Designing and Testing a Relative Resiliency Framework for Groundwater Management

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ABSTRACT

Texas depends upon its plentiful and reliable groundwater resources, particularly in times of drought. Groundwater has enabled economic growth, agriculture, and human expansion into areas that would otherwise not support large populations. The groundwater resources of Texas have so far proven to be relatively resilient in most areas despite considerable pumping. However, anticipated population growth will amplify the vulnerability of these resources. During the next 50 years, the population of Texas is expected to increase by 70%, with the majority of growth expected in the municipal sector. The planning information published every five years by the Texas Water Development Board (TWDB), such as population projections and State Water Plans, aid the policy making process to meet the intense demand on our surface and groundwater resources. In addition, Regional Water Planning Groups develop water management strategies that recommend prioritization of projects for funding considerations. Robust planning and implementation of water resources management programs can ensure inter-generational equity, robust economic growth, and the satisfaction of demand. In addition to meeting the needs of human, planners and managers need to consider the characteristics and state of the aquifers to avoid depletion or unacceptable impacts to the resource. This research presents a resiliency framework that incorporates multiple dimensions using spatial and temporal variables to assess vulnerability on a relative scale. The framework is used to implement a comparative analysis for counties along the Interstate-35 corridor, or the projected "growth corridor" projected to experience the highest rates of growth in Texas. Results are presented graphically to highlight the relative risks within the region. However, given the relative nature of the variables and the scales upon which they are measured, the framework becomes stronger and more accurate as additional data is added to it. Resilience is defined as the ability to recover from a stress event, such as the ability of an aquifer to rebound from drought or overdraws. Within the framework, aquifer vulnerability is defined as how susceptible an area is to shortfalls and aquifer stress when considering variables such as shortages, climate, the aquifer formation, and existing regulation. From this point of view, vulnerability and resilience are inverse to each other and serve as opposing ends of a spectrum. The relative measurement scale which this framework is built upon tested using county-level data to depict the relationships between regions. The preliminary implementation presents indicator results as a relative proportion in relation to the set of counties under consideration, therefore the vulnerability or resilience scores reflect the comparative set. As the information is expanded to include broader numbers of counties, the usefulness of the approach will improve. As designed, the Relative Resiliency Framework (RRF) is scalable and multi-dimensional allowing for adaptation or use in other settings. Most importantly, the RRF allows development and discussion of various resiliency components that affect the groundwater resources in Texas and the regions they serve.

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