

# Groundwater Scarcity: Implications for U.S. Agricultural Production and Global Food Security

In 2021, BANR proposes to develop a concept for a major, high-level consensus study on the implications of water scarcity on the U.S. food and agriculture sector in partnership with the National Academies Water Science and Technology Board. The concept will be explored with representatives of the USDA, the National Science Foundation, USGS, and other agencies, as well as private foundations in order to build a case for the need for such a study and determine the nature of recommendations that will be most impactful.

The World Bank (2020) estimates that a fifth of world's agricultural production takes place using irrigation on lands that provide 40% of the food produced globally. The source of approximately 40% of the water used for irrigation in agriculture globally is groundwater. Alarming, satellite data and other monitoring tools have documented that groundwater supplies in many of the world's key agricultural regions are shrinking (Figure 1) at a time when global food needs are increasing.

In many areas of the United States, groundwater sources are also declining as the consequence of unsustainable, long-term drawdowns in fossil aquifers, negative recharge rates of active aquifers, and continued warming and drying trends throughout the western and central U.S. (Figure 2).

The reality that groundwater supplies are falling has been on the agriculture radar screen for decades, but the nation's policymakers do

Trends in Groundwater Storage from NASA GRACE Mission (2003-2013)

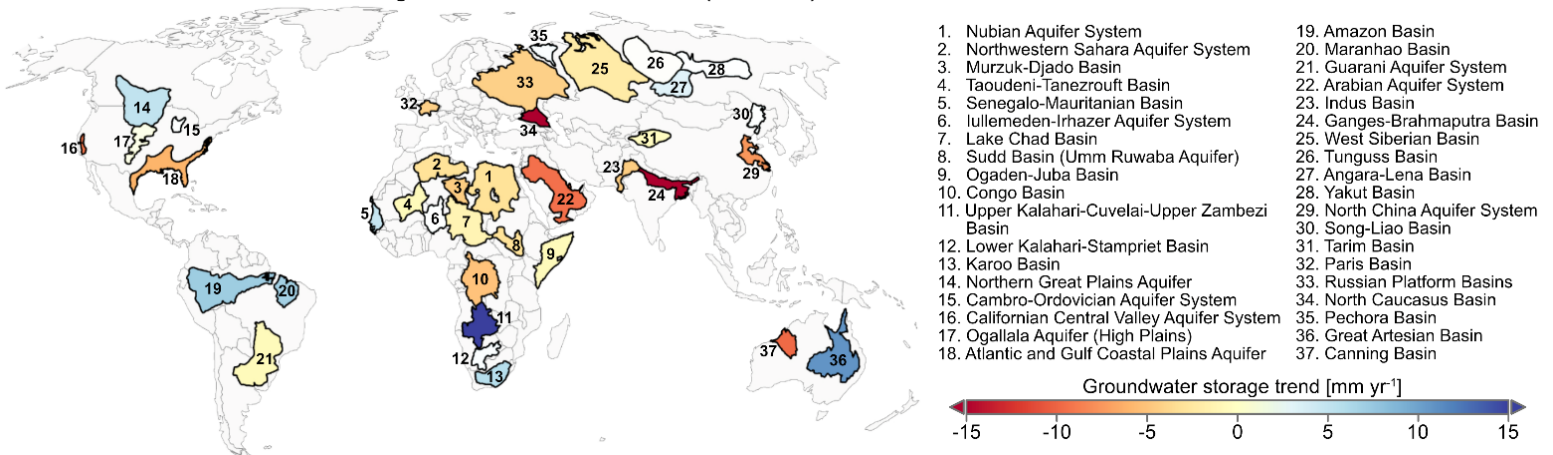


Figure 1. Trends in Groundwater Storage Globally. SOURCE: Richey et al., 2015.

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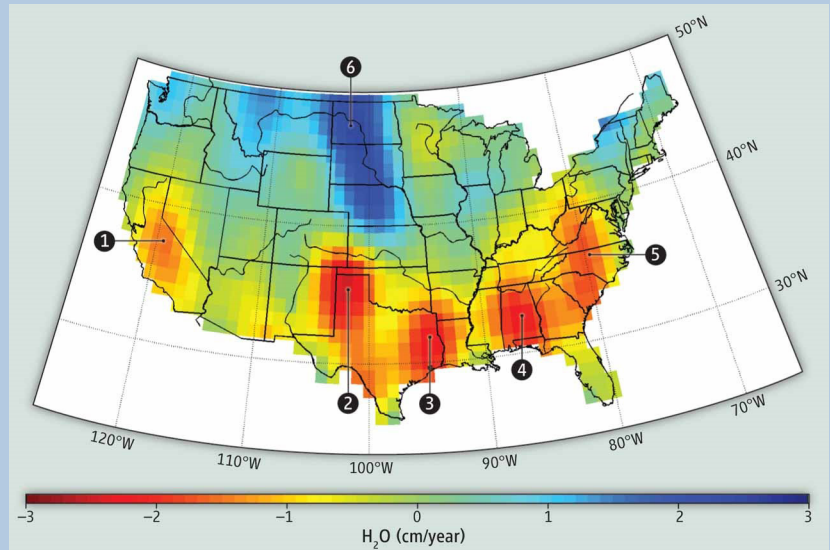
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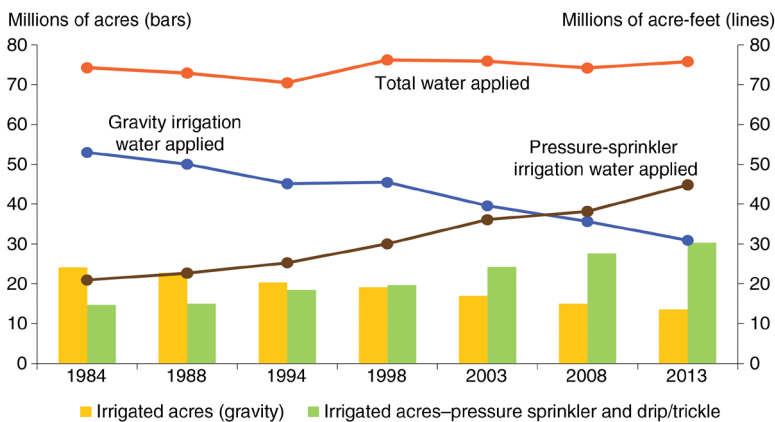
not yet recognize the potential seriousness of these conditions and the immense challenges of developing and executing adaptation strategies that would reverse or mitigate the negative trend. Even as U.S. farmers in some parts of the country have taken steps to adopt more water-efficient irrigation technologies (Figure 3), it is not clear how those changes are and will affect groundwater supplies in the long term.

The U.S. has not adequately addressed this slow-moving crisis. The scientific and policy communities are just beginning to get a sense of what declining groundwater supplies will mean for our regional food production systems and the economic implications for the agricultural sector, not to mention the potential impact on global food security. A comprehensive synthesis of current research is necessary to understand the many dimensions of the groundwater problem and to support the development of systems-level solutions.

Figure 2. Between 2003 and 2012, GRACE data show water losses in agricultural regions such as California's Central Valley (1) ( $-1.5 \pm 0.1$  cm/year) and the Southern High Plains Aquifer (2) ( $-2.5 \pm 0.2$  cm/year), caused by overreliance on groundwater to supply irrigation water. Regions where groundwater is being depleted as a result of prolonged drought include Houston (3) ( $-2.3 \pm 0.6$  cm/year), Alabama (4) ( $-2.1 \pm 0.8$  cm/year), and the Mid-Atlantic states (5) ( $-1.8 \pm 0.6$  cm/year). Water storage is increasing in the flood-prone Upper Missouri River basin (6) ( $2.5 \pm 0.2$  cm/year). Data from (15) and from GRACE data release CSR RL05. SOURCE: Famiglietti and Rodell, 2013.



Irrigation systems in the arid Western States have shifted toward more efficient pressurized sprinkler systems



Note: Water-use information from USDA's Farm and Ranch Irrigation Survey (FRIS) reports onfarm water applied, not withdrawals. Also, the area tracked includes only acres irrigated in the open. It excludes area (square-feet) under protection on horticulture operations. Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service 1984, 1988, 1994, 1998, 2003, 2008, and 2013, FRIS data.

This year, BANR will engage the scientific, economic, policy, and stakeholder communities concerned with water supply issues in shaping a proposal for a National Academies' consensus study on how water scarcity will affect food production and the U.S. agricultural and food economy. The study will explore how climate change, population growth and water management are impacting freshwater availability, and the threats to food security and address the question of whether sustainable groundwater management and sustainable food production are mutually exclusive. It is anticipated that the synthesis would also identify knowledge gaps, and explore technologies to both better understand water use and how water can be conserved (through monitoring, changes in irrigation efficiency/water use, modifications to cropping decisions, and other mechanisms). The analysis should examine how different actors, institutions and policies can play a critical role in water conservation and ultimately lead to policy-relevant recommendations.