WATER DIPLOMACY AT THE MACRO SCALE:
AGRICULTURAL GROUNDWATER GOVERNANCE IN THE HIGH PLAINS AQUIFER REGION OF THE UNITED STATES

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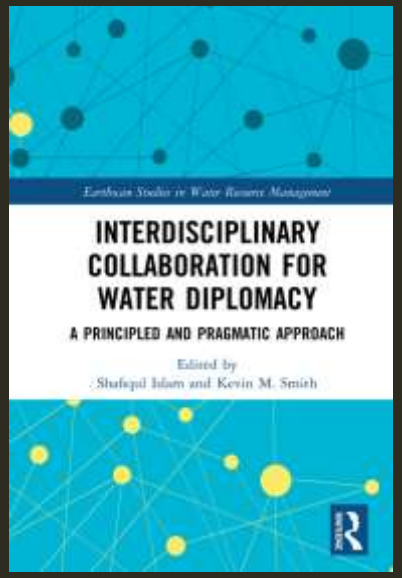
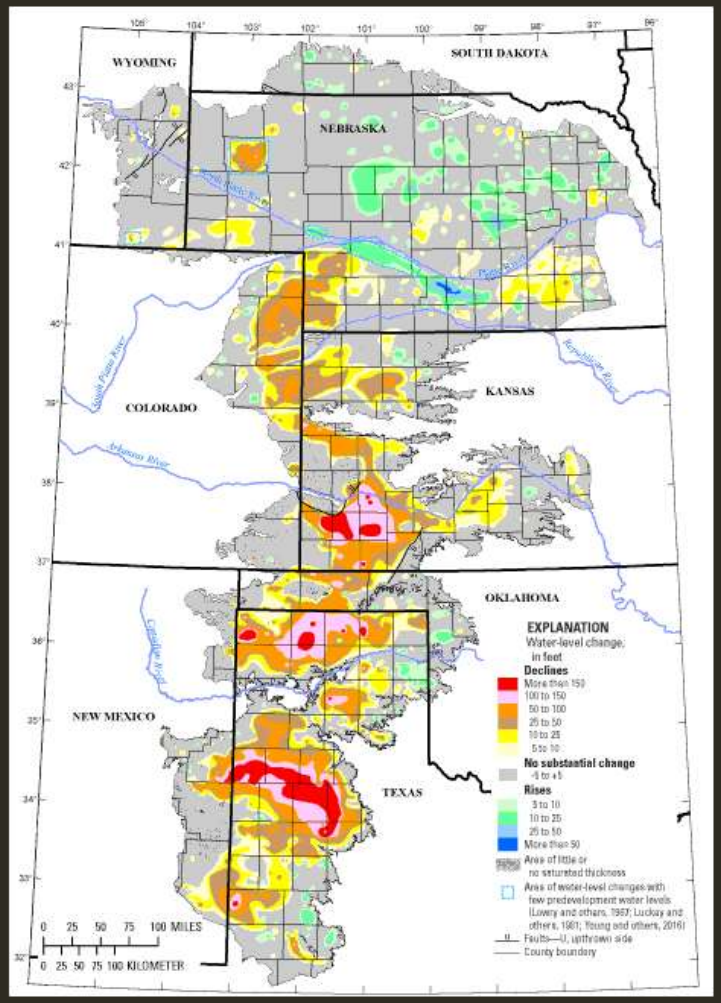


STUDY AREA – HIGH PLAINS AQUIFER



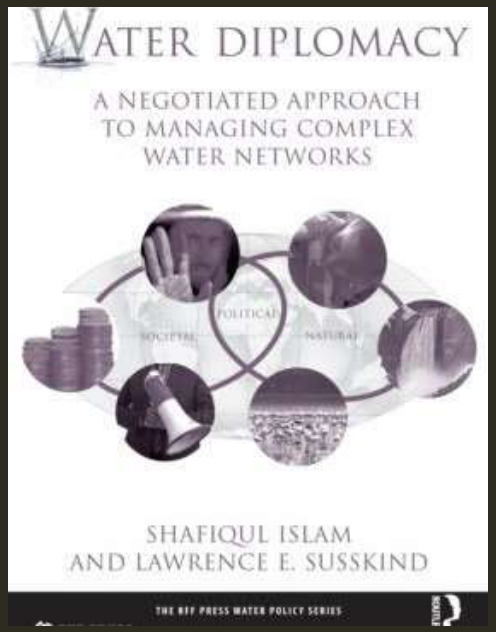
High Plains aquifer water-level changes, predevelopment to 2015 (usgs.gov)

- One of the largest aquifers in the world
- Most intensively used aquifer in the U.S. (Sophocleous, 2011)
- Supports ~20% of corn, wheat, cotton, and cattle production (USDA-NRCS, 2016)
- Drinking water for >80% of people in the region (Sophocleous, 2011)
- Water-level decline a major problem - but spatially variable

ANALYTICAL CONTEXT
WATER DIPLOMACY

- What is Water Diplomacy?
  - Interdisciplinary
  - Engages state & non-state stakeholders
  - Address, resolve, avoid tensions/conflicts over water

- Water Diplomacy has two scales
  - Micro - Water negotiations
  - Macro – Higher-level, governance institutions



ANALYTICAL FRAMEWORK
WATER DIPLOMACY AT THE MACRO SCALE

Water Diplomacy at the Macro Scale
(Adapted from Ostrom 1990, 2008)

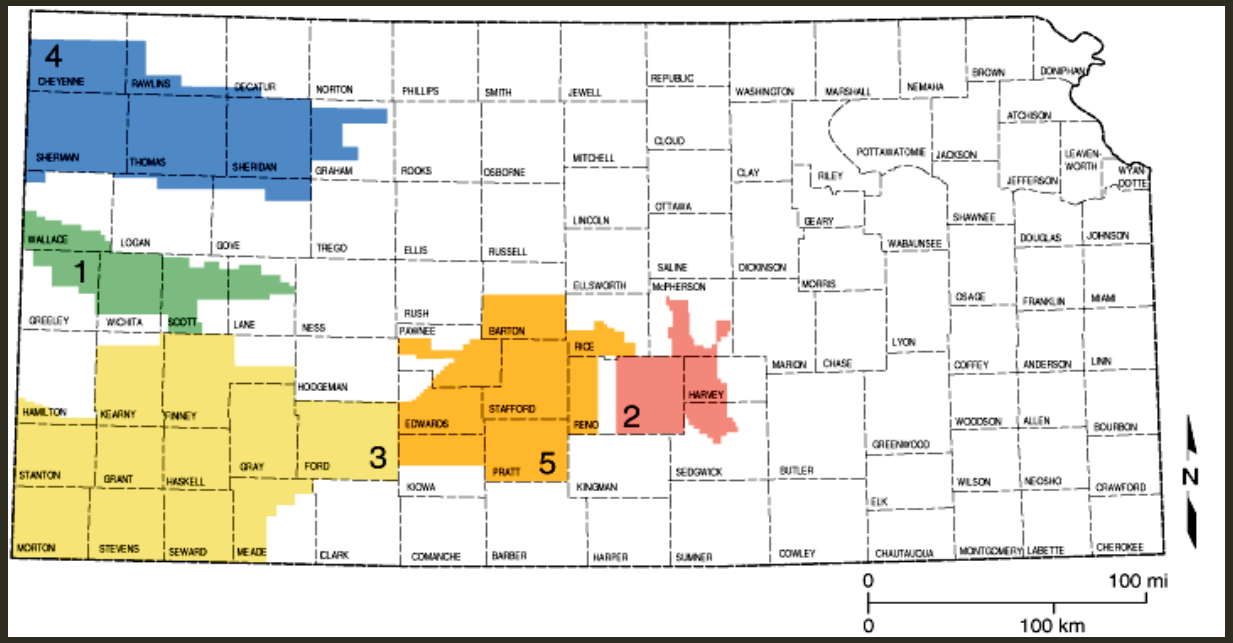
1. Clearly defined boundaries
2. Proportional equivalence between benefits and costs
3. Collective choice arrangements
4. Monitoring
5. Graduated sanctions
6. Conflict-resolution mechanisms
7. Minimal recognition of rights to organize
8. Nested enterprises

GROUNDWATER GOVERNANCE IN THE U.S.
TWO FUNDAMENTAL PRINCIPLES

- **Water Rights**
  - Important distinction between property right and for public good
  - Major impact on management options

- **Allocation rules**
  1. Rule of Capture (aka Absolute Ownership)
  2. Reasonable Use Doctrine
  3. Correlative Rights
  4. Prior Appropriation

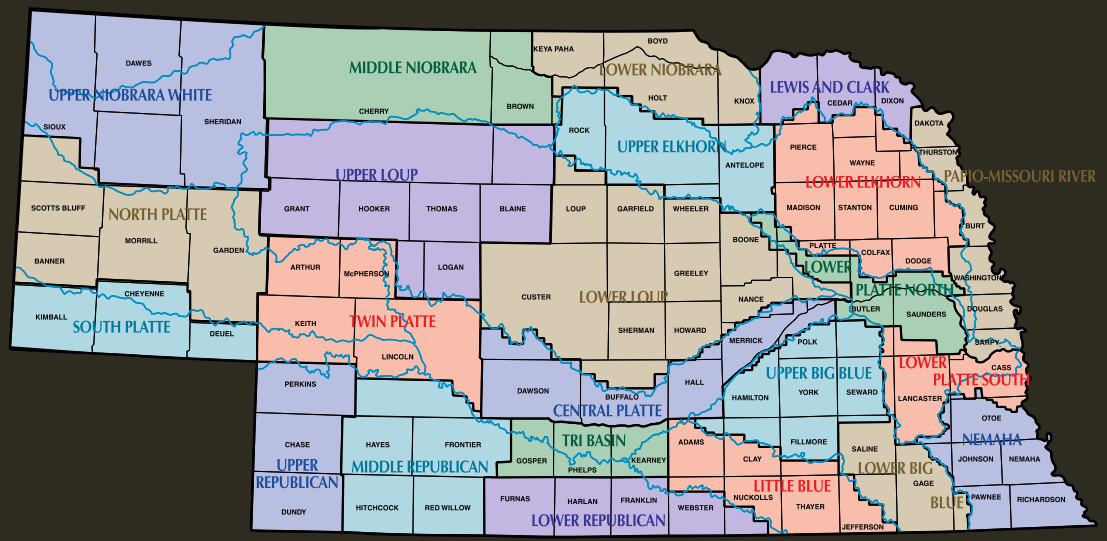
KANSAS



Kansas GMD and county boundaries (www.kgs.ku.edu/Hydro/gmd.html)

- GW is a Property Right
- Allocation: Prior Appropriation
  - More water rights granted than GW supply
- GW governed through KDWR and 5 GMDs
  - Ultimate authority in Chief Engineer of KDWR

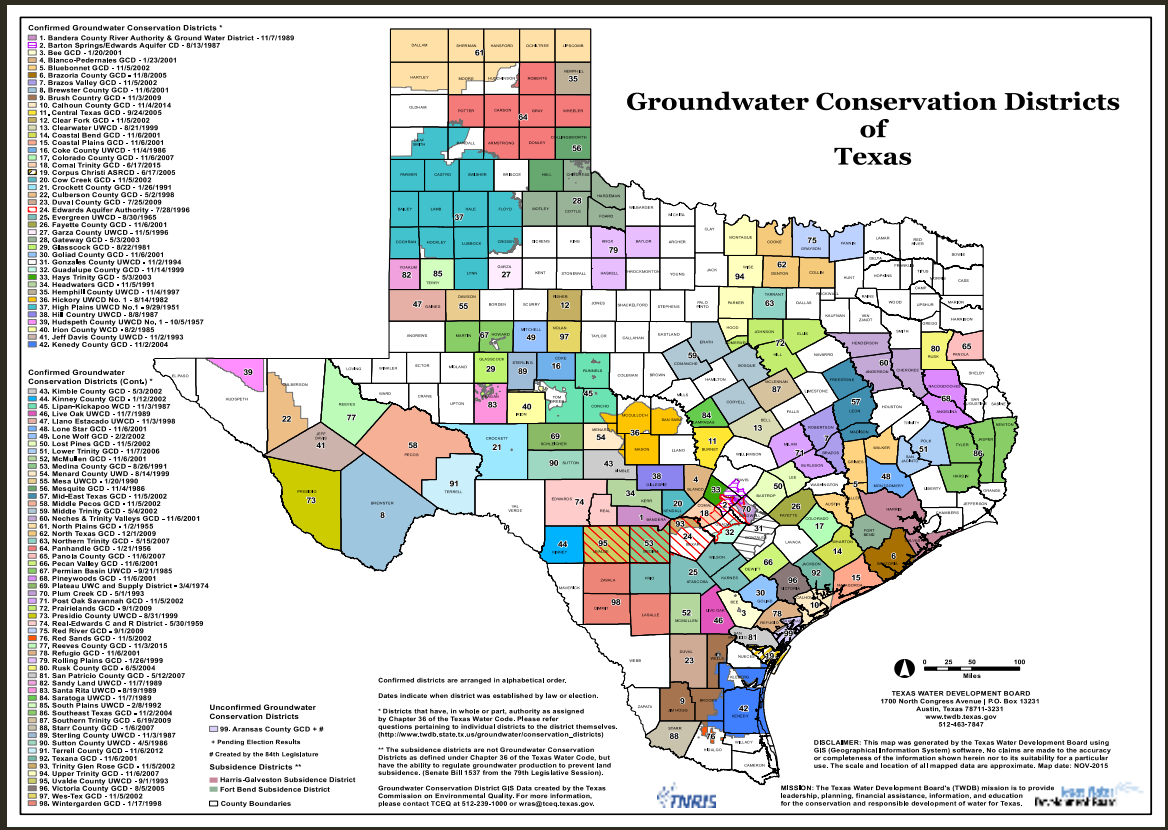
NEBRASKA



Nebraska NRDs and county boundaries (https://www.papionrd.org/)

- GW owned by the state "for the benefit of its citizens" *(Neb. Rev. Stat. §46-702 (Reissue 2010), 2007)*
- Allocation: Reasonable Use/Correlative Rights hybrid
  - Unique to NE
- GW governed through locally elected 23 NRDs

TEXAS



- GW is a property right (http://www.twdb.texas.gov/)
- Allocation: Rule of Capture ("Law of the biggest pump")
- GW governed through GCDs – some elected

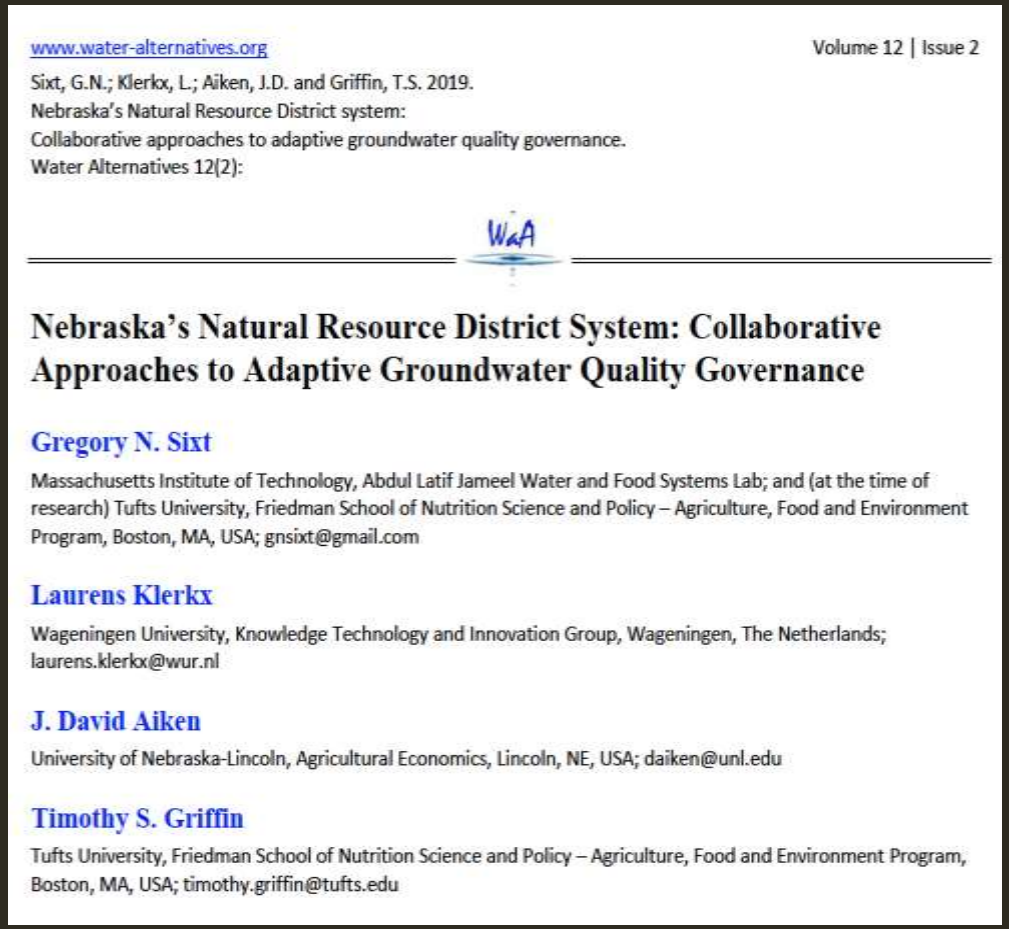
RESULTS

Water Diplomacy Design Principle	Kansas	Nebraska	Texas
1. Clearly defined boundaries	- Clearly defined GMD boundaries roughly correspond to aquifer	- Clearly defined NRD boundaries roughly correspond to aquifer	- Clearly defined GCD boundaries, but politically drawn - No mechanism for hydrologically connected surface and groundwater
2. Proportional equivalence between benefits and costs	- Prior appropriation allocation not reflective of local conditions - More water allocation than supply	- NRDs have flexibility to regulate based on local conditions at necessary scales	- Rule of Capture allocation not reflective of local conditions
3. Collective-choice arrangements	- Water regulation authority rests with Chief Engineer - Definition of eligible voter narrowly defined	- NRD boards locally elected, anyone can run, and all voters can vote	- Not all GCD boards are elected
4. Monitoring	- Chief Engineer not a user and is appointed, thus not accountable to users	- All NRDs have some combination of required monitoring measures, and most require metering	- Not all GCDs boards monitor - Most GCDs do not require metering
5. Graduated sanctions	- Sanctions reflective of severity and context of violation	- Sanctions reflective of severity and context of violation	- Sanctions reflective of severity and context of violation
6. Conflict-resolution mechanisms	- Only avenues through litigation and Chief Engineer	- Complaint between users through NRDs - Complaint between NRDs/NRD and state ad hoc appointed board - No formal process for between users and officials	- Only avenue through litigation
7. Minimal recognition of rights to organize	- Users can establish GMD or control area, but requires approval of Chief Engineer - Users have long-term transferrable water rights	- Users organize through NRDs and NRDs can create own rules and regulations - Users have long-term transferrable water rights	- Users can petition to create GCD and GCDs can create own rules and regulations - Users have long-term transferrable water rights
8. Nested enterprises	- Authority rests with Chief Engineer not GMDs	- Nested, empowered NRDs with state oversight	- Officially GCDs have nested authority, but Rule of Capture hinders authority

● = Fully meets design principle; ● = Partially meets design principle; ● = Does not meet design principle

NEBRASKA'S NRD SYSTEM
ADAPTING TO EMERGING CHALLENGES

- In-depth study on NRD system using key informant semi-structured interviews
- How NRDs have adapted to address groundwater *quality*
- Collaborative, adaptive governance for emerging challenges – like climate change



www.water-alternatives.org Volume 12 | Issue 2
Sixt, G.N.; Klerkx, L.; Aiken, J.D. and Griffin, T.S. 2019.
Nebraska's Natural Resource District system:
Collaborative approaches to adaptive groundwater quality governance.
Water Alternatives 12(2):

Nebraska's Natural Resource District System: Collaborative Approaches to Adaptive Groundwater Quality Governance

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