

Polycentric and Integrated Groundwater-Surfacewater Governance: Advantages and Limitations of the Natural Resources District Model in Nebraska, U.S.A.

Jedd, T.⁽¹⁾, G. Sixt⁽²⁾, A. Schutz⁽³⁾, M. Burbach⁽⁴⁾

(1) Chair of Environment and Climate Policy, School of Governance, Technical University of Munich, Germany theresa.jedd@hfp.tum.de ; (2) Abdul Latif Jameel Water and Food Systems Lab, Massachusetts Institute of Technology, Cambridge, MA, USA sixt@mit.edu; (3) University of Nebraska-Lincoln, College of Law, USA; (4) University of Nebraska-Lincoln, School of Natural Resources, Conservation & Survey Division, USA



Introduction The authority to make decisions about water allocations in Nebraska is distributed across local, regional, state, and federal institutions. At the center of Nebraska’s polycentric water governance is the working relationship between sub-state entities called Natural Resources Districts (NRDs) and the state’s natural resource agency, the Nebraska Department of Natural Resources (NeDNR). Generally speaking, surface water is administered by the NeDNR and groundwater is governed by NRDs. While other states use local resource planning units to manage water, the NRD model does not exist in any other state and is unique in its scope of responsibilities for managing the hydrological connections between ground and surface water when maximum allocations have already been issued. This interplay of political authority is an instance of polycentric governance.

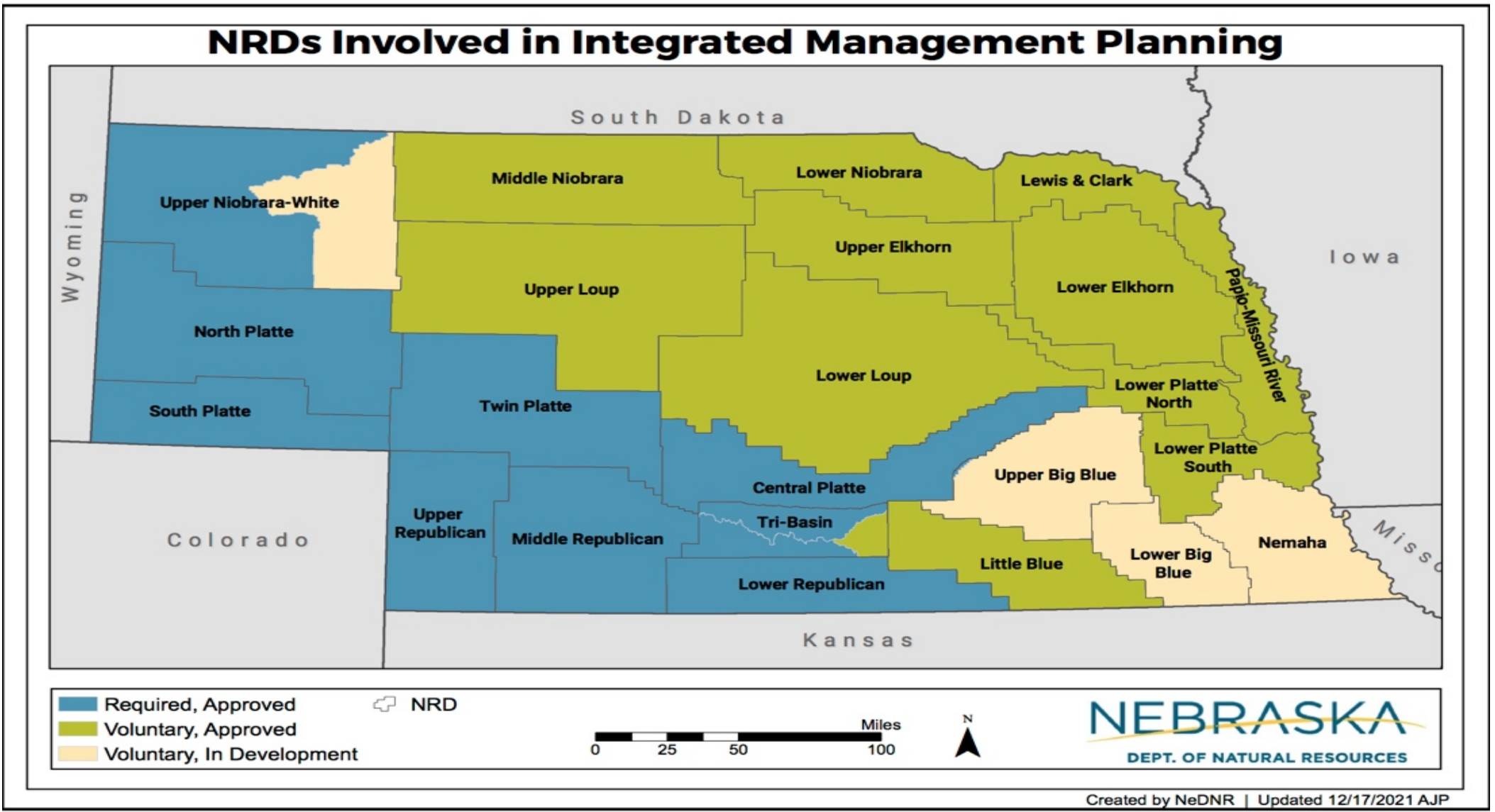
Research Questions Flexibility that comes with governing at multiple levels can be an asset in building social legitimacy, but it can also result in weak rules and resource depletion. This is a shortcoming that is not yet fully addressed in the Sustainable Development Goals (SDGs) (DiVaio et al, 2021). We fill this gap by investigating questions related to integrated governance of groundwater and surface water in a U.S. state that has previously had relatively abundant agricultural water supply, but has experienced shortages in recent decades. Can the socially-based authority of NRDs serve as a basis for making rules in over-allocated basins? What types of governance mechanisms are used for surface water-groundwater interactions? How can they be revised in accordance with changing water availability?



Sustainable Development Goals Multiple SDGs are related to groundwater governance. Groundwater is a key component of crop irrigation and food production, water source for communities, and an input for various industrial and energy processes. The most direct connections are with Goal 2 (Zero hunger), Goal 6 (Clean water and sanitation), and Goal 12 (Ensure sustainable consumption and production patterns).

The Need for Polycentric Governance Polycentricity is a condition in which decisions are made by multiple distinct but overlapping centers of authority (Ostrom, 2010) and is often applied to environmental governance due to the complex, multi-dimensional, and diverse range of resources subject to overuse or depletion (Carlisle and Gruby, 2017). This framework is fitting for analyzing Nebraska’s water governance because of the diversity of actors and levels of decision-making.

Nebraska is known for its thriving agricultural economy, due in large part to irrigation. In addition to agricultural production, the state also hosts irrigation input manufacturing and sales. Both of these have depended on adequate water availability. However, in recent decades, some areas of the state now face water stress. Groundwater gives a buffer against variable surface water availability, especially during droughts. Among U.S. states, Nebraska has the most irrigated cropland and pastures (Bleed and Babbitt, 2015) with between 8-9 million acres of farmland under irrigation, 32% of the state’s total area (U.S. Department of Agriculture, 2019). Most irrigation is supplied by groundwater from the Northern High Plains (Ogallala) Aquifer. Groundwater in the northern region of the aquifer is being withdrawn at a higher rate than it is being recharged. Almost half of the loss in 2000-2009 occurred in the Republican River Basin, which is shared between Colorado, Nebraska, and Kansas. These losses are due to irrigation withdrawal, driven by decreased rainfall and increased surface water evaporation (Peterson et al., 2020).



Natural Resources Districts with Integrated Management Plans as of December 17, 2021. Source: Nebraska Department of Natural Resources. Reprinted with permission.

Study Area Nebraska is a state of stark ecological contrasts, which influence the diversity of agricultural production. About a quarter of the state is a Sandhills ecotype with high soil erosion and low precipitation. These areas are used more for cattle grazing than crop production. In the rest of the state, however, prairie and humus soils are suitable for small grain production. The average annual rainfall varies geographically. The eastern portion of the state receives about twice as much rain (35 inches) as the western part (15 inches) (Shulski, 2018). Because of drought, irrigation is a major dimension of agriculture in Nebraska (Ulrich, 2018), and has led to increased yields and an increase in property value. In recent decades, droughts plagued the state from February 2002 to September 2008 and again at a peak the first week of October 2012 with more than 77% of the state in severe drought (National Drought Mitigation Center, 2021). Without groundwater irrigation, the state’s agriculture-heavy economy would suffer more than it already does during droughts.

Results NRDs can (and do) exercise controls; they do so by using their authority to make institutional changes and sanction violators for over-abstraction. This authority is granted and legitimized by publicly elected boards, an ongoing leadership training network, and a history of locally driven rule-making. However, there are also shortcomings to the model: in particular, it is difficult to address cross-border issues or legal conflicts. Furthermore, there is scant research on its effectiveness in actually preventing groundwater decline. The Nebraska model and its local examples may offer lessons for other basins where water resources have historically been relatively plentiful but are now facing drought stresses and the growing demands of intensive irrigated agricultural production.

Revisions to Integrated Management Planning

Natural Resources District and Revision Order Document Name	Examples of Institutional Changes	Types of Sanctioning Allowable for Violations
Upper Republican NRD Order No. 34 Adopting Ground Water Controls (2018) ⁵	Amended groundwater rules and regulations for the 2018–2022 period; spacing requirements for industrial and commercial livestock wells; changed criteria for the transfer of irrigated acres	The District can revoke or reduce irrigation allocation permits if compliance is breached. Violators are subject to further sanctioning under District rules and Neb. Rev. Statute.
Upper Big Blue NRD Groundwater Management Rules and Regulations (2020) ⁶	New rules for Groundwater Management Area #1 and #2 to supersede previous GMA rules	The District can issue a cease-and-desist order to enforce withdrawal rules and regulations; violators can request an adjudication hearing. The District set new rules for groundwater transfers, and reserves the right to revoke authorization.
Lower Platte South NRD Groundwater Rules and Regulations, Revised (2020) ⁷	Establishes a Groundwater Management Area that includes the entire District	Allows for mandatory education requirements to reduce groundwater depletion; authorizes District compliance officers to issue a cease-and-desist order for abstraction violation, followed by subcommittee consideration, and eventually a civil misdemeanor for non-compliance
North Platte NRD Rules & Regulations for Enforcement of the Nebraska Ground Water Management and Protection Act and the Nebraska Chemigation Act (2019) ⁸	Establishes procedures for violation of the Nebraska Ground Water Management and Protection Act	The District can issue a cease-and-desist order when acts or activities violate state or District rules; a hearing may follow; penalties may be imposed as determined by the Board and/or future allocation amounts may be accordingly reduced; violations can result in civil penalties from \$1,000–\$5,000 per day of intentional violation (p. 54)

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Conclusion In Nebraska, groundwater and surface water are managed in a somewhat coordinated polycentric model, which offers needed flexibility given the growing demand for irrigation coupled with cyclical changes in water availability. The NRDs’ IMPs are a key component for basins in crisis (over appropriation), and the Republican and the Platte River basins offer examples of how Nebraska’s water governance model holds up in fully or over appropriated basins. The localized model, together with state and federal planning and legal mechanisms, is designed to mitigate the impacts of diminished supply. It has the advantage of involving public and private stakeholders across levels of governance.

However, there are also shortcomings and limitations. The model of groundwater allocation, in particular, requires a great deal of stakeholder participation and the active oversight of a Board of Directors. When participation and oversight are lacking, lawsuits related to breach of allocations have ensued, pushing the state to revise its statutes, particularly to address the challenge of managing hydrologically connected waters. Furthermore, the disparate legal philosophies and mechanisms used in over-appropriated areas can cause problems: when sanctions are used on groundwater access, irrigators can be subject to the fluctuating availability of surface water. Droughts and annual changes in water availability can create conflicts in hydrologically connected areas. Integrated management planning is now beginning to address these challenges. If NRDs exercise their full potential in designing and implementing these plans, with stakeholder involvement, conflicts may be reduced while increasing the sustainability of water supply in Nebraska.

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