Emerging Irrigation Technologies Lead to Water Conservation Strategies

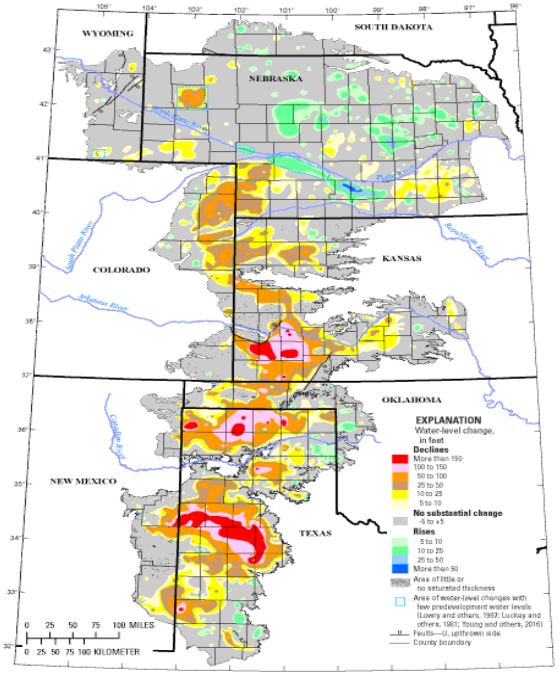
By Brittany Davis

Importance

Much of America's food, clothing, and many other products come from crops grown in the Great Plains – much of which is made possible through irrigation. Crop irrigation accounts for 41% of all freshwater consumption in Oklahoma, making it the number one water user.[1] Over the past four decades, the water in this region's aquifers has severely declined. This decline is a major concern because the aquifers are where almost half of Oklahoma's freshwater comes from.[2] Declining groundwater levels have not greatly affected the nation as a whole (yet), but farmers have been making changes to the way they irrigate to prevent the nation from feeling the effects.

Challenges

Irrigation challenges vary by location. The Oklahoma Panhandle has declining groundwater levels, especially in the Ogallala Aquifer. The more the decline, the more the energy needed to pump the water. Because of its extremely low recharge rate, the Ogallala is considered at risk of almost complete groundwater depletion. The aquifer currently loses about 1-3 feet per year.[4] If losses continue at this rate, the aquifer will essentially be depleted in about 30 years.[5]



Map of Declining Water Levels in Ogallala Aquifer[3]

In the opposite corner of the state, southeastern Oklahoma has a lot of groundwater, but the salt content is very high. High salinity can damage crops.

Widespread challenges include both droughts and excess rainfall, as ideal crop production is best achieved when the exact amount and timing of rain or water is provided.

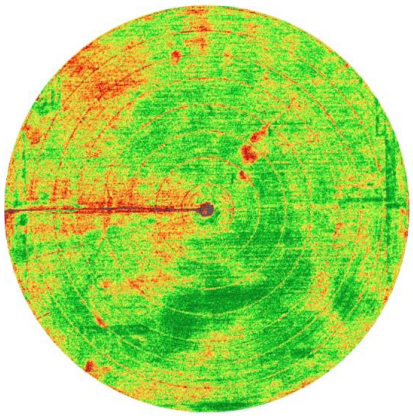
Barriers to improving irrigation include high installation costs, limited workforce, and the lack of irrigation management. Smaller family farms may struggle to purchase and maintain equipment. Further, these farms may not have sufficient manpower to optimally manage their irrigation systems. Precision irrigation management is something every farm should do in theory; in practice, this management can be very hard. At Oklahoma State University, we are leading research on efficient irrigation in hopes of conserving water, while improving crop production and benefiting American producers.

Current Research

Current irrigation research at OSU consists of evaluating soil moisture monitoring sensors and other technologies, assessing irrigation system efficiency, and performing economic assessments

and crop comparisons. Dr. Saleh Taghvaeian, an assistant professor and Extension specialist in Biosystems and Agricultural Engineering department at OSU, studies irrigation. He focuses on use of low quality irrigation water and precision management. According to Taghvaeian, "precision irrigation management is where maximum crop efficiency meets maximum water efficiency." In other words, precision irrigation management delivers the exact amount of water the crops need when it's needed. Dr. Taghvaeian also measures irrigation well pumping efficiency. He has found that many irrigation pumps across the state are not working as well as they could. This deficiency contributes to wasted irrigation water. Improving plant efficiencies could 1) create huge cost savings for farmers, 2) decrease the water used, and 3) decrease the emissions of greenhouse gases caused by the pump plants.

Dr. Taghvaeian also researches irrigating with low quality water, particularly water with high salinity. He has found that it is possible to use water with high salinity if, and only if, it is applied with a high level of irrigation monitoring. For example, when low quality irrigation water is applied, sensors should be used to monitor soil conditions. Dr. Taghvaeian cautions that there are risks involved in using low quality water. Water with too poor of quality may damage crops and/or land, possibly to the point of rendering them useless. Even with intensive management, high salinity water may only be used once or twice per crop cycle. Despite the risks, Taghvaeian believes it is necessary for producers to begin considering this resource to combat increasing water scarcity.



NDVI Image Created from Aerial Imagery[6]

Dr. Jason Warren, an associate professor in Plant and Soil Sciences, has also been conducting research on irrigation strategies. His recent project uses commercially available technology and applies it to large-scale research. Warren hopes to learn more about the limits of full-scale pivot irrigation through this research. He also wants to examine irrigation capacity and nitrogen requirements. Aerial and satellite imagery can be collected to create a dataset that can identify areas with excess or poor nitrogen levels, variances in irrigation water application, and density of the crop. Using this imagery will support better irrigation water management by producers.

Warren has also worked with Karthik Ramaswamy, a doctoral student in Agricultural Economics, on crop efficiencies in the Oklahoma Panhandle. This research revolves around determining which crops are the most effective overall. A holistic comparison of corn and milo considered total water use, landmass required, profit, and depreciation of land. Milo requires less water than corn, saving money on irrigation pumping and conserving water. However, corn is more lucrative. Thus, the two crops have similar net values. With the decline of the Ogallala Aquifer in mind, Ramaswamy's research suggests a collective move to milo production. More about this project will be published in the April 2019 issue of *Currents*.

Subsurface drip irrigation is being researched as well. This form of irrigation maintains a higher water efficiency than center pivot irrigation. Drip irrigation delivers water directly to the root zone,

which produces higher yields with less water. It is Oklahoma State's hope that ongoing research will result in an increase in crop production and a decrease in aquifer drawdown.

Master Irrigator Program

In another effort to benefit producers and conserve water, OSU is working with farmers, conservation agencies, farm groups, and others to create a "Master Irrigator" Program in Oklahoma. The purpose is to increase and hone farmers' knowledge on irrigation technology and water resources. Advanced irrigation management and the practical mechanics of how to use irrigation technology will be discussed in a multi-day in-class training for producers. The program will help growers identify irrigation issues, while providing technology and education to solve them. Site visits to participating producers' farms will follow the in-class instruction to provide the one-on-one assistance needed to improve efficiency. These site visits will evaluate farm irrigation systems and recommend possible solutions based on current research. After the initial site visit, the site will be revisited at least annually to assess the status of implementation and help address any other issues that may have arisen. This program is expected to kick-off in 2020—stay tuned for updates.

Future of Oklahoma

Oklahoma has many challenges to overcome in regards to irrigation, but progress is being made. Producers are increasingly aware of and interested in conquering these water challenges with an eye on the big picture. Going forward, it is important to further the relationship between producers, researchers, and Extension efforts. Feedback loops that allow producers to provide input on research and extension programs will ultimately result in better crop production and increased water savings. The extension of knowledge will provide the highest likelihood of success, as mutual support creates small steps of progress. Through time, we will be able to see the benefits that stem from these changes – if we continue to work together.

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[1] "Water Facts." Oklahoma Water Resources Board the Water Agency. Accessed December 06, 2018. https://www.owrb.ok.gov/util/waterfact.php.

[2] Ibid

[3] "High Plains Aquifer Water-level Changes, Predevelopment (about 1950) to 2015." What Is an Earthquake and What Causes Them to Happen? Accessed December 05, 2018. https://www.usgs.gov/media/images/high-plains-aquifer-water-level-changes-predevelopment-2015.

[4] Karthik Ramaswamy, PhD student in Agricultural Economics at OSU, personal communication

[5] Karthik Ramaswamy, PhD student in Agricultural Economics at OSU, personal communication

[6] "Home." Agricultural Aerial Imaging | United States | Brasil | Terravion. Accessed December 05, 2018. https://www.terravion.com/.