Watershed Markets
with Lessons from Nebraska

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Duke Fuqua + Economics

April 2016

Caltech Workshop on Rationalizing the Allocation of California Water

CPNRD APPROVES FIRST TEMPORARY LEASING TRANSACTIONS IN NEW GROUNDWATER EXCHANGE PROGRAM

BY CPNRD | April 4, 2016

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Central Platte Natural Resources District

One of Nebraska's 23 NRDs: Protecting Lives, Protecting Property, Protecting the Future

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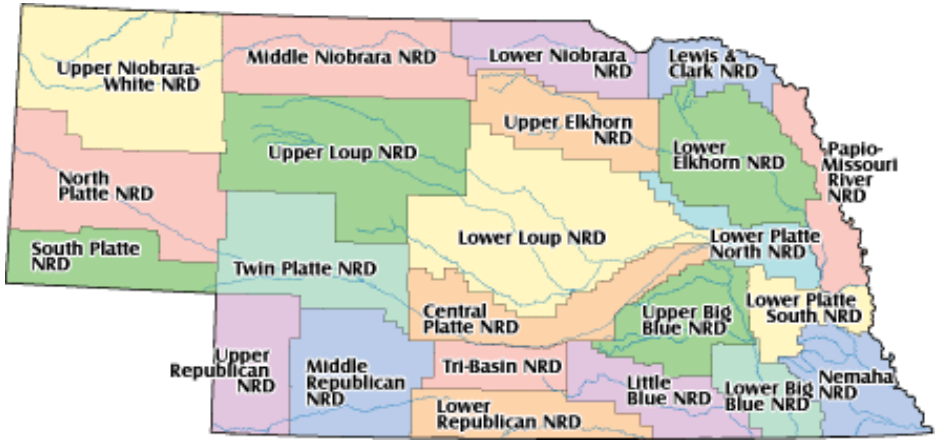
(GRAND ISLAND, NE) The Central Platte Natural Resources District's (CPNRD) board of directors approved the first transactions of the Groundwater Exchange pilot program on Thursday. Sellers placed 30 locations online for leasing, with six buyers placing bids- three for irrigation and three for streamflow 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



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

- locally elected
- boundaries coincide with major surface drainage divides

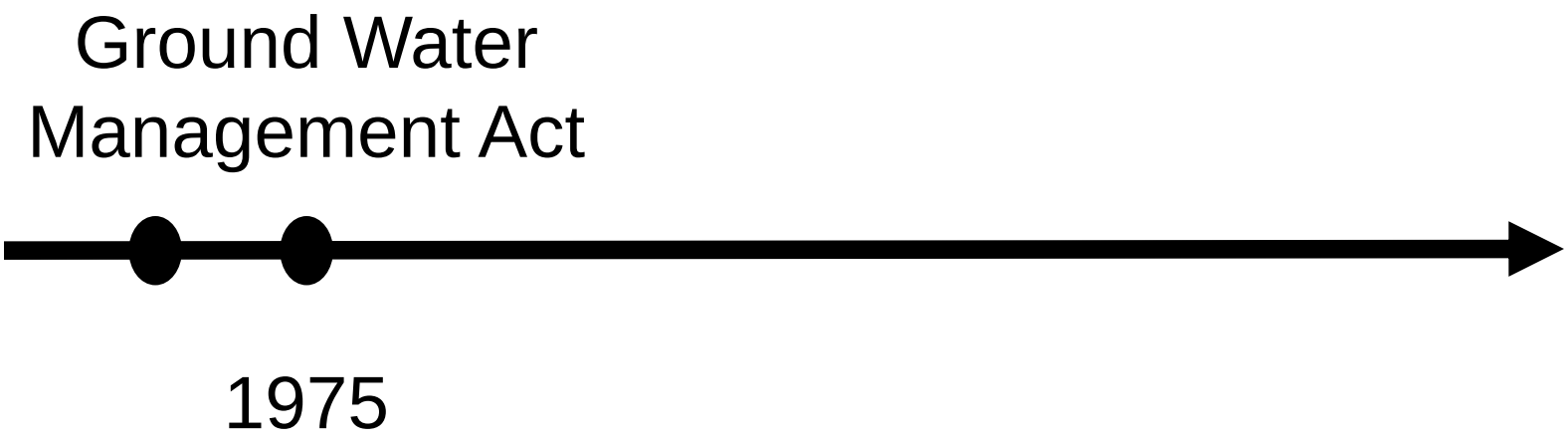
NRDs formed by state

1969

Central Platte Groundwater Exchange Program: Background

NRDs granted broad authority in “control areas”:

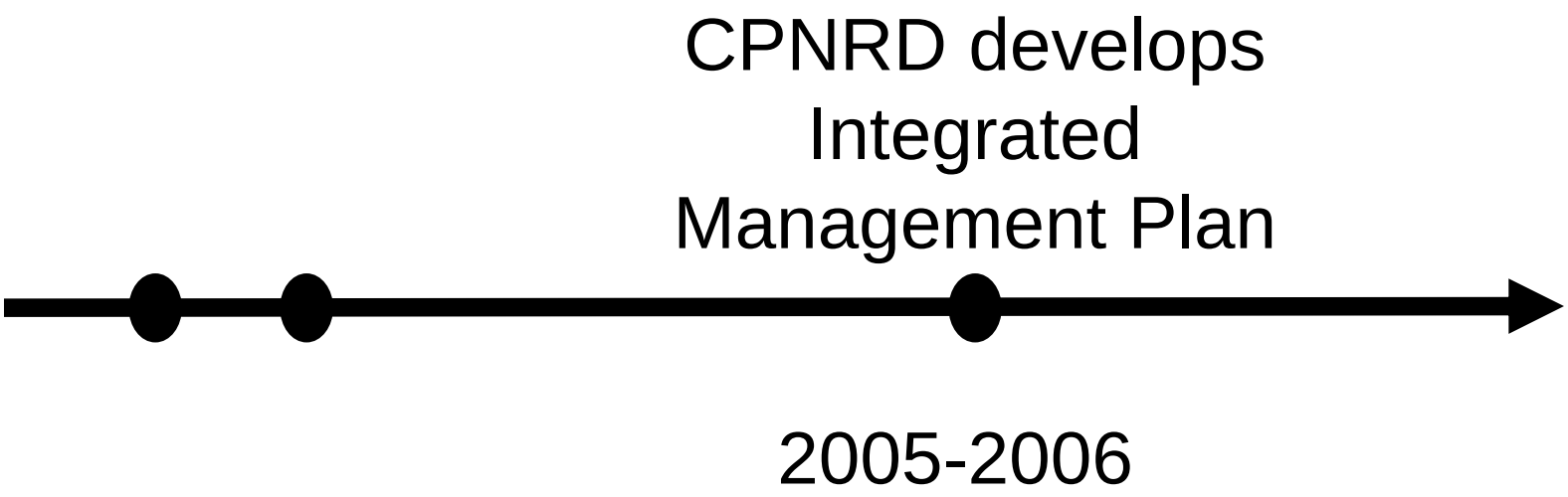
- well-spacing restrictions
- rotation of pumping wells
- limitations on groundwater withdrawals
- moratorium on new well drilling



Central Platte Groundwater Exchange Program: Background

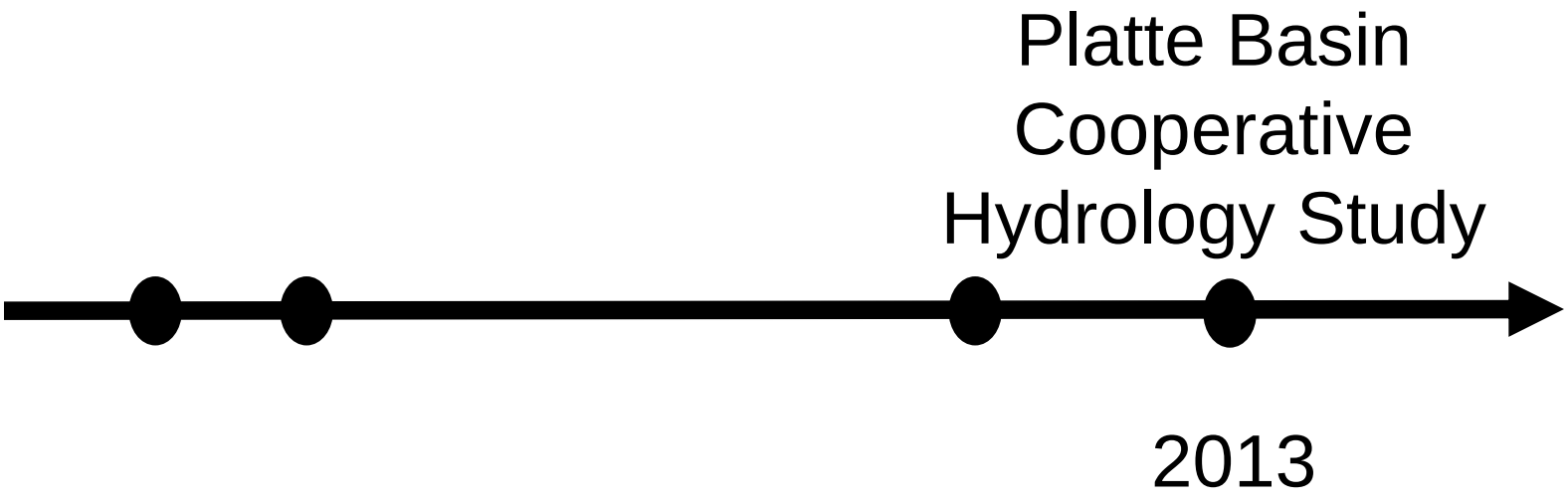
Integrated Management Plan explicitly recognizes connection between groundwater and surface water

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



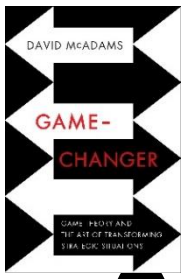
Central Platte Groundwater Exchange Program: Background

"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."



Central Platte Groundwater Exchange Program: Background

Jim Schneider
Jesse Shapiro



Nebraska
Department of Natural Resources

I am invited to spend two days with NE DNR:

- we brainstorm idea for GW/SW market
- meet with Platte River Program (SW user)

Jerry Kenny

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

Oct 2014

Central Platte Groundwater Exchange Program: Background

Lyndon Vogt

Central Platte
Natural Resources District

One of Nebraska's 23 NRDs:
Protecting Lives, Protecting Property, Protecting the Future

NRD partner on board

Nov 2014

Central Platte Groundwater Exchange Program: Background

NERA Economic Consulting

Market Design w/ CPNRD Input

- Product definition
- Constraints
- Pricing Algorithm
- Bidder Qualification
- Rules & Regs Amendments

Jan 2015 – March 2016

Central Platte Groundwater Exchange Program: Background

Central Platte Groundwater Exchange Program

2016

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

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

value = **$8**
has water

A

value = $12
wants water

B

TOTAL VALUE
OF WATER USE
[BEFORE TRADE]

$22

C

value = $18
wants water

D

value = **$14**
has water

value for C's stream
impact = $10

Enable Value-Enhancing Trade

value = $8
paid $10

value = **$12**
pays $10

A

B

groundwater price
= $10

C

D

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**

Price Discovery

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

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   - some key details

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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

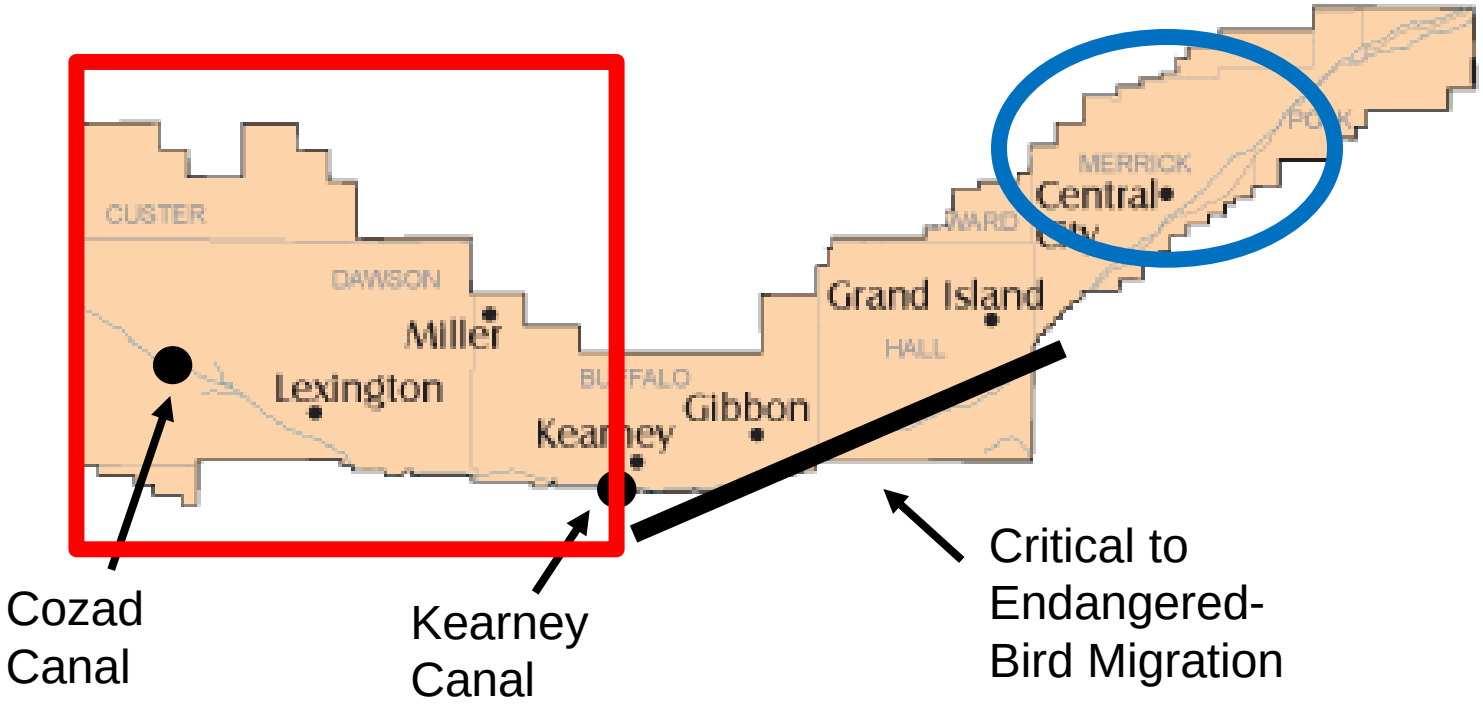
What Water-Use Constraints?

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

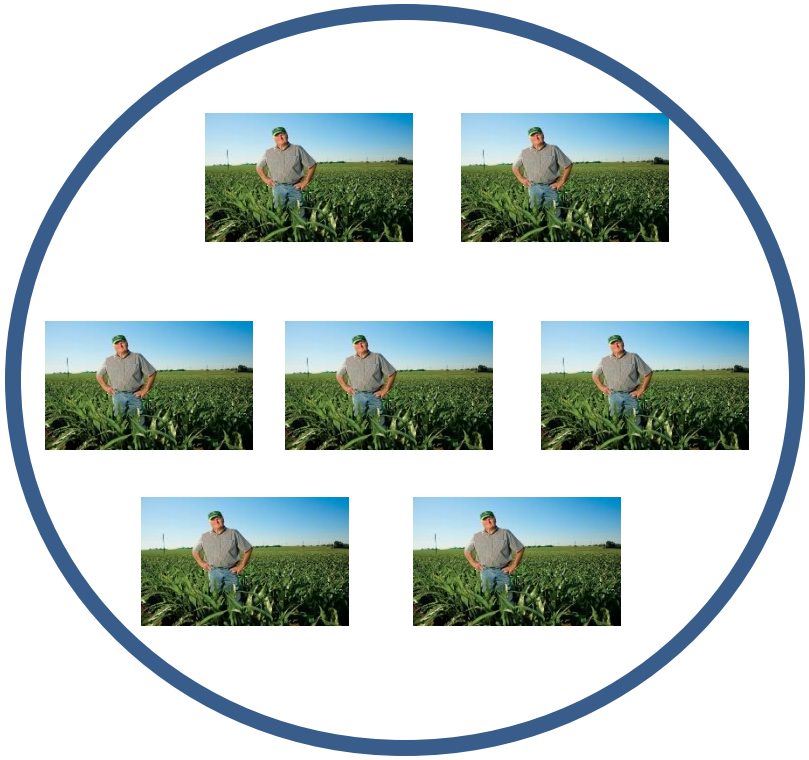
TRADING POSSIBILITIES

- volume … via acreage/volume hybrid

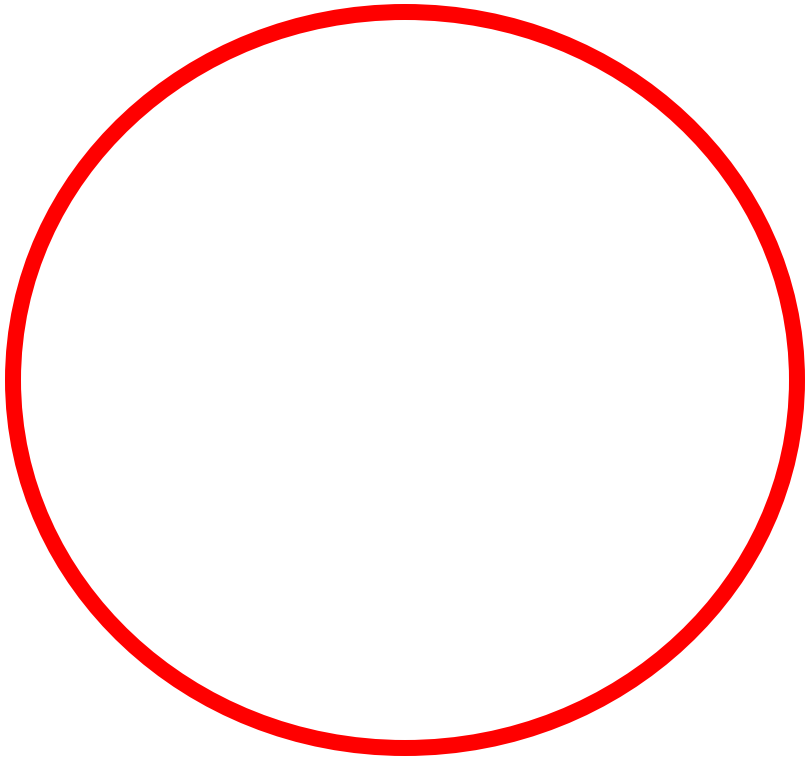
- [more finely-tuned hydrological impacts]
- [more finely-tuned timing of water use]

The Transition to Metering

UNMETERED

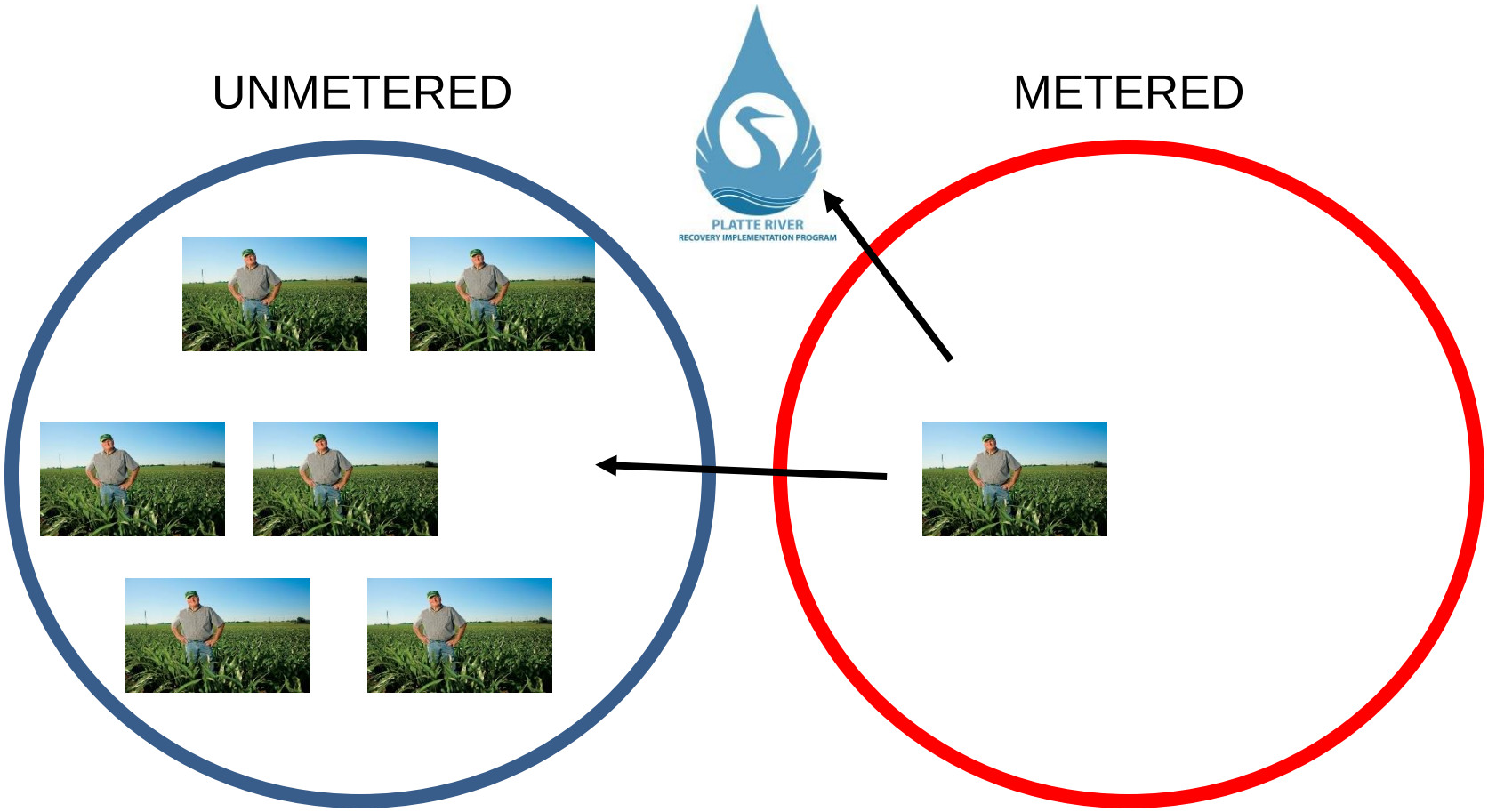


METERED



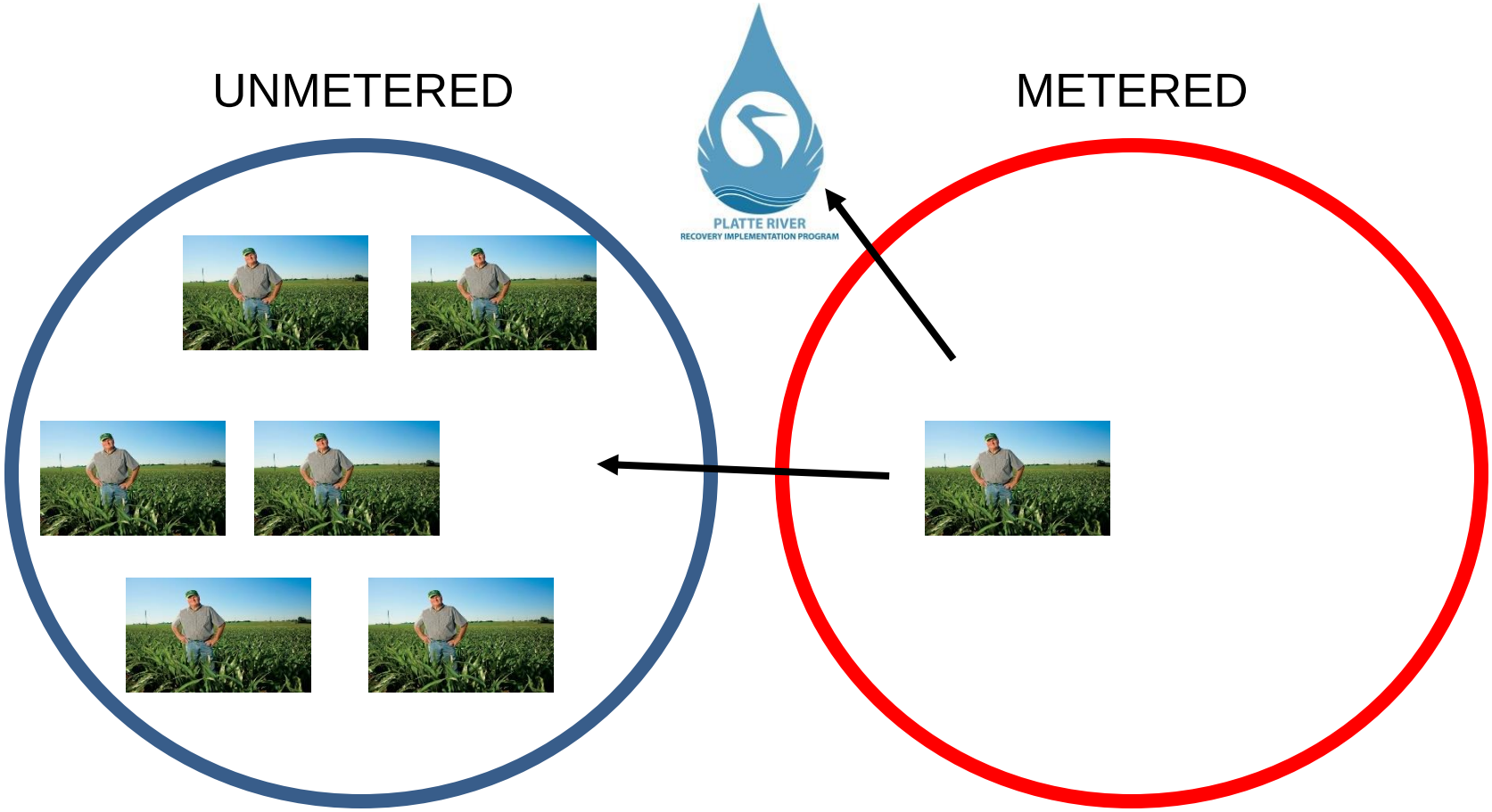
What motivates the FIRST farmer to meter??

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