Developing Sustainable and Resilient Cotton Cropping Systems in the Semi-Arid Texas Great Plains

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Project Goal

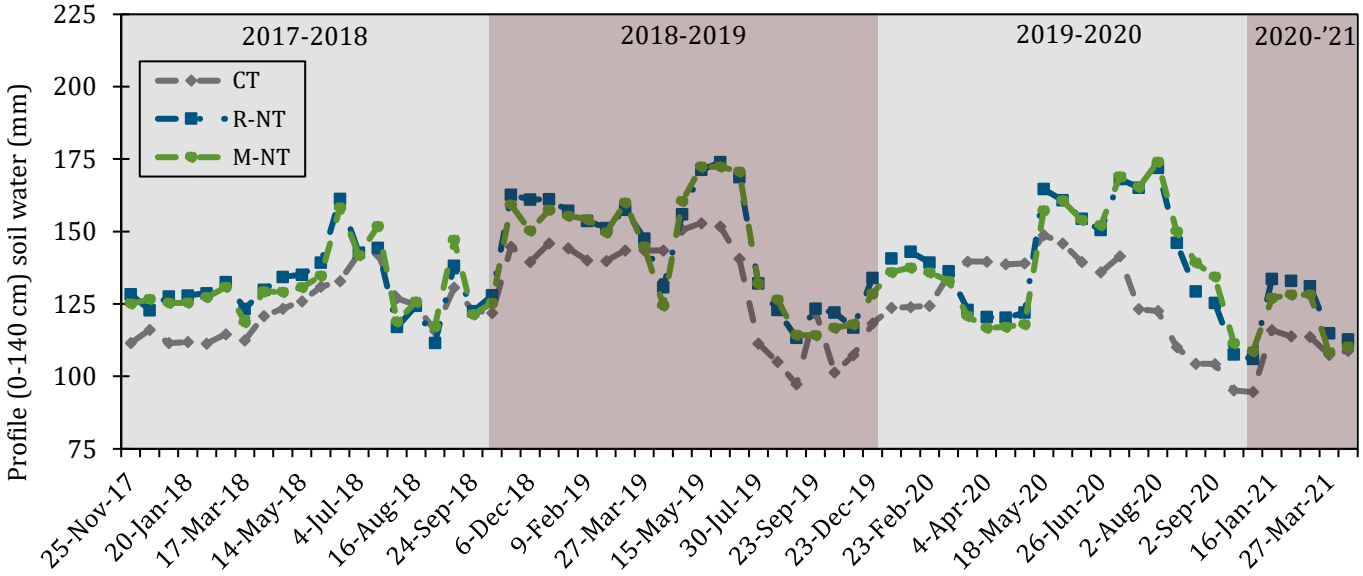
Assess future water availability and economic sustainability in the region following adoption of conservation management practices and investigate how current agronomic practices influence soil water dynamics in order to develop more resilient and sustainable cotton cropping systems in this semi-arid ecoregion.

Water in the Southern High Plains

Water availability is essential to the continued agricultural production on the U.S. Great Plains. Increasing water-use efficiency and soil water storage capacity is paramount considering the predicted annual changes in temperature and precipitation due to global climate change. The future viability of agricultural production in this region relies on the sustainability and security of usable groundwater for irrigation. The Ogallala Aquifer is the main source of irrigation for much of the Great Plains and is the largest freshwater aquifer in the U.S., underlying eight states.

The semi-arid southern portion of the Great Plains, the Southern High Plains (SHP), produces an estimated 30% of the U.S. annual cotton production and receives approximately 90% of its irrigation demand from the Ogallala Aquifer. However, the aquifer is a closed basin, and the recharge rate is dependent on precipitation. The saturated thickness and subsequent water quality of certain areas of the aquifer are decreasing at an unsustainable rate due to the withdrawal far exceeding the annual recharge rate. This is even more prevalent in the SHP, where the aquifer recharge rate in most counties (0-76 mm) is extremely low due to geomorphology and climate. Projected climate change is expected to compound the issue with predicted increases in annual temperature in the SHP paired alongside more frequent extreme weather events such as droughts and dust storms.

The SHP region is the nation's top cotton-producer, however, certain areas in this region have a projected useable aquifer lifetime of approximately 2 years and the aquifer has a saturated thickness of less than 10 m in certain counties of the SHP. As a result, many producers in this region have been transitioning to dryland cotton production systems. The continued unsustainable withdrawal of the groundwater from the Ogallala Aquifer for irrigation, paired with the potential increase in annual mean temperature due to climate change puts the future agricultural viability of the region at risk.



Left. Profile soil water was significantly impacted by cropping system management practices. Cover crops caused initial decrease in soil water, but water capture and storage was greater in-season.

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