Watershed Markets
with Lessons from Nebraska

David McAdams
Duke Fuqua + Economics
April 2016

Caltech Workshop on Rationalizing the Allocation of California Water
(GRAND ISLAND, NE) The Central Platte Natural Resources District’s (CPNRD) board of directors approved the first transactions of the Groundwater Exchange pilot program on Thursday. Sellers placed 30 locations online for leasing, with six buyers placing bids- three for irrigation and three for streamflow rights. The computer program matched the three irrigation bids with sellers in the eastern area of the District.
Plan for Talk

1. Why Nebraska? Why Central Platte?

2. “Sales Pitch” for the Market

3. Next Steps: Driving Market Adoption
Central Platte Groundwater Exchange Program: Background

1969

NRDs formed by state

Nebraska Legislature reorganizes ~150 conservation districts into 24 Natural Resources Districts

- locally elected
- boundaries coincide with major surface drainage divides
Central Platte Groundwater Exchange Program: Background

NRDs granted broad authority in “control areas”:
- well-spacing restrictions
- rotation of pumping wells
- limitations on groundwater withdrawals
- moratorium on new well drilling

Ground Water Management Act

1975
Central Platte Groundwater Exchange Program: Background

Integrated Management Plan explicitly recognizes connection between groundwater and surface water.

Failure to design adequate IMP can trigger Interrelated Water Review Board & externally-imposed controls.

CPNRD develops Integrated Management Plan

2005-2006
Central Platte Groundwater Exchange Program: Background

“The goal of the study is to provide scientifically supportable databases, analyses and detailed computer groundwater models to more accurately identify and quantify the relationship between the Platte River and adjacent groundwater resource.”

Platte Basin Cooperative Hydrology Study

2013
Central Platte Groundwater Exchange Program: Background

I am invited to spend two days with NE DNR:
- we brainstorm idea for GW/SW market
- meet with Platte River Program (SW user)

Jim Schneider
Jesse Shapiro
Jerry Kenny

Oct 2014
Central Platte Groundwater Exchange Program: Background

Nov 2014

NRD partner on board

Lyndon Vogt
Central Platte Groundwater Exchange Program: Background

Market Design w/ CPNRD Input
- Product definition
- Constraints
- Pricing Algorithm
- Bidder Qualification
- Rules & Regs Amendments

NERA Economic Consulting

Jan 2015 – March 2016
Central Platte Groundwater Exchange Program: Background

See video at https://www.youtube.com/watch?v=yYKVvmysogI
See radio interview at http://ruralradio.com/agricultural/new-groundwater-exchange-program-approved-by-cpnrdf/
Plan for Talk

1. Why Nebraska? Why Central Platte?

2. “Sales Pitch” for the Market
   - benefits to groundwater users
   - benefits to streamflow users
   - some key details

3. Next Steps: Driving Market Adoption
Groundwater-User Benefits

1. Enable value-enhancing trade
2. Price discovery
3. Support sustainable farming practices
Enable Value-Enhancing Trade

A: value = $8
   has water

B: value = $12
   wants water

C: value = $18
   wants water

D: value = $14
   has water

TOTAL VALUE OF WATER USE [BEFORE TRADE] $22

value for C’s stream impact = $10
Enable Value-Enhancing Trade

value = $8
paid $10

value = $12
pays $10

groundwater price = $10

value = $18
paid $10 + $10

value = $14
pays $10

TOTAL VALUE OF WATER USE [TRADE AMONG ALL IN WATERSHED]

$36

value for C’s stream impact = $10
Groundwater Exchange Program establishes:

- **“groundwater price”**: price for (next-season) groundwater right at hypothetical location with zero stream impact
- **“streamflow price”**: price for (30-year-averaged) surface-water impact at each location in the stream
Groundwater-User Benefits

1. Enable value-enhancing trade

2. Price discovery

3. Support sustainable farming practices
Support Sustainable Farming

“Use-it-or-lose-it” water rights can discourage farmers from adopting the most efficient / most sustainable farming practices

Nebraska Example: Crop Rotation
Nebraska Example: Crop Rotation

Rotating corn with soybean has many benefits, including

- enhanced corn yields
- pest mitigation

Allowing farmers to lease their water rights on an annual basis would free them to rotate crops when doing so is most efficient!!
Plan for Talk

1. Why Nebraska? Why Central Platte?

2. “Sales Pitch” for the Market
   - benefits to groundwater users
   - benefits to streamflow users
   - some key details

3. Next Steps: Driving Market Adoption
Streamflow-User Benefits

1. Flexibly/efficiently source water supply

2. Protect natural habitats [e.g. PRRIP in NE]

3. Encourage sustainable farming practices
Plan for Talk

1. Why Nebraska? Why Central Platte?

2. The Idea of Watershed Markets
   - benefits to groundwater users
   - benefits to streamflow users
   - some key details

3. Next Steps: Driving Market Adoption
What Can Be Measured?

In Central Platte NRD, farmers’ irrigated acres are measured (by airplane reconnaissance) but water use is unmetered.

→ Farmers can trade on “irrigated vs rainfed” BUT NOT on “more vs less irrigation”

Trading on water volume would encourage efficient adoption of low-water crop varieties
What Water-Use Constraints?

In Central Platte NRD, regulations constrain water-use outcomes in several ways:

- **overappropriated areas**: no additional water use in certain regions
- **no negative stream impact**: no decline in flow anywhere along the Platte River

The market algorithm I designed for CPNRD works under *multiple interlocking constraints* on (i) stream depletion and (ii) aquifer depletion
Central Platte Constraints

- Streamflow cannot decrease anywhere along the river
- Groundwater use cannot increase in overappropriated areas
Plan for Talk

1. Why Nebraska? Why Central Platte?

2. The Idea of Watershed Markets

3. Next Steps: Driving Market Adoption
   - … in Nebraska
   - … in California
Deepening “Market Penetration”

GEOGRAPHICALLY

– reps from three other NRDs attended my presentation at CPNRD HQ in April 2015

– success at CPNRD will give these other NRDs more confidence to deploy their own markets ...

– ... and increase benefit from doing so, as long as their design is “interoperable” with CPNRD’s

TRADING POSSIBILITIES
Deepening “Market Penetration”

GEOGRAPHICALLY

TRADING POSSIBILITIES

– volume … via acreage/volume hybrid

– [more finely-tuned hydrological impacts]
– [more finely-tuned timing of water use]
The Transition to Metering

What motivates the FIRST farmer to meter??
The Transition to Metering

So long as unmetered use can be reliably estimated (based on crop type, etc), metered and unmetered use can be traded in the same “currency”: VOLUME
The Transition to Metering

Farmers who can REDUCE USE have an incentive to meter, to enter into direct-volume contracts.
Transition to Metering

1. Average Use Determined and Assigned as “Volume Equivalent” for Unmetered Farmers
   - Note: If farmers differ a lot in their unmetered use, a challenge emerges as those who meter will be adversely selected
   - Example: if 10 acre-feet is average use but I use 8 acre-feet under business-as-usual, metering allows me to get paid for 2 acre-feet, even as I do nothing to conserve water!!
Transition to Metering

1. Average Use Determined and Assigned as “Volume Equivalent” for Unmetered Farmers

2. Farmers will adopt metering (only!) once they also adopt water-saving farming methods
   – **Note**: Metering adoption need not follow the classic “S-curve” → incentives may be needed to drive last adopters
Plan for Talk

1. Why Nebraska? Why Central Platte?

2. The Idea of Watershed Markets

3. Next Steps: Driving Market Adoption
   - ... in Nebraska
   - ... in California
Driving Market Adoption in California

ESTABLISH STANDARD MARKET-DESIGN TOOLKIT

– groundwater transfer-market template that GSAs can customize in their sustainability plans
– groundwater reallocation-market template for overappropriated areas
Driving Market Adoption in California

ESTABLISH STANDARD MARKET-DESIGN TOOLKIT

MARKET-DESIGN TESTBEDS

– it may also be helpful to work closely with a small number of GSAs to understand real-world issues and iterate improved market-design toolkit

BUT

– we should aim for making many small impacts

– “starting small” wastes a golden opportunity to plant many market-design seeds across the state
Driving Market Adoption in California

ESTABLISH STANDARD MARKET-DESIGN TOOLKIT

MARKET-DESIGN TESTBEDS

HARMONIZE INTRA-GSA MARKETS
  – timing, modelling & monitoring standards, etc
Driving Market Adoption in California

ESTABLISH STANDARD MARKET-DESIGN TOOLKIT

MARKET-DESIGN TESTBEDS

HARMONIZE INTRA-GSA MARKETS

MAXIMIZE OPPORTUNITY FOR INTER-GSA TRADE

— addressing the Delta bottleneck
Idea: Flowing Through the Bottleneck

• San Joaquin flows benefit Delta ecosystem
• Imagine X > 1 acre-feet delivered on San Joaquin + 1 acre-foot pumped
  – “clear win” for broader Delta, San Joaquin farmers, and SoCal water users
  – “potential win” for smelt
  – ... and a motivator to adopt inter-GSA market standards