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MISCONCEPTIONS

ADDRESSING KEY MISCONCEPTIONS: “THINGS WE EXPLAIN AGAIN AND AGAIN"

The Ogallala Aquifer is a large, complex system that is widely known outside of the High Plains region. It has been used as a poster child for good management and bad management, hope and despair, or simply as a lens for a larger message. Members of the High Plains farming, research, and professional communities find ourselves explaining a few key points over and over to folks who may have learned about the aquifer through case studies that give only a broad overview with a particular moral. At the same time, “common knowledge” in one field might be considered a misconception in another discipline or industry.

This white paper is meant to help us learn from one another. No single individual can be an expert in all aspects of the Ogallala Aquifer. We can all learn from each other, even through disagreements—communication is better than avoiding the conversation. People involved in planning the Ogallala Summit have been invited to submit misconceptions or other information that might be useful for people outside their area of expertise.

Authors: Erin Haacker, Amy Harsch, Billy Tiller, Dayle McDermitt, Mark Cox

HIGH PLAINS OR OGALLALA?

The Ogallala Group is a set of geologic deposits from the Miocene Period. Most of the High Plains Aquifer consists of rocks from the Ogallala Group, but there are remnants of these formations that are disconnected from the main aquifer or don't contain water, and there are also younger and older rocks that form parts of the aquifer. Hydrogeologists are likely to prefer "High Plains Aquifer" because it automatically includes all the rocks with groundwater regardless of their geologic history. However, "Ogallala Aquifer" is the more popular term, and it is often used interchangeably with "High Plains Aquifer."

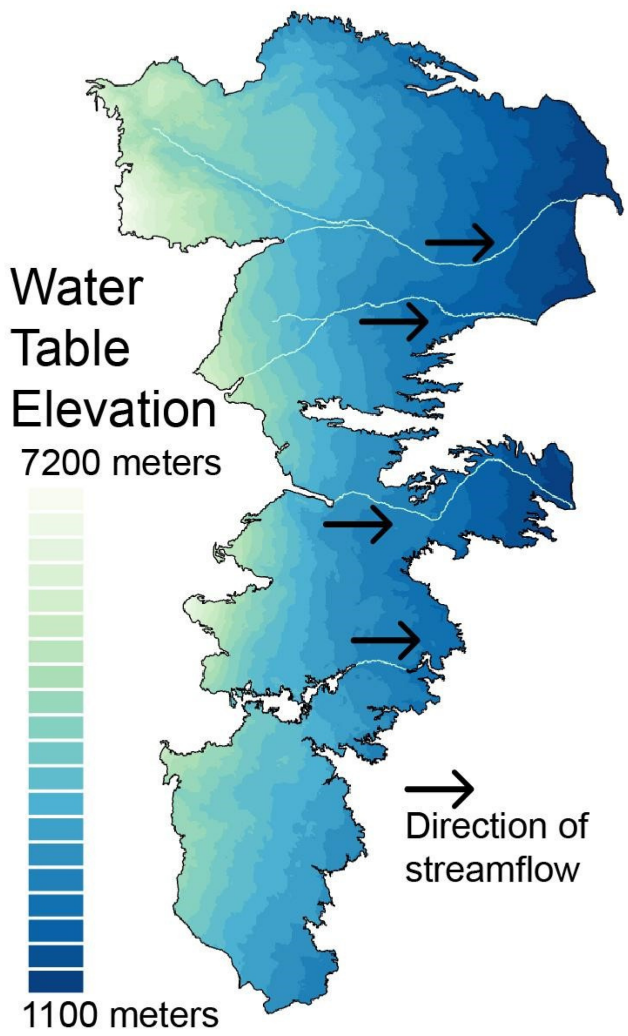

Figure 1. Water table elevation of the High Plains Aquifer as of 2016, showing a gradient from west to east. Data derived from USGS Groundwater Data for the Nation.

WILL DRAINING THE AQUIFER IN TEXAS AFFECT GROUNDWATER IN NEBRASKA?

Have you ever driven from east to west across the High Plains and noticed that it takes more gas than driving the other direction? The Ogallala sediments were eroded from the Rocky Mountains and deposited on a base with a slight west-to-east slope. The resulting land surface also has a gradient in the same direction. As a result, just like the rivers (Figure 1), the groundwater of the High Plains tends to flow from west to east. It is possible to redirect water locally in a north-south direction, but it isn't going to happen on a big (hundreds of miles) scale.

There are also a few eastward-flowing rivers that form natural flow barriers, either because groundwater is likely to flow into or out of the river and not underneath the river from one side to the other (the Platte River), or because the river has completely eroded through the aquifer sediments to the less-porous base sediments beneath (at least parts of the Republican River, Arkansas River, and Canadian River). Groundwater that encounters one of these eroded river valleys will emerge as a spring and flow into the river channel. This also helps to isolate the northern, central, and southern parts of the aquifer.

Most of the water in the aquifer - about two thirds - is in the Nebraska Sandhills. The Sandhills is sometimes referred to as the main area of recharge for the aquifer, and a high proportion of rainfall does enter the aquifer. However, the regional gradient causes the water in the Sandhills to drain toward the east, mostly via the Loup River drainage network.

On the bright side, this also means that contaminants won't spread throughout the aquifer. For example, nitrate contamination that occurs in one part of the Ogallala will slowly spread downgradient, but it won't mix across the entire aquifer. This is also true for any potential pipeline spills - while locally devastating, these contamination events cannot spread throughout the entire High Plains.

WILL DRAINING THE AQUIFER IN TEXAS AFFECT GROUNDWATER IN NEBRASKA?

Irrigation technology can improve water use efficiency, but different people will define "water use efficiency" in different ways. Farmers have to pay for the energy to transport water to their fields, and any evaporation, runoff, or return flow (water that percolates downward past the root zone) is waste. To a groundwater hydrologist, on other hand, return flow is like the money given in change from a transaction - you don't count that money as part of the price. When return flows are reduced, water use is more efficient to a farmer, but it doesn't make a difference to the aquifer.

Efficient irrigation often reduces the gallons per minute needed for a well to operate a center pivot. When this is the case, areas that previously couldn't support irrigation - areas that were considered 'drained' - may be irrigated again. The net effect of increased irrigation efficiency is often to increase groundwater withdrawals. The efficiency comes in the form of maximizing transpiration relative to runoff, evaporation, and deep percolation; it does not come in the form of minimizing total water use. This has been described as an example of Jevons' Paradox, which describes how increased efficiency in using a resource can increase demand for that resource.

CAN FLOW METERS AND OTHER MEASUREMENT TOOLS SOLVE THE CHALLENGES OF WATER MANAGEMENT?

Flow meters are an excellent way to measure the flow of water to a field. However, installing a flow meter or other piece of equipment is never the end of the story. Flow meters are not going to collect perfect data, and the quality of data can decline over time if the flow meter isn't calibrated and maintained. There is also a level of uncertainty with any measurement. Flow meters are one tool in the toolbox. It's always best to have more than one source of data - including more flow meters, so that it's easier to tell when something is going wrong with the system. Individual flow tests are affected by factors such as the location of the pivot arm and whether there is an end gun sprinkler in operation. Also, data won't interpret itself. It is important to have a quick way to access data, and access it regularly. Finally, once the data is collected and analyzed, it is up to the farmer to decide how to weigh that information and act on it.

Farmers also do not have unlimited resources for instrumentation and data analysis. Although it is a common misconception that farmers are rich, it can be very difficult—in some years unusual—for farms to turn a profit. Farmers may also have to balance crop insurance requirements for irrigated parcels, regulations governing water rights, and expectations from companies that buy farm products. This increases the pressure to both irrigate fully and focus on activities with a high return on investment. Often there is no clear return on investment for increased data collection and analysis, in part because this is difficult to demonstrate, but also because this is not always an explicit part of the research process when new management practices are developed.

WHY DON'T FARMERS JUST USE PRECISION IRRIGATION/COVER CROPS/DROUGHT-RESISTANT CROPS?

Precision irrigation is a promising tool to help reduce unnecessary withdrawals from groundwater (although refer to the "improved irrigation technology" section above for discussion on actual water savings resulting from water use efficiency). However, despite technological advances, a lot of precision irrigation practices remain experimental, prohibitively expensive, or both.

Other practices, such as cover crops, sometimes have different effects depending on location and vagaries in weather, and are difficult to assess using existing tools. For example, crop models are usually designed to evaluate a single crop growing in one season, and calibrated to harvested yield. A cover crop might include several species, and might help soil health in a way that is hard to measure and encode in a model.

Farmers are also limited in the number of crops that can be grown and sold profitably. Some of the most popular crops are subsidized by the federal government, which can make the difference between a profitable year and a non-profitable year. Specialty crops may need to be shipped further to be sold and processed, which can also reduce profitability, and crop insurance may not be available. It is difficult to experiment with new crops because some equipment, like certain seeders and harvesters, is specialized to only work for a particular crop.

It can be difficult even to assess the total impact of a crop on the water balance. Many farmers believe that crop residues are unimportant for farm water management, and have better value if baled off, without factoring in the cost of selling off nutrients such as nitrogen and contained in that residue, or the effect of reducing biomass on water capture during winter months. Although research shows that corn silage takes less water to produce than corn for grain, baling off silage also can lead to significant soil compaction that farmers might remedy using aggressive tillage, leading to breakdown soil aggregates and soil crusting, reducing water infiltration from irrigation or precipitation. Sometimes silage or forage might be produced in a year where a farm double crops with wheat or another crop; even though both crops are technically "lower water use" the combined yearly water use may be above that of a corn crop grown for grain. Or take the example of cotton, which is also generally considered to be a lower water use crop. Since cotton produces little to no crop residue, making soils more prone to drying out and subject to wind erosion especially in hot and windy environments, affecting the overall water balance of a field. The overall pattern in these examples above is that components of the farm water budget are usually measured and assessed in isolation, which can be misleading.

There is a much larger universe of ideas that could be included in this paper. Everyone has some misconceptions about the Ogallala Aquifer, and everyone at the Ogallala Summit has a perspective that they can share to help unmask other people's misconceptions. Nobody knows everything, but everybody knows something. We also have different opinions, but by sharing the realities that we can perceive from each of our professions, we can sort opinions from facts and ground our conversation in our broad overlap in valuing the stewardship and vitality of communities, ecosystems, and the environment.

Cover photo. Center pivot irrigation system with end gun in operation, Paulman Farms, Nebraska. Photo by Erin Haacker.

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