Conserving Water on the Texas High Plains

Integrating Crops, Livestock, and New Technology

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Declining availability of groundwater, new pumping restrictions, and persistent drought have farmers and ranchers in the Texas High Plains eager to adopt new ideas to stretch each drop of water that falls on their farms. A new program utilizing the expertise of water conservation districts, universities, and USDA-NRCS, is helping to refine and transfer irrigation management technology and practices to producers to make the most efficient use of existing water. What have they learned so far and what does the future hold for farming in this area?

Preserving the Ogallala Aquifer for future generations on the High Plains is a delicate balance for farmers and ranchers of maintaining profitability while using less water—all in the midst of one of the worst droughts in history.

In Texas where the drought has been particularly painful since 2011, getting the most out of every drop hasn’t been an easy chore, says Chuck West, professor of forage systems at Texas Tech University. West administers the state-funded Texas Alliance for Water Conservation, or TAWC, which helps producers learn to do more with less water.

“The natural recharge rate [of the Ogallala Aquifer] is very slow and the use of water is very high,” West says. “In general, it’s been declining by about a foot per year. But we found that in the drought years in 2011 and 2012, it dropped more than a foot per year.”

Irrigation well capacity, meanwhile, has dropped significantly. Wells that once produced 400 to 500 gallons per
minute five years ago, he says, can now only produce 200 to 300 gallons per minute.

Groundwater management districts are also imposing restrictions on the number of acre-inches of water an irrigator can pump in an effort to lift water demands off the continually shrinking aquifer. An acre-inch equates to 27,154 gallons, the amount needed to irrigate an acre of land with one inch of water.

“It started out a couple years ago at 21 inches that can be applied in a year on a field. And then, this year, it dropped down to 18 inches. In another couple years, it will go down to 15 inches,” West predicts. “So, there’s this stepping down in the amount of how much water a farmer can apply.”

Declining availability of groundwater, new pumping restrictions, and persistent drought have farmers and ranchers like Glenn Schur eager to adopt new ideas to stretch each drop that falls on his farm near Plainview, TX. Schur, along with 28 other farmers in Floyd and Hale counties north of Lubbock, TX, has volunteered to take part in the TAWC program to help him adapt to the increasing challenges of irrigating on the High Plains. TAWC works with the High Plains Underground Water Conservation Districts, Texas A&M AgriLife Extension, USDA-NRCS, and university researchers to refine and transfer irrigation management technology and practices to producers to make the most efficient use of existing water.

Rick Kellison, program director for TAWC, says the program brings all aspects of water management together to help irrigators adapt while maintaining profitability. The answer to achieving more crop per drop, he says, lies in adopting a multi-faceted approach, including choosing the right irrigation technology, picking the right crop mix, adopting conservation tillage, regularly monitoring soil moisture, tracking crop water needs, and scheduling irrigation accordingly.

To help irrigators juggle the many aspects of water management, TAWC created a website (www.tawcsolutions.org) to tabulate water usage. It works just like balancing a checkbook, Kellison explains. “It actually calculates the costs of what the farmer can produce, what the profitability is, and how much income they can make per acre-inch of water applied, and how much yield.”

The farmer starts the accounting procedure by inputting his or her beginning soil moisture balance and selecting a nearby weather station through the Texas Tech Mesonet, a network of 76 stations dispersed throughout West Texas. The precipitation amounts reported by the farmer’s local weather station are then downloaded each night at midnight, thereby automatically updating the farmer’s soil moisture balance to view each morning.

The user of the website also tabulates PET, or potential evaporation transpiration, to figure how much water the crop is using on a daily basis.

“That tool allows the grower to input information that would be specific for a field as far as what he thinks his rainfall would be depending on topography, crop residue,
and tillage,” Kellison says. “He can also target a level of ET [evapotranspiration] he wants to achieve, and that is based on total number of acres and gallons per acre available.”

Armed with the knowledge of what the water balance is in the field and local weather forecasts, the user can then plan an irrigation schedule based on actual crop needs.

This accounting approach to managing water has made Schur more aware of his true water needs and helped him reduce his water usage by two or more inches per year.

“It made all of us much more aware of how much water we’re using because we’re counting every inch that we’re applying from the very beginning,” Schur says.

Picking the right crops, rotations, and tillage

Now in the ninth season of collecting data on the nearly 5,000 acres enrolled in the TAWC program, West says the accounting method that irrigators have employed via the TAWC Solutions.org website have revealed much regarding best—and worst—farming practices on the High Plains.

“Corn is very wasteful,” West notes. “It shows the lowest water use efficiency, and it just takes so much water to produce it. When the farmer has enough water, corn makes a good profit because corn prices have been high the last several years, and that has unfortunately encouraged a lot of people to grow corn. But, it’s very difficult for the producer to reduce pumping when growing a corn crop. In my view, there is no long-term future for corn here because it just takes too much water.”

Center-pivot fields that once were growing continuous corn are now evolving to more diverse crop rotations to stretch the continually shrinking water supplies. Farmers often times now only irrigate a portion of the circle while leaving the rest as dryland crop or fallowed in an effort to reduce the total number of acres irrigated within a growing season.

“After the 2011 drought, which was kind of a life-changing event for us, it was amazing how fast our growers understood that they’re going to have to alter their number of irrigated acres,” Kellison says. “They found they needed to irrigate a half circle of wheat and some percentage as winter crop, then go to a warm-season crop like corn, cotton, grain sorghum, or sunflowers.”

Water-efficient crops like grain sorghum, in particular, have made inroads into crop rotations during the drought, West notes, thanks to their dependability under drought stress.

Cotton, though, still remains an integral crop in Texas with farmers planting it in both irrigated and dryland. But as well capacity declines and water restrictions increase, cotton becomes less enticing for farmers, he says.

“Cotton is still the main crop out here in the southern High Plains, but in some of these areas, they are starting to diversify away from continuous cotton,” West says. “Cotton is still a pretty good crop with between 16 and 18 inches of irrigation if you follow all the best practices. But when that gets down to a 15-inch restriction, it gets harder during drought years.”

Left: Rick Kellison, program director for the Texas Alliance for Water Conservation (TAWC), and Vivien Allen, retired Texas Tech forage agronomist and animal scientist. Allen led a long-term integrated crop–livestock experiment that helped launch the TAWC program. Photo by Philip Brown.
Right: “There is no long-term future for corn [in the Texas High Plains] because it just takes too much water,” says Chuck West, professor of forage systems at Texas Tech University. Photo by Kay Ledbetter (Texas A&M AgriLife Research).
For Schur, mixing cotton, wheat, and sorghum into his rotation has been a successful water-saving strategy with cotton and sorghum being his chief cash crops. Wheat, meanwhile, fits in as pasture for his cattle during the off-season.

James Todd, crop consultant with Todd Ag Consulting in Plainview, TX, and president of the National Alliance of Independent Crop Consultants, says wheat has become a valuable crop in irrigated rotations, thanks to the ample stubble it leaves behind to protect soil moisture. Irrigators will then plant corn, cotton, or grain sorghum into the stubble after wheat harvest.

Some irrigators who run cattle have even gone as far as going back to establishing grassland, West adds. A diverse mix of prairie grass achieves most of its growth in May, June, and July, which can be a limited time span for grazing. Other types of grasses like old world bluestem, though, can offer a longer grazing season, he says.

And, forage grasses are less demanding on the aquifer. Rather than producing cotton on 18 to 20 acre-inches of water, irrigators can produce ample forage with a perennial grass on 9 to 10 inches of water that cattle can graze throughout the summer and into fall. Grazing can then be extended into the winter by planting a winter annual crop like wheat, rye, or triticale. By spring, the cattle can be moved back onto the grass.

“That has been shown to work pretty well,” West adds. “That is a way of reducing the amount of irrigation while still doing a profitable type of agriculture that also brings in more diversity in the landscape.”

Like other cattlemen across the High Plains, Schur has also made do with less water and tighter feed supplies by culling his cow-calf herd. But by integrating drought-hardy wheat into his irrigated crop rotation, Schur has been able to stretch his water and forage throughout the year while keeping his herd intact and fed.

During the summer months, Schur also gradually feeds his herd crop residue. That integrated approach of getting dual use out of crop residue as feed and ground cover sparked Schur’s interest in conservation tillage to preserve soil moisture.

“You have to do some grazing management,” Schur warns. “You don’t want to graze all the stubble off the ground that you possibly can. I try to leave as much as I can because water conservation is still a priority. Even when we’re grazing livestock, it’s still a priority.”

Schur uses the crop residue to protect the soil moisture from evaporating when temperatures soar during the summer. To build crop residue on the soil surface, he has switched from conventional tillage to no-till and strip-till practices that minimize residue disturbance.

Listed as a best management practice for irrigators by the Texas Water Development Board, conservation tillage improves the ability of the soil to hold moisture, reduces the amount of water that runs off the field, and reduces evaporation of water from the soil surface. In addition to strip till and no-till, other conservation tillage methods include mulch tillage and ridge till.

While Kellison says more farmers are adopting strip till and no-till, all forms of conservation tillage can help irrigators become better at stretching their water.

“We’re not trying to endorse one technology over another,” he says. “What we’re trying to do is expose growers through demonstration to as many of the different technologies as possible, let them talk to the growers that have been using those technologies, and determine if one of those might fit their management approach.”

Picking the right hybrids at the right plant population is another strategy to help stretch summer water needs, Todd adds.
“A lot of what I do comes down to making recommendations on cotton, corn, and grain sorghum hybrids to plant,” he says. “I try to match their water needs to the crop and even the plant population. We have lower populations on corn and maybe some shorter-season hybrids to try to maximize our water and still maintain yields.”

**Monitoring efficiency and scheduling irrigation**

While most irrigators long ago abandoned furrow irrigation for more efficient irrigation technology like pivots and sub-surface drip, some are still employing it even though it only has 60 to 65% efficiency, West says.

Meanwhile, today’s center-pivot sprinkler systems have an efficiency of 80 to 90%, depending on nozzle type. A nozzle that produces big water droplets that can fall through the crop canopy and reach the soil, he says, will be more efficient than a nozzle that produces a fine spray with smaller droplets that can more easily evaporate.

Subsurface drip irrigation is the maximum in water efficiency at 95%, according to West. But even with perforated irrigation tape buried 15 inches in the soil, some water will still move to the soil surface where it can evaporate. Reaching 100% efficiency, he says, will be an unlikely achievement for irrigators.

But combined with other technologies that can aid in scheduling optimum times to irrigate, West maintains that irrigators can still achieve greater efficiency with their water. Capacitance probes are one technology that can help farmers determine when precisely to irrigate to reduce or eliminate unnecessary watering.

The probes are equipped with a series of sensors placed 4 inches or more apart and are inserted at least 4 ft into the soil. Each sensor records the level of moisture and transmits the information to the farmer’s computer, keeping the farmer updated on how wet or dry the soil is. The probes also indicate how the crop is using the water.

“They’re fairly accurate,” Schur says, who uses capacitance probes on certain irrigated fields on his farm. “They show where your irrigation or rainfall has been going, and how deep it’s moving through the soil profile. And, they show where and how much water is being extracted from the soil profile by the root system.”

But at a cost of $2,000 to $3,000 per unit, Todd says capacitance probes may be out of reach for some farmers. Simply doing a manual soil probe in the field and using gypsum blocks, he says, can help farmers monitor soil moisture cost-effectively.

Gypsum blocks, he says, are a simple monitoring tool containing two-pieces of wire gauze that measure how fast electrical current passes through the soil, depending on soil type. With that information, the farmer can figure out the water content of his soil, he says.

Todd places blocks at a depth of 6 inches, 1 ft, 2 ft, and 3 ft in his clients’ fields. He then inputs the data into a computer program to develop charts for his farmer-clients twice a week to track water levels in the field.

“It’s helping out quite a bit to try to manage our water,” he says. “We’re not watering when we don’t need to and watering when we do.”

Infrared monitors that track crop canopy temperatures are also a helpful tool in scheduling irrigation, Kellison adds.

“As water starts to be mined out of the soil, it begins to cool the crop, so we know what the optimum temperature is for specific crops,” he explains. “That aids growers in knowing when to initiate irrigation or terminate irrigation.”

Some water-saving strategies include mixing cotton, wheat, and sorghum into a rotation or, for those who run cattle, establishing grassland.

**Left:** Cotton planted into terminated wheat cover. **Middle:** Sorghum. **Right:** Range grass. Photos courtesy of Texas USDA-NRCS.
However, such a multi-faceted approach to managing water might be overwhelming for some growers. That’s where CCAs can make a difference.

Farmers may be uncomfortable using computers and new technology, West says, and they can be reluctant to switch to new farming practices and rotations. Or, they simply may not have the time to dedicate to moisture monitoring. CCAs can be an important bridge connecting the farmer to new ideas and technology behind irrigation scheduling, he says.

The crop consultant’s role is so important, Kellison adds, that they will be the focus of the TAWC project in the coming years to promote water-saving concepts and technologies to a wider audience of farmers.

To help farmers and their CCAs pull the practices of integrated irrigation management together, TAWC recently initiated a series of field walks where producers and crop consultants can learn about different irrigation delivery technologies, capacitance probes, and infrared thermometers. Future meetings will include demonstrations on calculating ET using the irrigation scheduling tool and how to match crops to specific fields based on water supply and crop demand with the Resource Allocation Analyzer on the TAWCsolutions.org website.

And, future workshops will be available specifically for CCAs to learn the necessary tools, so they can then pass that knowledge and technology on to their clients, West adds.

Below: Infrared monitors that track crop canopy temperatures (left) and capacitance probes (right) are helpful tools in scheduling irrigation. Photos by Peggy Greb and Stephen Ausmus (USDA-ARS), respectively.
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