New study identifies contributing factors to groundwater table declines

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It's no secret groundwater levels have declined across the state over the past eight decades, and that the primary reason was the onset of irrigation in agriculture and population growth. But a recent Texas A&M AgriLife Research study has identified other factors having an impact.

The groundwater declines have been most severe in the past four decades, but the news isn't all bad, according to Dr. Srinivasulu Ale, AgriLife Research geospatial hydrology assistant professor in Vernon.

"Long-term (1930-2010) trends in groundwater levels in Texas: Influences of soils, land cover and water use," authored by Dr. Sriroop Chaudhuri, former post-doctoral research associate at Vernon, and Ale, was published in the *Science of the Total Environment* journal recently.

Ale said they conducted the study because by 2060 the state's population is expected to double, increasing the demand for water at a time when the existing water supply is expected to be reduced by about 10 percent.

"We wanted to know which areas are more vulnerable to water shortages," he said. "In order to plan and implement strategies to deal with the water level declines, we needed to know how these levels were declining spatially and temporally."

Previous hydrologic studies on Texas groundwater levels were conducted mostly on an aquifer-specific basis, and lacked the statewide panoramic view Ale and Chaudhuri wanted to present. They wanted an overview of trends in groundwater levels from 1930 to 2010, and they wanted to identify spatial patterns from the 136,930 groundwater level observations from the Texas Water Development Board's database.

They utilized the boundaries of the Texas Water Development Board's designated Groundwater Management Areas, or GMAs, for their assessment. The 16 GMAs, with boundaries identified in response to legislation passed in 2001, included all major and minor aquifers in the state. The objective behind GMA identification was to delineate areas considered suitable for management of groundwater resources.

"Our results indicated a progressive decline in statewide decadal median water levels in Texas from about 46 feet to 118 feet between the 1930s and 2000s," Chaudhuri said. "We identified hot spots of deep water levels in GMA 8 (North Central Texas) and the Texas Panhandle regions since the 1960s, mainly due to extensive groundwater withdrawals for urban and irrigational purposes, respectively."

For the purposes of this study, the Panhandle region includes 12 western and central counties in GMA 1 and three northwestern counties in GMA 2, he said.

Statewide, the number of counties with deeper median water levels, a water-level depth below 328 feet, increased from two to 13 between 1930s and 2000s, he said. At the same time, there was a decrease in the number of counties, from 134 to 113, having shallower median water-levels or groundwater located within 82 feet of the ground surface.

"We know irrigated agriculture is the major cause of depletion in the Texas Panhandle, as compared to increasing urbanization in GMA 8," Chaudhuri said. "We saw a significant drop in median groundwater levels in irrigation wells from 75 to 180 feet between the 1940s and 1950s in the Texas Panhandle, coinciding with the initiation of widespread irrigated agricultural practices."

But he said they knew there was more to the decline than just these uses, because "unused" wells monitored across the state throughout the decades were also showing varying levels of decline. That was when they studied groundwater and surface-water use patterns, soil characteristics, geology and land cover types to better understand the water-level changes in Texas.

For instance, the South Plains and Panhandle were equally involved in agriculture and irrigated crops over the Ogallala Aquifer. However, the sandier soils of the South Plains allow more infiltration and recharge than the tighter clay soils of the Panhandle.

In addition to population growth in GMA 8, the high clay content in soils coupled with shale/claystone type geology and more land area covered by highways and parking lots have lowered the amount of recharge, thus contributing to the decline in water levels.

There is a brighter note, Ale said.

"Interestingly, the trends we observed over the decades show the water-level declines are leveling off recently in some parts of the state, including GMA 8, suggesting a recovery from historical drawdown due to implementation of conservation and regulatory strategies," Ale said.

The leveling off of the decline has been seen in the past decade after the implementation of the GMAs and the guidelines and regulations that were established with them, he said. Increased use of surface water and assessment of water levels are some measures being utilized to address groundwater depletion issues in the Houston, GMA 14, and Dallas, GMA 8, areas.

However, these voluntary conservation or regulatory strategies have resulted in a variable pattern of recovery in ambient water-levels, which are still occurring frequently at deeper depths in the hot spots and thus warrant further investigation, he said.

Ale said the need for more spatially intensive and frequent water-level monitoring has been realized over the course of this study. In addition, further investigation of aquifer-specific influences such as groundwater recharge and flow paths, human dimensions on water-level fluctuations and climate are warranted.

"Overall, our study indicated that use of robust spatial and statistical methods can reveal important details about the trends in water-level changes and shed light on the associated factors," Chaudhuri said. "Due to their very generic nature, techniques used in this study can also be applied to other areas with similar eco-hydrologic issues to identify regions that warrant future management actions."

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