Drought on the Rio Grande

BY ZACK GUIDO

Nearly all the surface water had been drained from Elephant Butte Reservoir by October, and the Rio Grande below the dam flowed at a trickle. Sandy bars had become exposed where the chocolate-colored river had flowed only weeks before. At Greg Daviet's pecan farm in the Mesilla Valley outside Las Cruces—about 40 miles downriver from Elephant Butte—the drone of groundwater pumps filled the air. Wells gushed crystalline water onto thirsty orchards.

Despite another dry year—the ninth time in the last decade that farmers received a fraction of the surface water they need to sustain their crops—Daviet's pecan trees were primed for a healthy harvest thanks to bountiful groundwater. The extra pumping during the dry time, however, comes at a price. Groundwater costs more than surface water and its higher salinity harms crops over the long run.

"Drought will never be as profitable as wet times," Daviet said. "While, the water is still sufficient in a drought, how we [manage] it needs to change."

On the Rio Grande—the wellspring for more than five million people living in Colorado, New Mexico, Texas, and Mexico—coping with scarcity is now a reality, and water and agricultural practices may become leading examples of how to adapt to drier times.

Water Use on the Rio Grande

From the white-clad peaks of southern Colorado to the Gulf of Mexico, the Rio Grande flows for about 1,800 miles. In New Mexico, the river pauses several times behind dams, including the state's largest reservoir Elephant Butte, which stores about 2.2 million acre-feet of water. (An acre-foot covers one acre of land in one foot of water and satisfies, on average, the annual water needs of about eight Albuquerque residents.) About 25 miles down river, Caballo Reservoir impounds an additional 350,000 acre-feet. In a good year, these reservoirs release 790,000 acre-feet, with 416,000 acre-feet destined for the Elephant Butte Irrigation District (EBID) in southern New Mexico, and 314,000 and 60,000 acre-feet passed to Texas and Mexico, respectively.

When flows in the river and storage in reservoirs are sufficient, the EBID doles out a full irrigation allotment of 36 inches of water per acre of land. In some years, EBID can allocate more. Recently, allocation has been a lot less.

"In about 1978, we began a 23-year full supply of surface water," said Gary Esslinger, director of the EBID. "We had plenty of snowpack runoff. The lakes were full. We were just over our heads in surface water."

In 2003, drought set in. It was a wake-up call, Esslinger said. The last two winters have done little to ease his concerns.

Current Conditions

Back-to-back La Niña events during the 2010 and 2011 winters helped steer storms away from the Upper Rio Grande Basin in Colorado, where most of the water flowing in the Rio Grande originates. Rain and snow totaled less than 82 percent of the 1971–2000 average during these winters, contributing to a decreasing trend in reservoir storage. As of November 30, Elephant Butte stood at about six percent of capacity, and the water available for future irrigation was completely exhausted. For the foreseeable future, the amount of surface water accessible to farmers will depend entirely on the winter's precipitation and likely will be insufficient to meet demand. To compensate, irrigators will continue to rely heavily on groundwater.

"Around half a million acre-feet of water is the amount of water that needs to be put on the fields [in EBID]," Daviet said. "In wet years, the reservoirs provide plenty of that. In years where we are drier, we supplement that with groundwater pumping."

A Protective Shield

Porous sediments below the Rio Grande have soaked up river water through geologic time, forming a reservoir vastly larger than Elephant Butte. The aquifer beneath Mesilla Valley is more than 2,000 feet thick in some places (Texas Water Development Board, 2007), providing ample water that safeguards against droughts. On Daviet's farm, for example, water levels have dropped only 30 feet in the last 10 years despite

ramped up pumping. With many wells in the region penetrating hundreds of feet into the aquifer, concern about running out of water is low.

"Do I think that we will ever see a drought that will deplete 300 feet [dropping water below the wells]," Daviet said. "Probably not in my lifetime."

The large store of groundwater is not only a savings account that protects crops against inadequate surface water allotments, but it also allows farmers to apply water on demand. In the middle of the summer when demand is high, for example, EBID can move only a fraction of the water needed, and some farmers have to wait for water. This can occur in both wet and dry times, and access to groundwater enables farmers to shield their crops from distribution bottlenecks that would otherwise stress crops and lower yields.

Daviet is lucky. His farm sits on a sweet spot for water in the Lower Rio Grande. About 40 miles north, near Hatch, the aquifer is substantially smaller and water is found at depths less than 200 feet. On Lack Farms, onions, chili, cotton, and other crops cover more than 1,500 acres. Wells there only penetrate 60 feet, and the recent declines in groundwater have caused the water table to dip below the intake valves when the pumps are turned on. This causes water and air to be drawn together, straining the pumps and reducing water flow.

"Our wells are surging; our water level is dropping," said Rosie Lack sales executive for Lack Farms, noting that continued low surface water allotments will be difficult to overcome.

The Added Costs

Even where ample water exists, farmers like Daviet are not immune to drought. Rather than drying out fields, the drought has shriveled savings.

"When we have to pump nearly all of our water, for a pecan farmer it adds 10 to 15 percent to our normal expenditures," Daviet said.

PICTURED: BLEACHED ROCKS THAT LINE ELEPHANT BUTTE, THE NAMESAKE FOR ELEPHANT BUTTE RESERVOIR IN SOUTHERN NEW MEXICO, ARE A VISUAL REMINDER THAT WATER STORES ALL NEARLY EXHAUSTED. IN EARLY JULY WHEN THIS PHOTO WAS TAKEN, ELEPHANT BUTTE RESERVOIR CONTAINED ONLY ABOUT 12 PERCENT OF CAPACITY; STORAGE IS CURRENTLY EVEN LESS. PHOTO BY ZACK GUIDO.

These unwanted costs can skyrocket when large capital improvements need to be made to irrigation systems—added investments that occur more often in times of drought.

"About every 10 feet that our water table drops, I lose about a 100 gallons per minute," Daviet said.

To overcome this shortfall, Daviet was forced to spend $150,000 on a new well, a significant portion of his operating budget. For profitable farms, these added expenditures can be absorbed. For farms functioning on the margins of profitability, it can push them over the edge.

"Big infrastructure improvements could be as much as 30 to 40 percent [of annual budgets] in years that big improvements need to be done to enable groundwater pumping," Daviet said. "When you are talking about that level of investment, if you have a farm that is marginal, that could be the straw that breaks them."

Groundwater also has other, hidden costs. Because the local geologic deposits are rich in salts and groundwater spends long amounts of time in contact with them, salts are extricated from the sediments much like hot water extracts caffeine. Consequently, groundwater carries higher salinity concentrations than surface water, and requires purchasing additives to prevent harm to the crops.

The added costs affect more than pecan growers. In Hatch, the chili pepper is king. Jim Lytle's family has been farming the valley since the late 1800s and has helped pioneer chili production in the region. A variety of pepper, the one found on most chili relleno dishes, even bears the name of Lytle's father—The Big Jim. The drought has been a burden on his family as well.

"We use approximately four feet of water to irrigate one acre of chili," Lytle said. "We were only allocated [10] inches [this year], so the rest of it we have to pump. That's going to impact us significantly, and what it comes to is at the tail end, we are going to make, probably, half of what we normally make."

At Lack Farms, the recent dry conditions have lowered crop yields while also raising production costs.

"I feel like the drought has probably affected the yield potential by at least 40 percent and our expenses are up too," Lack said.

A History of Drought

While the recent dry spell has been severe, it is not unusual for the Southwest. Researchers at the University of Arizona used tree rings to recreate streamflows at Otowi Bridge, about 60 miles north of Albuquerque, for the years 1450–2002. This 552-year record shows five 10-year periods in which flows were less than the lowest historical values measured by stream gauges (Figure 1). The most persistent drought occurred in the late 1800s, when flows measured 73 percent of average during an 11-year period. In other words, the 20th century—especially the wet period near the end—is not representative of streamflow variability in the Rio Grande, said Connie Woodhouse, professor at the University of Arizona's School of Geography and one of the scientists who reconstructed the streamflow history of Rio Grande.

The record is a warning: the severity, frequency, and duration of naturally occurring droughts in the Rio

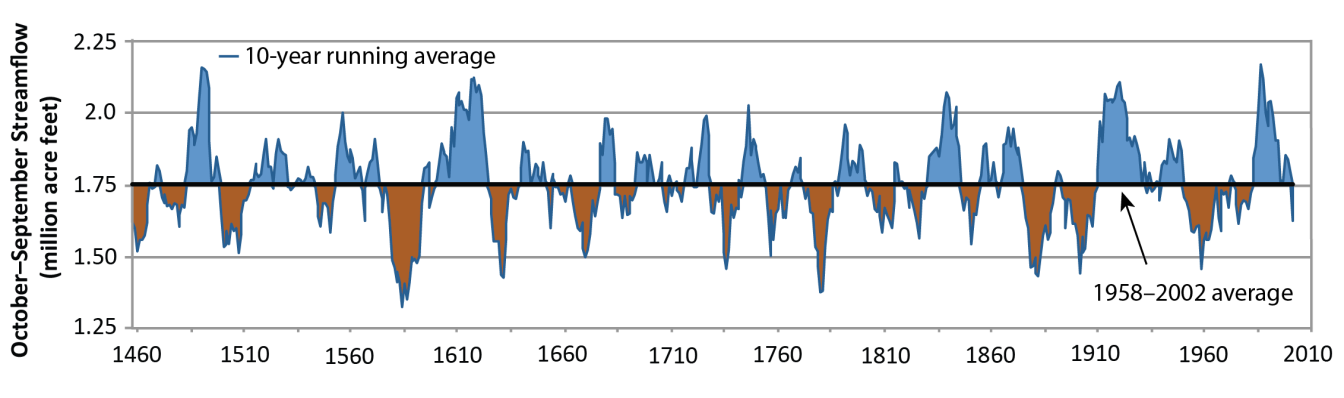

FIGURE 1: RECONSTRUCTED STREAMFLOW OF THE RIO GRANDE AT OTOWI BRIDGE NORTH OF ALBUQUERQUE, NEW MEXICO. THE RECORD WAS DEVELOPED USING TREE RINGS. (WOODHOUSE CA, ET AL. 2012.) DATA AVAILABLE ON THE WEB AT TREEFLOW.INFO.

PICTURED: RIO GRANDE IN NEW MEXICO. ISTOCKPHOTO.COM.

Grande watershed may exceed those of recent years. That could mean greater challenges for water management than those the region has faced.

Adapting to Drought

In many places in the Lower Rio Grande, groundwater has been the saving grace during the last dry 10 years, but relying on groundwater is not a failsafe strategy. The groundwater and river are tethered to each other so that declines in the Rio Grande ultimately reduce infiltration.

"The groundwater is hydrologically connected to the river. It's not magically making water; it's really borrowing it from future water supplies," King said.

While groundwater reserves are currently ample, those supplies may eventually lower to where it's no longer profitable to use groundwater, a prospect that has caught the attention of water managers.

"The greatest uncertainty is the changes that are coming with climate change," said Filiberto Cortez, manager of the Bureau of Reclamation's El Paso Field Division.

Developing safeguards against future change also has immediate payoffs. The EBID is exploring new strategies to boost supply, including capturing monsoon torrents by building earthen structures that funnel water spilling from drainages into irrigation canals.

"We've been really intense in developing a stormwater management plan to capture the water and use it to recharge our aquifer," Esslinger said.

Capturing monsoon precipitation, however, cannot completely compensate for reductions in streamflow experienced in the recent decade, King said. Other coping strategies are also needed, including more coordinated management. Daviet, for example, could sell his surface water allocation to farms in Hatch in return for compensation for the added expenditure of pumping more groundwater. This transfer allows water to move from places of abundance to those of scarcity. Water managers also foresee changes in land tenure in order to adapt to drier climates.

"I think what you will see is a change in the crop types," King said. "Probably, [farmers will] concentrate what little water there is on smaller acreage and grow higher value crops."

Esslinger agrees. "Farmers here are very progressive, very innovative. Garlic and things that we've never thought of may be grown here and may be a new source of agriculture."

More than 10 years of drought has undoubtedly taken its toll on farmers in the region, and if drought becomes more commonplace in the future, it will likely carry burdens too heavy for some to overcome. Nonetheless, farming will not disappear. Daviet, for one, remains optimistic.

"Drought is not the end of the world," Daviet said. "We can adjust to it. We do adjust to it, as long as you don't fight change and try to adapt to it."