Kent Butler Groundwater Essay

Climate Change and Its Effects on Texas Groundwater Aquifers

Growing up in the Austin area, one of my first exposures to groundwater knowledge was at our local Barton Springs park. Fed directly by San Antonio's far reaching Edwards Aquifer, the rushing water and tight packed caves were a foundational part of my childhood. Yet in my blissful ignorance, I failed to recognize that aquifers are not known for their longevity. With a harsh history of droughts in central Texas, there was no telling how long it'd be for the supply to disappear with the ramping up of climate change. It's no secret that climate change has already led to dramatic shifts in Texas climate, including the recent snow storm and record summer highs. The severity of the situation becomes all the more apparent when we look at the agricultural industry, and most importantly, the fact that a majority of the state depends on these diminishing groundwater aquifers to survive.

Due to their nature as a water recharging and recycling center, estimated usable lifetimes for aquifers have remained only that: estimates. A variety of factors are capable of determining the rate of depletion for aquifers, from usage to annual rainfall to artificial recharge (Sophocleous). The general trend of groundwater depletion has been relatively linear in its descent, though several bumps in the road have made it far more difficult to anticipate the following year's saturated thickness, or the vertical thickness of porous rock filled with water in an aquifer (Schloss).

Texas is no stranger to droughts, and even more so intense heat. When looking at just the 21st century, with the most recent drought being 2020, our ability to cope with harsh weather grows more strained by the day. As boil water notices swept through the Austin area, residents descended into chaos, clearing countless shelves of their water bottles to the point of enforced buying limitations. If we look farther back into the beginning of the century, 2005 and 2007 had brought about year long droughts, resulting in a loss of over $4.1 billion. Following soon after was the 2010 drought, which led to at least $5.2 billion lost and the one of the driest years in Texas history (Henry). Not accounting for the long-term impacts of depleted aquifer recharge in those years, the loss of surface water in the form of lakes and rivers only contributed to worsening conditions. Considering that the time for an aquifer to fully replenish itself ranges from years to centuries, Texas' fluctuating weather patterns prove to hinder proper recharge.

Unfortunately, Texas' population is estimated to double in the next 50 years, and even then the tech boom in Austin has yet to be accounted for (Henry). As of 2020, the current demand for water in Texas is a whopping 18.4 million acre-feet per year (TWDB). With this rapidly increasing trend of water exploitation, the estimated lifetime for artesian zones decreases with each observation of yearly consumption trends (Schloss). According to the 2017 Texas state water plan, water usage and demand has increased in areas such as manufacturing, steam-electric, mining, and livestock. While irrigation, with its long history of greatest water use in Texas, has noticeably decreased in its demand due to improved technology, the uncertainty of these demands alongside population growth makes it increasingly more difficult for the state to draft an accurate water plan.

So how does climate change play into this water roulette? It's a well established fact that climate change has the capability to affect yearly weather conditions with a mixture of heavy torrential rain and periods of extreme drought and heat, primarily in the Southern region. These bouts of rain prove to be of high risk for flash flooding, especially since Texas soil is usually dried due to its typically hot condition. A sudden onslaught of rain would result in the contamination of surface water as flash flooding drags unwanted debris into vital sources, and seeing as the predictability of weather has changed for the worse, attempts to prepare for such situations may not be as effective as they had been in the past (Climate Central). As threats of harsher droughts loom across the state, so does the urgency for water demand, primarily in the agricultural industry.

In terms of our aquifer situation, however, these turn of events may prove to fix a part of the depleting water supply. In a 2015 study conducted by Qian Yang and Bridget Scanlon of UT Austin, they'd found that when compared to typical surface reservoirs such as lakes, depleted aquifers proved to be much more efficient in their storage capacity (Ravilious). Not only could the depleted aquifers help to mitigate intense flooding through redirection of run-off, but they would also play a crucial role in storing water during periods of drought. Safe beneath the earth, groundwater aquifers would provide the perfect solution to areas suffering from both floods and droughts.

According to another study though, it was found that upon taking into consideration the increase in pumping alongside population growth, when in severe drought conditions, there was not a viable method of pumping that would not result in discharge shortages in areas such as San Marcos and Comal springs. Unless groundwater removal is severely cut back and regulated, the rate at which the Edwards region is developing will undoubtedly be threatened by $2 \times CO2$ climatic conditions (Loáiciga). However, this study was only a simulated experiment of what the scientists had thought would replicate the aquifers' saturated thickness over the course of global warming. Because these models were unable to take into account natural variables such as torrential rains or differing weather conditions outside of drought season, there is some room for error in the findings.

Ultimately, the situation with Texas' essential aquifers is a complicated scenario to judge. There are countless "what-if's" that could throw these predictions entirely off course: unexpected weather consequences of climate change or human interference. All we do know is that the Edwards Aquifer, like all others, is a finite resource, and with the rate at which our world continues to develop and boom, it's only a matter of time until it's gone. Conservation groups have sought alternatives to mass pumping, and one of the most effective methods has been the development of better technology to regulate the water already available on the surface. The irrigation water demand is a clear product of that. Groundwater conservation is a fickle task and climate change an even fickler antagonist. We can only hope that as we make leaps and bounds in technological innovation, so too does our understanding of the natural world around us.

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