Reduce, Repurpose, Recharge: Establishing a Collaborative Doctrine of Groundwater Management in the Ogallala Aquifer

Zoe Kanavas

May 2022

The Day One Project Early Career Science Policy Accelerator is a joint initiative between the Federation of American Scientists & the National Science Policy Network.

Summary

Climate change has resulted in extreme and irregular rain events across the United States. Consequently, farmers in the High Plains region have been increasingly dependent on the Ogallala Aquifer for water supplies. With an estimated value of $35 billion, this aquifer supports one-fifth of the nations' wheat, corn, cotton, and cattle. The Ogallala once held enough water to fill Chicago's Sears Tower over 2,000 times. Today, the aquifer has lost 30% of its supply—and it is being recharged at half the rate it is being depleted. The consequence of inaction is 70% aquifer depletion by 2060, which will reduce crop output by 30–40%.

This $14 billion loss to the High Plains agricultural production may be slowed and eventually reversed by (1) reducing Ogallala use, (2) repurposing existing supplies, and (3) recharging the aquifer. The U.S. Department of Agriculture (USDA), in collaboration with the Department of the Interior (DOI) and the Federal Emergency Management Agency (FEMA), should accordingly create the Reduce, Repurpose, Recharge Initiative (RRRI), a voluntary program designed to keep farmers engaged in groundwater conservation. This multi-state program will provide financial incentives to participating farmers in exchange for pledges to limit groundwater withdrawal and participate in training that will equip them with knowledge needed to fulfill those pledges. The RRRI will also make expert advisors available to consult with farmers on policies and funding opportunities related to groundwater conservation. Finally, this program will connect farmers across state lines, allowing them to learn from each other and work together on sustainable management of the Ogallala. The program should be funded through the various water-sustainability budgets of the DOI and USDA, as well as through FEMA's Building Resilient Infrastructure and Communities grant program.

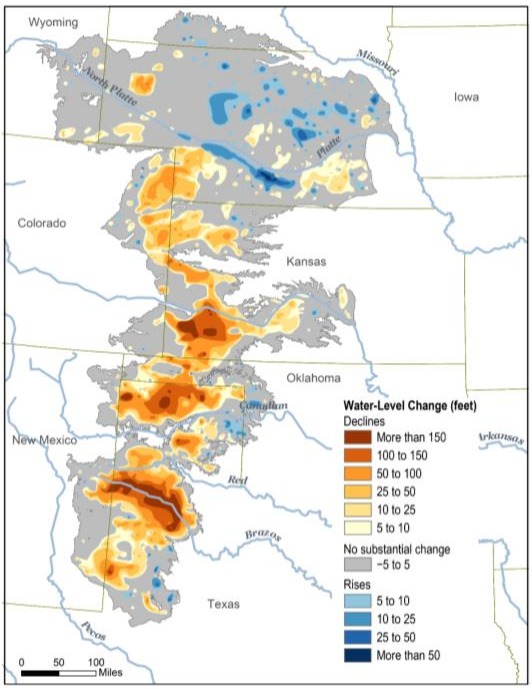

Figure 1. Changes in groundwater levels in the Ogallala Aquifer from predevelopment to 2015. Adapted in the Fourth National Climate Assessment from McGuire et al. (2017).

Challenge and Opportunity

Climate-change-induced droughts have increased the nation's dependence on groundwater as a source for agriculture, industry, and domestic use. Excessive groundwater pumping has led to land subsidence and deterioration of water quality, increasing water-use cost and jeopardizing crop yield. The problem is especially acute in the Ogallala Aquifer of the High Plains region. The aquifer underlies eight states of the nation's breadbasket—including Nebraska, Kansas, and Texas—and spans 175,000 square miles. Dependence on the Ogallala has depleted its supply by 30% to date, as shown in Figure 1. 90% of water withdrawn from the Ogallala is used for agricultural irrigation.

Strategic plans for the USDA and DOI make it clear that drought preparedness and water conservation/sustainability are national priorities. Multiple federal efforts exist to advance these priorities. Publicly accessible platforms hosting and providing groundwater data exist at the United States Geological Survey (USGS), the National Institute of Food and Agriculture (NIFA), and the cross-agency National Integrated Drought Information System (NIDIS) partnership. The 2018 Farm Bill strengthened technical- and financial-assistance programs to help individual farms implement water-conservation technology; the bill also created an incentive program for agriculture-to-wetland conversion. From 2011–2018, the USDA's Natural Resources Conservation Service (NRCS) ran the Ogallala Aquifer Initiative (OAI) to "support targeted, local efforts to conserve the availability of water, both its quantity and quality, in each of the States" covering the Ogallala. The OAI was successful in meeting its water-conservation goals. Recent surveys found that 93% of agricultural producers in the High Plains region believe that water conservation is important.

These past and ongoing initiatives demonstrate that federal will and stakeholder buy-in for aquifer conservation and restoration are there. The key need is for a program that provides farmers the incentives and technical assistance needed to minimize groundwater reliance, ending the tragedy of the commons in the Ogallala once and for all.

Plan of Action

USDA, DOI, and FEMA should launch a joint program designed to embed the three pillars of groundwater conservation—Reduce, Repurpose, and Recharge—into the practices of farmers in Ogallala states. The RRRI will provide a financial incentive to farmers in exchange for farmer commitments to:
(1) Achieve specified water-conservation targets.
(2) Participate in training opportunities and workshops teaching best practices for water conservation and aquifer recharge.

To succeed, the RRRI will require enthusiastic, voluntary participation from farmers across the High Plains region. Participation should be voluntary because studies have shown that voluntary programs are significantly more effective than mandates in achieving water-conservation goals. In a comparative case study about implementing

a voluntary versus mandated water restriction, farmers under the voluntary restriction conserved more water relative to the mandatory regulation. A survey of these farmers attributed the group-education component of the voluntary program as the driving force for their restriction. Another survey similarly found that farmers' altruistic views of water conservation led to longer-lasting participation in water-conservation activities. A comprehensive review of the outcomes of different water policies found that educational programs about water conservation were more effective in water use reduction and improving attitudes towards water conservation relative to mandatory water use restrictions.

To encourage voluntary participation, farmers who enroll in the RRRI would receive a financial incentive. The exact nature of the incentive would need to be determined by the implementing agencies, but could include preferential price setting, preferential market placement, or subsidies based on crop type. In exchange, farmers would agree to an initial water-use assessment performed by field experts (either employees or contractors of USDA or DOI). An appointed advisor (again, either employees or contractors of USDA or DOI) would then work with each farmer to establish long-term (5-year) water-conservation targets based on the assessment results. Each participating farmer would meet quarterly with their advisor to review their water-conservation plan, assess progress towards targets, make mutually agreeable target adjustments, and discuss challenges and solutions. Advisors would also be available in between quarterly meetings for interim questions and concerns.

Farmers who enroll in the RRRI would also commit to attending group trainings and workshops designed to help them identify and implement best water-conservation practices. These learning opportunities would be led by experts sourced from existing agricultural committees (e.g., NRCS Conservation Planners and Technical Service Providers, State Technical Committees, etc.) and water-conservation groups (e.g., Ogallala Water Coordinated Agriculture Project, Groundwater Protection Council, etc.). The group-education curriculum would cover the three tenets of groundwater conservation: reduce, repurpose, and recharge. Table 1 provides a brief description of each tenet, along with examples of aligned activities and potential sources of funding for those activities. The curriculum would teach farmers how each tenet contributes to groundwater conservation, existing and emerging technologies and practices that farmers can implement to achieve each tenet, and financial vehicles available to fund implementation. An added benefit of the group education will be the establishment of a community of farmers across the Ogallala states in which ideas and experiences can be shared.

Table 1. Definition, example activities, and potential funding sources for each groundwater-conservation tenet.

Tenet	Definition	Example activities	Potential funding source(s)
Reduce	Minimizing water needs for	More efficient irrigation	NRCS's Agricultural Management Assistance and Conservation Innovation Grants

	existing systems		
Repurpose	Move away from water-intensive practices	Switch to less water-intensive crops	NRCS's Regional Conservation Partnership Program and Conservation Stewardship Program
Recharge	Replenish groundwater source (aquifer)	Capture excess stormwater; convert agricultural land to wetlands	FEMA's Building Resilient Infrastructure and Communities Grant; NRCS's Agricultural Conservation Easement Program

The RRRI should be established as a multi-agency collaboration. Each involved agency (USDA, DOI, and FEMA) can provide unique expertise. USDA can leverage its research arm, NIFA, to produce up-to-date technology recommendations and scientific assessments. USDA's NRCS can provide the underlying technical and financial support for realizing the RRRI tenets. DOI can rely on USGS's existing groundwater database and the NIDIS's affiliated expert community of data scientists to support the granular, up-to-date groundwater measurements needed to assess water-conservation progress. DOI's Bureau of Land Management (BLM) can ensure the RRRI tenets are enacted (in parallel with implementation on privately owned farmland) across public lands in the High Plains region. Finally, FEMA can collaborate with NIDIS and with USDA's Risk Management Agency (RMA) to formally assess risks of drought and Ogallala depletion—assessments that can be used to make the case for the RRRI to farmers, funders, and policymakers.

Early actions needed to launch the RRRI include:

- Appoint a joint USDA/DOI task force to refine program goals and implementation strategy.
- Create teams of technical and financial experts to build the group-education curriculum.
- Identify people working at the interface of water conservation, land use, and drought preparedness who could serve as potential advisors.
- Recruit an initial cohort of farmers for a pilot version of the program. One pool to draw on for initial recruitment consists of the respondents to Lauer and Sanderson's 2019 survey of producer attitudes in the Ogallala region.
- Socialize the proposal for RRRI with the House Agriculture Committee staff for authorization. The RRRI would fit well as part of the upcoming (in 2023) Farm Bill renewal.

Conclusion

Climate-change-induced droughts have increased farmer dependence on groundwater, resulting in a 30% depletion of the Ogallala Aquifer to date. Under current management practices, depletion of the Ogallala will reach 70% by 2060. We can solve the problem. The technology, technical expertise, programmatic and data infrastructure, and financial support for groundwater conservation exist. The key need is to directly connect farmers with—and motivate them to use—these resources. A joint USDA/DOI/FEMA program founded in the "Reduce, Repurpose, Recharge" tenets of water conservation can do just that for farmers across the High Plains region. By coupling financial incentives with tailored water-conservation targets, technical expertise, and group educational opportunities, the RRRI will meaningfully advance the long-term security of the critically important Ogallala—and the farmers whose livelihoods depend on it.

Frequently Asked Questions

1. What is the estimated cost of this program?

Based on the budget for the Ogallala Aquifer Initiative, the RRRI would require $25 million per year for 10-20 years to support the program's staff and cover travel costs. This funding can be drawn from water-sustainability discretionary funds already allocated at USDA and DOI as well as FEMA's Building Resilient Infrastructure and Communities grant program.

2. What existing technologies can promote sustainable groundwater management?

Publications from the Ogallala Water Coordinated Agriculture Project cite numerous examples of existing technologies that can promote sustainable groundwater management, including irrigating with recycled water (i.e., direct non-potable reuse) and shifting to dryland irrigation.

3. How does the hydrology of the Ogallala region lend itself to aquifer recharge?

The sandy soils of the High Plains are ideal for managed aquifer recharge as they allow for fast infiltration.

4. Why focus on the Ogallala Aquifer when groundwater depletion is an issue across the US?

With no existing federal regulation on groundwater use, the country needs a pilot program to demonstrate the effectiveness of an interstate groundwater use policy to create precedent for future policymaking and begin to optimize water use policies at such a large scale. The Ogallala Aquifer is the largest and most productive aquifer in

the world and conserving the agriculture it supports is required for a sustainable future.

5. Why won't the federal government just put a limit on groundwater pumping?

While the federal government has regulations in place dictating water quality through the Environmental Protection Agency's Clean Water Act and Safe Drinking Water Act, water-allocation policy is left up to the states. Between the eight states above the Ogallala Aquifer, there are four distinct doctrines that define groundwater law, some in direct conflict with one another. State authority over water resources makes it difficult for the federal government to implement mandatory groundwater conservation measures. Voluntary programs like RRRI are an effective mechanism to reach groundwater conservation goals without infringing on states' water rights.

About the Author

Zoe Kanavas is a Ph.D. Candidate in Water Resources Engineering at the University of California, Davis. Her research reveals the fundamental physics that drive groundwater flow at extremely small scales, employing computational fluid dynamics, statistical analysis, and machine learning to do so. Zoe's leadership, collaboration, and innovation skills align with her career goals to use science policy to combat environmental injustice and promote evidence-based policy decisions. She holds a M.S. in Water Resources Engineering from the University of California, Davis and a dual B.S. in Geological Engineering and Geophysics from the University of Wisconsin, Madison.

About the Day One Project

The Federation of American Scientists' Day One Project is dedicated to democratizing the policymaking process by working with new and expert voices across the science and technology community, helping to develop actionable policies that can improve the lives of all Americans. For more about the Day One Project, visit **dayoneproject.org.**

The Day One Project offers a platform for ideas that represent a broad range of perspectives across S&T disciplines. The views and opinions expressed in this proposal are those of the author(s) and do not reflect the views and opinions of the Day One Project or its S&T Leadership Council.