Saving an underground reservoir

Story by Kathy Wythe

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Scientists partner to document efficient use

A visitor to the Central and Southern High Plains of the United States can gaze upon field after field of crops and rangelands for cattle—the sources of a significant part of the region's agricultural economy. Though the area has few rivers and lakes, underneath it lies a supply of water that has provided groundwater for developing this economy.

This underground water, the Ogallala Aquifer, is a finite resource. The amount of water seeping back into the aquifer is much less than the water taken out, especially in the southern half of the aquifer, which spreads out from western Kansas to the High Plains of Texas.

"Water levels are declining 2 to 4 feet per year over the south half of the aquifer," said Nolan Clark, a research engineer with the U. S. Department of Agriculture's Agricultural Research Service (ARS).

"If all the water is removed, then the regional economy is gone," Clark said. "We have already seen isolated areas that have no irrigation water remaining and the economy has been crushed."

The region produces about 4 percent of the nation's corn, 25 percent of the hard red winter wheat, 23 percent of the grain sorghum, and 42 percent of the fed beef. Agricultural irrigation use accounts for 90 percent of the groundwater withdrawals in many areas of the Ogallala Aquifer region. A growing livestock industry accounts for another 3 percent, Clark said.

Because the economy and viability of the agricultural industries and rural communities are so dependent on the aquifer, scientists at the ARS, Texas A&M University, Kansas State University, Texas Tech University and West Texas A&M University joined forces in 2003 to develop water conservation technologies and policies to sustain the aquifer.

Sustaining Rural Economies Through New Water Management Technologies, the ARS-University Ogallala Aquifer Initiative funded by Congress, seeks "solutions to the complex water problems and challenges being faced in West Texas and Western Kansas," according to the project's description. Since 2003, Congress has appropriated approximately $8.5 million to multiple projects. More than 60 scientists and engineers from ARS and the universities are involved in the initiative.

Clark, one of the project's leaders, said the initiative's research projects are centered on seven research priorities. Accomplishments to date include:

ECONOMIC ASSESSMENTS AND IMPACTS (MICRO and MACRO)

- Calculated from regional economic models that the projected total present value of irrigation over 60 years is $19.3 billion or $990 per acre.
- Determined that if no water management strategies are implemented in 60 years, the saturated thickness of the Ogallala Aquifer will decrease by an average of 48 percent, with a range from 0 percent to 90 percent. Water use would drop from 18.32 million acre-feet to 4.26 million acre-feet.

IRRIGATION AND PRECIPITATION MANAGEMENT

- Demonstrated that tillage influences crop productivity and water use by as much as 25 percent.
- Determined that genetic variations in crops create more than 50 percent variation in transpiration efficiency, meaning that within the same crop species, some varieties can produce twice as much.
- Released early versions of planning models that helped determine the best crop and number of acres planted based on water availability and market grain prices.

photo by Shelby Axtell, Texas Tech University

IRRIGATION SYSTEMS AND TECHNOLOGIES

- Demonstrated that subsurface drip irrigation systems increased seed germination by 50 percent when used in a modified bed system and at deficit irrigation levels.
- Demonstrated through laboratory tests the practicality of developing a prototype variable rate irrigation nozzle for center pivot systems.

PRODUCTION SYSTEMS

- Demonstrated the feasibility of selecting plants with higher transpiration efficiencies that produce more biomass with less water.
- Showed that integrating limited stocker cattle grazing into crop rotations increases net profitability by $45 per acre.
- Identified forage sorghums that have similar digestibility and yield as corn silage, but require 40 percent less irrigation water.

HYDROLOGY / CLIMATOLOGY

- Compiled existing relevant hydrologic and climatological data into a GIS format and corrected errors.
- Developed Web interfaces to distribute hydrologic and climatological data.
- Used GIS data to show and understand water flow in crops and soils.

TECHNOLOGY TRANSFER EDUCATION AND TRAINING

- Developed a logo for recognition and use in information sources.
- Developed a Web site for information management and internal communication. (http://ogallala.tamu.edu)
- Provided two irrigation scheduling schemes for producers that are accessible on the Internet. (www.oznet.ksu.edu/mil & http://txhighplainset.tamu.edu)

CAFO AND PROCESSING INDUSTRY WATER ISSUES

- Determined that southwestern dairies require an average of 60 gallons of water per cow per day for a dry lot system and 95 gallons of water per cow day per day for freestall.
- Determined that beef cattle consume 9 to 10 gallons per day per animal with more consumed in the summer. An additional one-third gallon per head is consumed for steam flaking the corn and an additional 5 gallons is used in the winter for overflow watering.

"Most areas have sufficient water for the next 10 to 20 years," Clark said, "but to impact the long-term, we must begin changing now to provide a sustainable economy for the future."

photo by Shelby Axtell, Texas Tech University