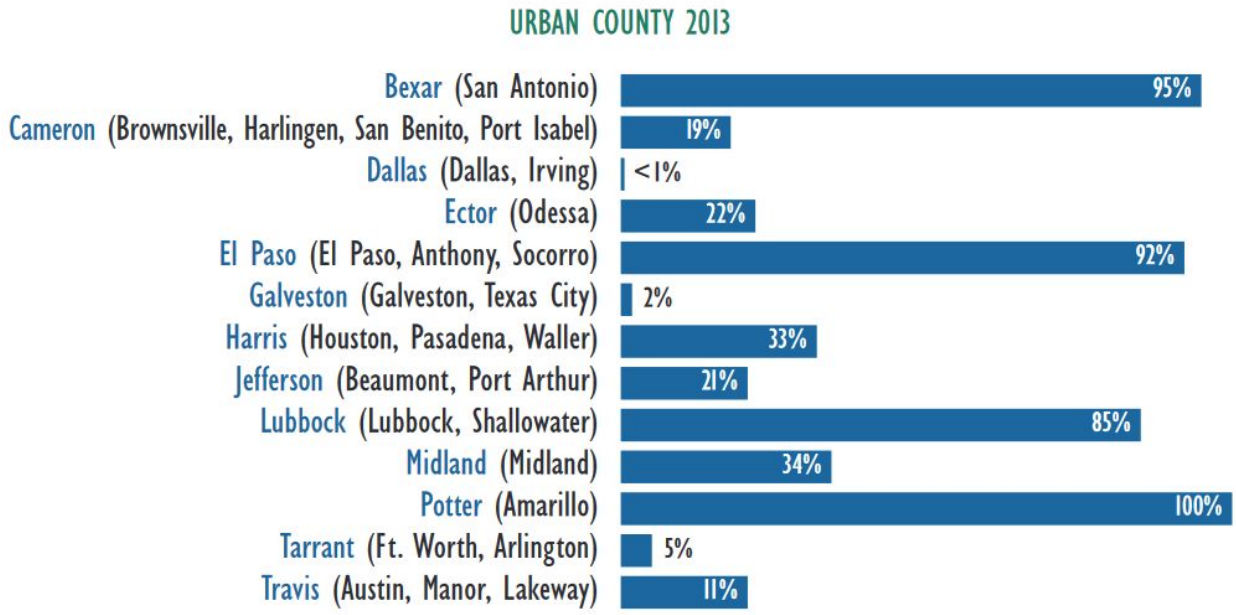

Figure 1: Percentage of total municipal use supplied by groundwater in Texas' major urban counties
Taken from *Facts About Texas Water*, Texas Living Waters Project

For the sake of brevity, the rest of this discussion of Ogallala's exploitation will be limited in scope to Texas. This is because Texas is the state which is withdrawing the most water from Ogallala, in the location where it is the least sustainable. However, the aquifer is being exploited and depleted in every single state which it resides underneath.

This heavy reliance on the Ogallala aquifer has certainly taken its toll. A 2015 report by the USGS on the saturated thickness of the Ogallala found that in many parts of Texas, the water-level has declined more than 150 feet since its 1950 high. Figure Two shows this same trend, highlighting that much of Ogallala's area in Texas has experienced a saturated thickness decline of as much as 60 percent. The exploitation which has caused this decrease began in 1949, and is only increasing in severity. When taking into account Ogallala's extremely slow

recharge rate, it is clear that without intervention the Ogallala aquifer may cease to exist as we know it.

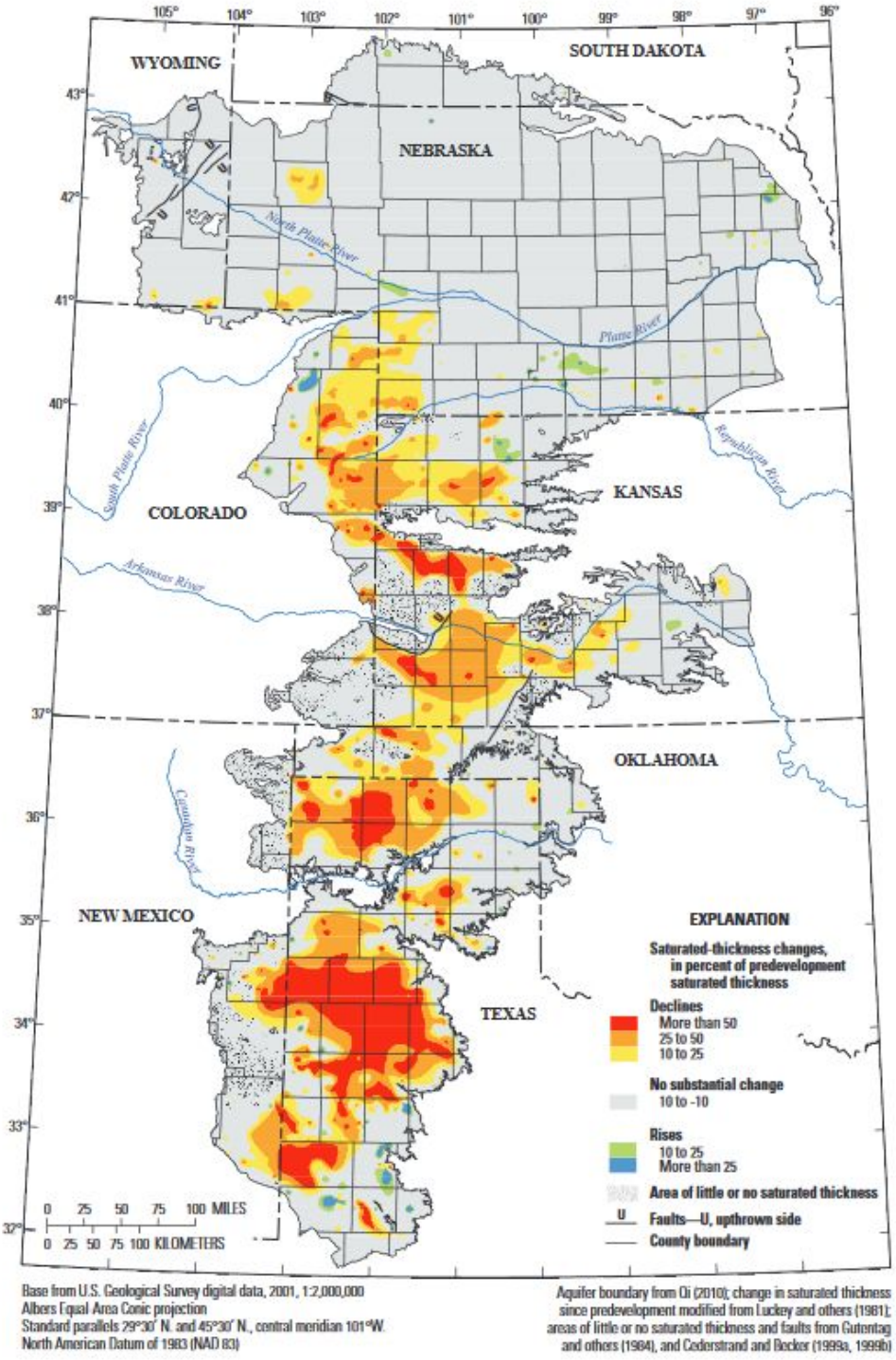

Figure 2: Change in saturated thickness of the Ogallala aquifer, predevelopment (about 1950) to 2015

Taken from *Water-level and recoverable water in storage changes, High Plains aquifer, predevelopment to 2015 and 2013-2015*

One of the biggest reasons that Ogallala has been so exploited is that it is fundamentally a very difficult resource to manage. How is it possible to administer and regulate a resource that you can't see? This is akin to regulating the air, or any other intangible resource. Another reason that the Ogallala's water is difficult to manage is that it is shared. Water is not a static resource, and although the majority of the water in the Ogallala moves slowly, water will flow from areas of high concentration to areas of lower concentration. This means that it is impossible to partition the Ogallala. If someone uses a vast amount of water in their section, all surrounding water will flow in to refill this section, and that person will be taking more than their fair share. This issue falls under a larger category of concerns broadly termed "The Tragedy of the Commons." A group of individuals, each acting in their own self-interest and withdrawing their desired amount of water, will invariably deplete the shared resource of the Ogallala and everyone will suffer.

Although the Ogallala has special properties which make it much more difficult to regulate than something like soil, the groundwater laws in the state of Texas fail to take this into account. They thereby encourage competition, and play further into the tragedy of the commons. Title 2, Subtitle E of the Texas Administrative Code underlies their rules and regulations for groundwater management. In summary, Texas abides by the rule of capture, otherwise known as the "law of the biggest pump." This law grants landowners the right to capture any water beneath their property. People are allowed to pump and utilize any water they can, regardless of the effect this has on neighboring properties (within reason). There are some limitations, such as it being illegal to pump water with the sole purpose of depriving others of that water, but for the most part it's a wild west out there. This means that owners of wells are not liable to other landowners for taking water from beneath their land. This rule of capture contrasts sharply with the laws governing surface water, which is all explicitly owned by the

state of Texas. This means that bodies of water such as rivers, lakes, and creeks can be used by landowners only with permission of the state. In addition, Texas groundwater rules also contrast with rules encouraged at the federal level known as “Reasonable Use.” This rule allows unlimited extraction so long as this extraction does not unreasonably damage others or the aquifer system.

The biggest step that Texas can take to prevent the depletion of the Ogallala aquifer is to implement new laws to better regulate this shared resource. It is clear that the current rule of capture is not sufficient to prevent depletion. Even shifting to the more reasonable (and aptly named) rule of “Reasonable Use” would be a big step in the right direction. However, the state of Texas does not seem keen to do so. Their rule of capture was brought under review during the 1999 Texas supreme court case *Sipriano v Great Spring Waters of America*. In this landmark decision, the court unanimously affirmed and supported the rule of capture. However, they stated that they might later change this rule if the legislature fails to adequately address overpumping. 21 years later, the rule of capture is still firmly in place. A good first step towards enacting change is to get another case like *Sipriano v Great Spring Waters of America* brought to the supreme court. This would allow a better ruling to be enacted, which adequately addresses the issues which are clearly present today.

Making a better law than the rule of capture is not hard, but making a law which will prevent the depletion of the Ogallala is much more difficult. The problem seems almost impossible, as it is currently being withdrawn from so much faster than it refills. A true solution will involve a mixture of strong legislation and a transition to alternative water sources. This author is certainly not qualified to present a concrete solution, but can discuss the general forms which this solution might take. As this issue can be viewed as a version of the “Tragedy of the Commons,” we can derive solution paths from there. One realistic solution is to get the Federal

Government further involved, and regulate the entire Ogallala aquifer on a national scale. This would provide a codified set of rules for the entire shared resource, and there would be ample oversight in order to enforce them. Perhaps allotted withdraw rates could depend on the current saturated thickness of the reservoir. This is probably the quickest solution to implement. However, another possible solution is to increase the local communal management of the aquifer. Elinor Ostrom postulates that local community groups are the best suited to manage their own resources, as they know exactly what they will need. However, since the aquifer is so large this would have to be implemented on a much larger scale. One realistic solution would be to create a board / task force made up of members from all 8 states which the Ogallala lies underneath. This task force would be responsible for managing groundwater withdrawal across the entire area, and would ensure that each state gets to utilize its resources without overexploiting them. These are just some possible solutions to this complex problem.

The Ogallala aquifer is the largest aquifer in the world, but it is not the only one which is being overexploited. A 2013 study by the USGS of 40 separate aquifers in the United States found that overall, Americans have depleted almost 1,000 cubic kilometers of underground water. This number has no doubt only increased in recent years. Alternative water sources like desalinization might be able to support the United States in lieu of aquifers, but not yet. Additionally, far-inland places like Kansas and Nebraska have no easy access to any other source of water. Humanity can definitely solve this issue, but we must act immediately and drastically in order to have a chance. It is clear that we must learn to manage our communal resources, especially those which are essential to life, responsibly.

Works Cited

Chapter 35: Groundwater Studies, Texas Administrative Code, Water Code, Title 2, Subtitle E, revised 2007. https://statutes.capitol.texas.gov/Docs/WA/pdf/WA.35.pdf. Accessed 17 May 2020.

Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L., and Linsey, K.S., 2018, Estimated use of water in the United States in 2015, U.S. Geological Survey Circular 1441. https://doi.org/10.3133/cir1441. Accessed 17 May 2020.

Ground Water. U.S. Geological Survey, November 2016, https://pubs.usgs.gov/gip/gw/gwgip.pdf

McGuire, V.L., *2017, Water-level and recoverable water in storage changes, High Plains aquifer, predevelopment to 2015 and 2013–15*, U.S. Geological Survey Scientific Investigations Report 2017–5040. https://doi.org/10.3133/sir20175040. Accessed 17 May 2020.

Opie, John, et al. *Ogallala, Third Edition: Water for a Dry Land*. NED - New edition ed., University of Nebraska Press, 2018. *JSTOR*, www.jstor.org/stable/j.ctv1ntfbc. Accessed 17 May 2020.

Sierra Club Lone Star Chapter, *Facts About Texas Water*. Texas Living Waters Project, May 2016, http://texaslivingwaters.org/wp-content/uploads/2016/06/FATW_Final__English_May-201

6_web-optimized.pdf

"Texas Water Law." *Texas Water*, Texas A&M University, 2014, https://texaswater.tamu.edu/water-law.

Texas Water Use Estimates, 2017 Summary. Texas Water Development Board, July 2019, https://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/data/2017TexasWaterUseEstimatesSummary.pdf.