Recharging the Ogallala: Water Development Board Project to Investigate Playa Lake's Role in Replenishing the Aquifer

Playa lakes may hold the key to the long-term viability of intensive agriculture on the High Plains, and a new Texas Water Development Board (TWDB) project aims to determine just how much water there is in the lakes and how fast it can get down to the aquifer.

High Plains agricultural production depends on irrigation. Hit or miss summer thunder showers can't sustain the capital and equipment currently invested on many farms. Irrigation on the High Plains means Ogallala groundwater, and the aquifer level is trending down in the districts most heavily invested in irrigation. Numerous farms have already been forced to convert to dryland farming as their wells no longer sustain pumping rates sufficient for irrigation. More farms are likely to follow suit in the coming years, according to projections from the local underground water conservation districts and the TWDB.

The bottom line is easily calculated on the back of an envelope. If total regional recharge averages ¼ to ½ inch of water per year, as the best recent studies suggest, and the average crop requires 1 acre-foot of irrigation water, then only 1/48 to 1/24 of the total acreage in the region can be irrigated sustainably. This means that out of the 20 million acres on the Texas High Plains, only something like 400,000 to 800,000 acres can be sustained in irrigation, given current recharge rates and irrigation practices. We're irrigating five to ten times that acreage today, but we can only pull water from storage for so long.

There are ways to alter the fundamental water equation. The amount of irrigation water needed to grow a crop depends on many factors; among them are the irrigation efficiency and crop water demand. U.S. Department of Agriculture (USDA) research has helped developed much more efficient irrigation technologies, tillage practices, crop varieties, and integrated production systems. Landowners and local water districts have widely adopted these innovations. But the water conservation benefit of these innovations has largely been lost to the tendency to increase the intensity or area of production to match the amount of water that can be produced. Productivity is up, but the aquifer is still trending down. Future incentives to encourage deficit irrigation or plant lower water-use crops can help, and research on drought-tolerant crops is promising, but to maintain the region's productivity we need to look at all sides of the water equation.

There are direct ways to get water back into the aquifer. Artificial recharge is increasingly important in water-short areas around the globe and even in places as wet as South Florida, where it is used to help balance out surface water flows. Playas have been considered as sources for artificial recharge since the 1950s, but early efforts did not pan out. High silt loads in the playa water quickly plugged injection wells or drainage basins, resulting in high maintenance and low recharge volume.

Playas are getting another look today. What has changed is not so much the lakes themselves, but how we look at them. In the 1960s we thought simple engineering approaches could fix all our problems. Today, we have a greater appreciation of the complexities of the ecosystems in which we operate and the value of the services that natural systems provide to society. The best way to increase

recharge from the playas may be to restore their pre-development function as recharge wetlands rather than draining them with pumps, wells, and plows.

It is difficult to determine exactly how much recharge playas contributed to the Ogallala in the past. The High Plains is one of the most altered landscapes in North America. Despite being one of the last areas of the American West to be settled, the Plains have been platted, fenced, grazed, and plowed more intensively than any other part of the continent. The flat landscape provides no natural barriers or buffer zones - no steep mountain slopes or canyon walls; no stream courses or rock outcrops – and few vestiges of the original landscape remain intact today.

But the very nature of the landscape disturbances today suggests that pre-development recharge from the playa lakes was substantially greater than it is now. The landscape today features conservation-terraced, furrow-diked fields plowed right up to or right through the playas. Overgrazed areas have been re-planted with non-native grasses selected for high forage production rather than local adaptation. The result is that playas are filling in with sediment, creating shallower lakes that hold less water and for a shorter time. The native short-grass prairie of the High Plains persisted for over a million years, slowly building soil over the Ogallala cap-rock as dust and volcanic ash blew in from the west and was trapped by the sod. The native short grasses had a lower water demand than today's crop plants or non-native grasses, and effectively stabilized the soil surface, limiting erosion and sedimentation in the playas. Although the unbroken sod was effective at intercepting runoff, today's landscape is probably even more effective at holding water on the fields where crops can use it. Between filling the playas with sediment and reducing runoff from the uplands, it is likely that recharge from the playa lakes has gone down as well.

The TWDB is working to determine the best strategy for restoring the playa's recharge function. The playa research project will create a monitoring system to establish baseline conditions using remote sensing, a network of instrumented sites, and citizen volunteers. After three years of initial monitoring, a sub-set of playas will be modified to test the effectiveness of different methods of recharge enhancement and then tracked for a period of three to five years to see how recharge is affected. Playa modifications may include sediment excavation and buffer strip planting; establishment of deep-rooted native grasses to increase the permeability of lake-bottom clays; and V-ditching or deep plowing to break up restrictive layers.

The TWDB playa project is being implemented in partnership with the US Department of Agriculture-Agricultural Research Service, the Natural Resources Conservation Service, Texas Tech University, and the groundwater conservation districts in the High Plains region. Landowner cooperation is also essential as almost all playas are on private lands. Playa modifications are intended to largely maintain the wetlands characteristics of the sites so as to avoid conflict with Federal wetlands regulations, but participating landowners are also protected from any loss of Farm Program benefits as a result of playa modifications under a specific exemption included in the 2008 Farm Bill.

We don't know how much recharge can be increased. Estimates of ¼ to ½ inch per year are based on the ratio of average chloride concentrations in the aquifer to the chloride concentration in

rainfall. Since virtually all the water in the aquifer was accumulated pre-development, that estimate really reflects recharge rates before modern agriculture began on the High Plains. The current recharge rate may be even lower. One-half inch per year may be as much as we can get on a regional basis.

We'll know more once we start systematically monitoring the playas. Right now, no one has any idea how much water is collected in the playas in any given year. Most of the US has an extensive stream gauging network that measures runoff in real time for flood control, emergency management, and water resource planning. There are less than a dozen stream gauges on the High Plains of Texas. The stream courses in which they sit intercept less than ten percent of the regions' runoff and can stay dry for years at a time. The playa monitoring network will let us know how much water we have to work with.

Managing playa water resources may require new thinking for the local, state, and federal organizations charged with groundwater, wetlands, and wildlife management. Substantial investments for recharge improvement may be required, spread over a large number of small sites. If individual landowners invest in improvements to increase recharge, can they count on being the ones to capture the benefits? How should benefits be calculated if different groups value the resources differently, from the perspectives of agriculture versus wildlife or urban use versus manufacturing, for example. Where will funding come from? There are federal programs to support wetlands conservation, but there is a widespread perception that the incentives are too low, and State wetlands conservation is focused on coastal wetlands, not the playas. Local efforts could supplement federal payments, but a piecemeal approach through purchase of conservation easement to compensate property owners for taking land out of crop production may not be enough. Costs and benefits will also be spread spatially and temporally. Not all areas with intensive irrigation have numerous playas, and it may take years for water captured in a playa today to reach the water table and be accessible to irrigation pumps. Addressing these issues will require creative thinking by all stake-holders.

There are some daunting challenges ahead for the High Plains. Water is and will remain a critical issue. Research can help define what there is to work with and may be able to eke some more available groundwater from the environment, but even under the most optimistic scenarios it is clear that truly sustainable groundwater withdrawals are far less than current amounts. Managing a controlled transition to sustainable use will be a major issue for the Texas High Plains in the 21st century. Making the best use of playa lake water resources may be an important part of the process.