



# **Droughts and Water Sales from N. California**

Anita M. Chaudhry & Dean H.K. Fairbanks

Department of Economics  
Department of Geography and Planning  
Center for Water and the Environment  
CSU, Chico



# Rice fields or... water reservoirs?



Rice fields surround the small towns of Nelson (foreground) and Richvale (middle ground) in the Sacramento Valley, with the Sutter Buttes in the distance (Anthony Dunn)

# I. Research Questions

- How do droughts and opportunity to sell water allocations affect farmers' land use decisions?
  - Participation in water sales by fallowing land
  - Unpack the temporal trends: drought, water bank , price of rice, groundwater export restrictions
  - Effect of district, parcel size, leased vs. owner-farmed
- What can spatial data tell us about farmers' response to changes in weather and policy?
- Effects of water trades, on habitat contiguity



## 2. Context

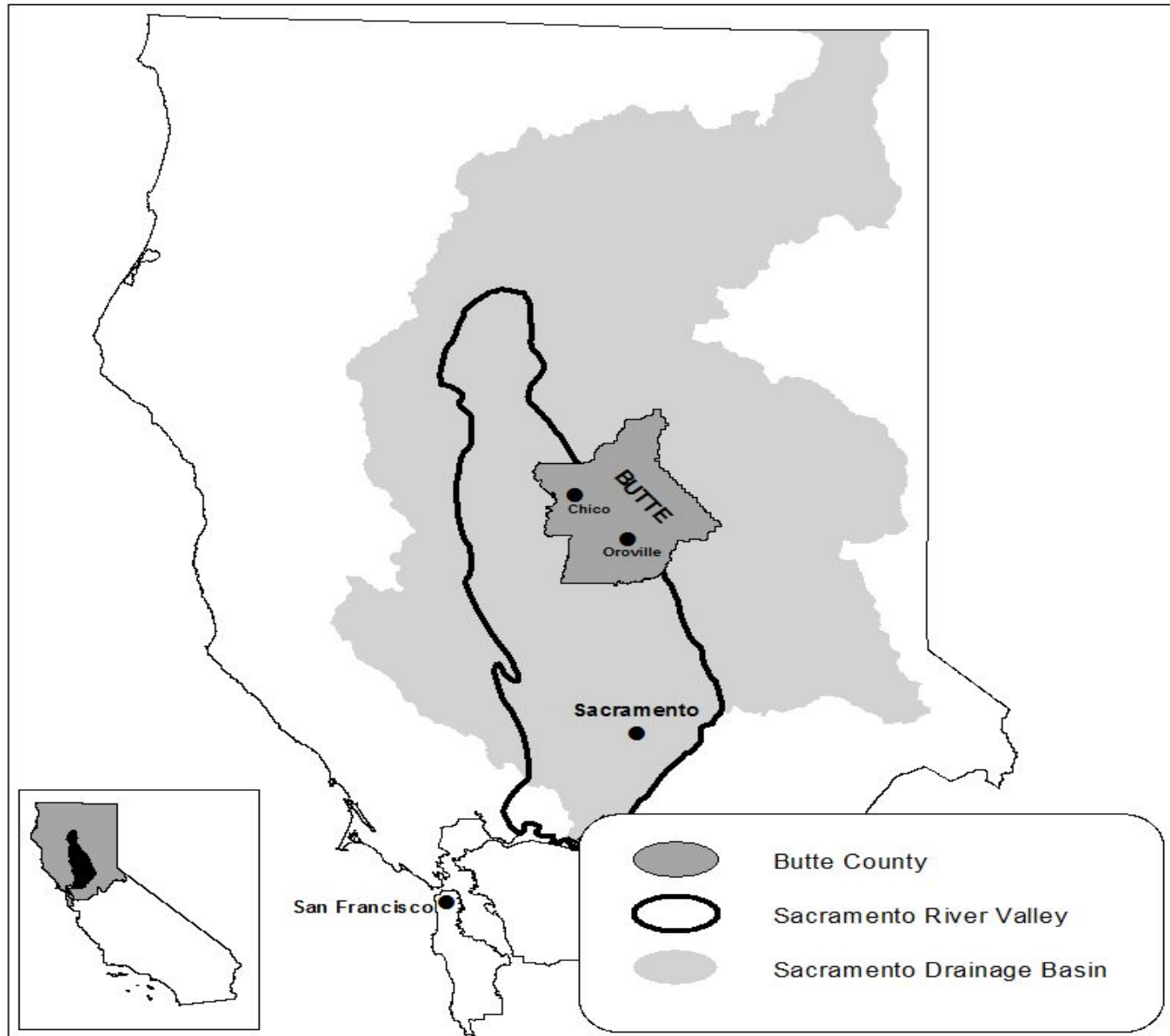
- Water trades are an integral part of coping with droughts
- ‘Water marketing’ is the temporary, long term, or permanent transfer rights to use water in exchange for compensation
  - Senior water right holders can sell (lease) in dry years.
  - About 5% all water is now traded in CA.

- Water trades are becoming more decentralized
- The State was a broker for trades during
  - Drought Water Banks of 1991, 1992, 1994, and 2009,
  - Dry Year Water Purchase Programs of 2001 and 2002
- Now, State is a facilitator: irrigation districts or ‘buyer groups’ are negotiating trades amongst themselves
  - Bilateral trades in 2010, 2012, and 2014
  - Some rules e.g. no more than 20% of county irrigated area can be allowed for transfers. Cal. Water Code §1745.05(b)

# Groundwater: Critical link for surface water trades


- 1992 and 1994 Drought Water Banks were largely based on groundwater substitution
- In November 1996, Butte County voters restricted groundwater exports and groundwater substitution-based surface water sales out of county
  - 22 of 58 CA counties have similar restrictions
- Sustainable Groundwater Management Act passed in Dec. 2014

# 3. Study Area: Butte County







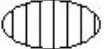
# Project Study Area: Butte County Private Irrigation Districts

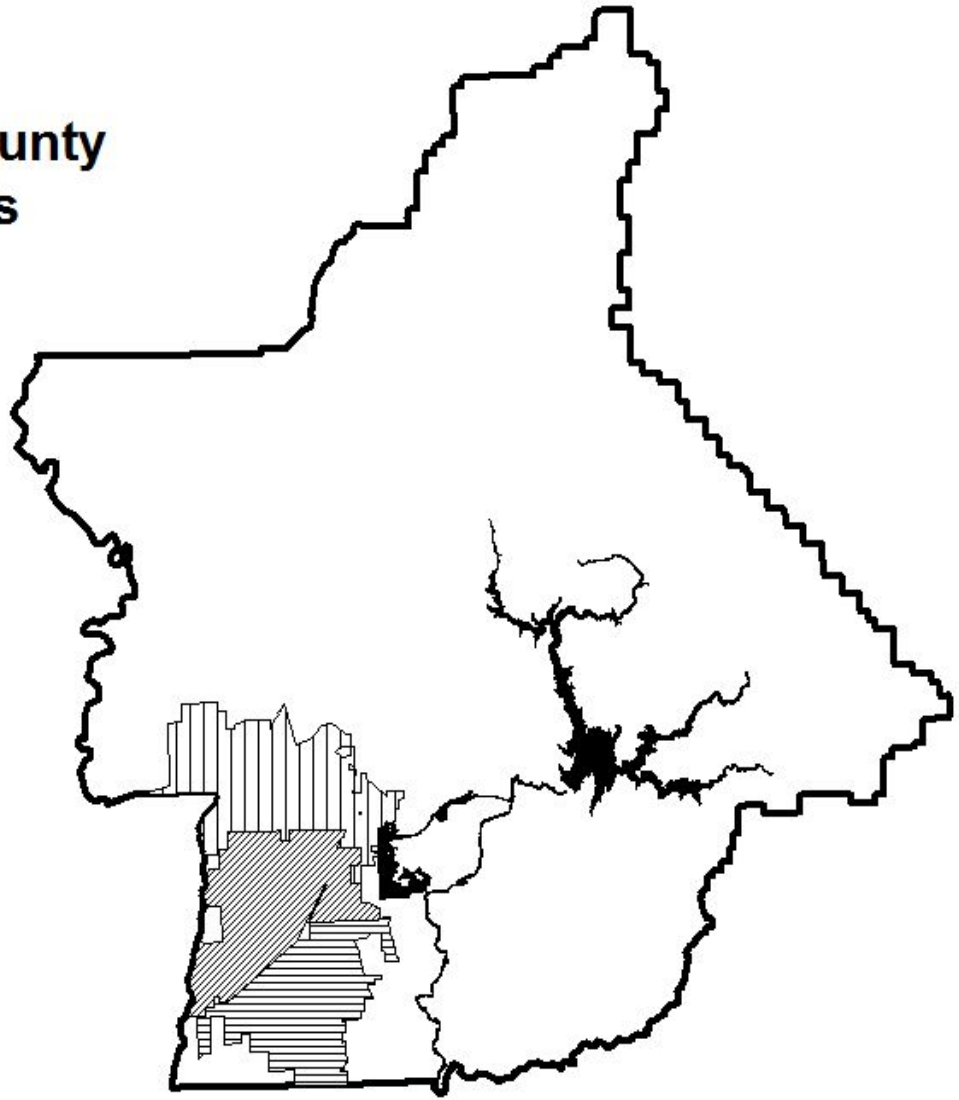
 State Water Project Reservoir System

**Irrigation Districts**

 Biggs-West Gridley Water District

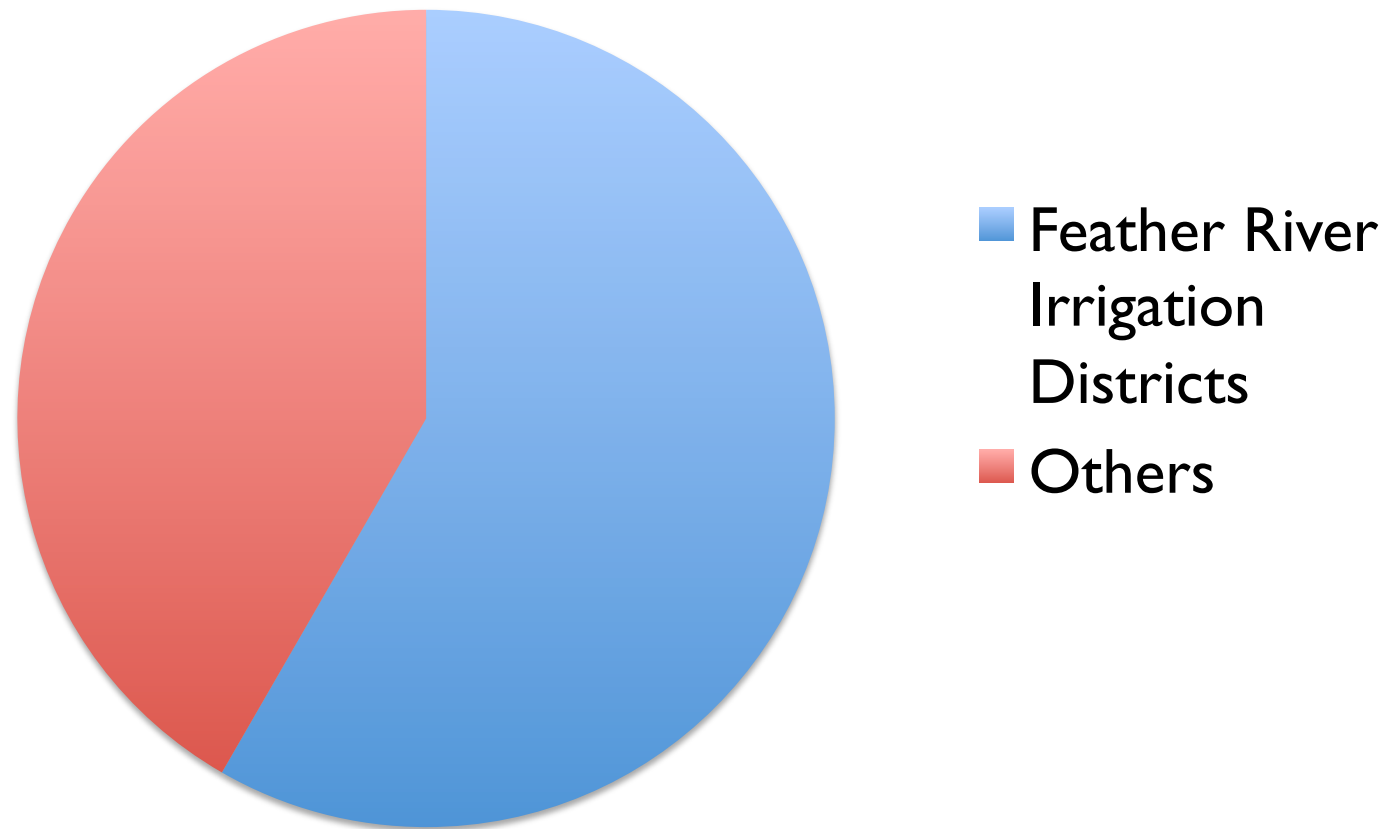
 Richvale Irrigation District

 Western Canal Water District



20 0 20 Kilometers

# Sample Irrigation Districts' Share of Water Sales in 2010 Dry Year Transfer Program



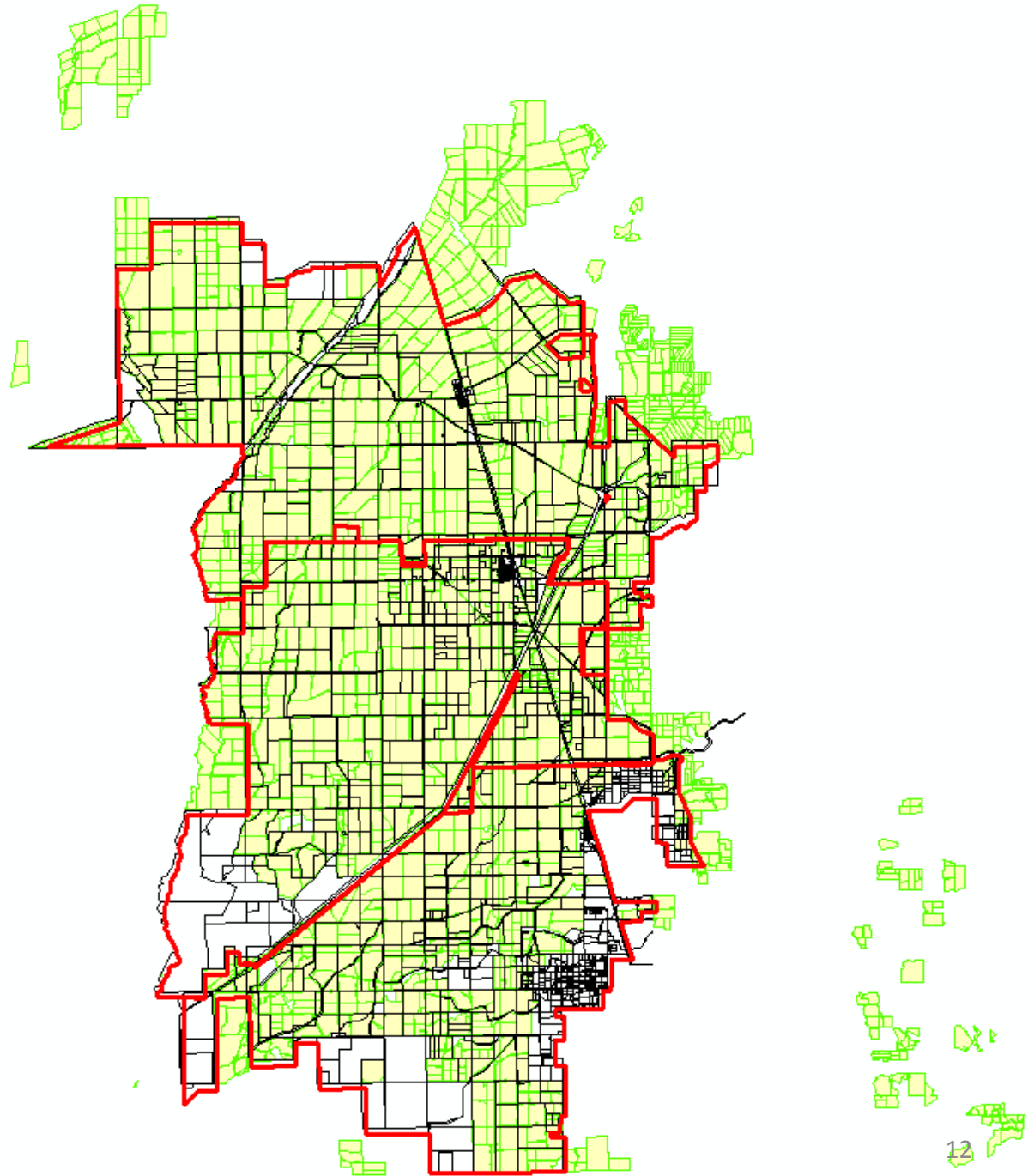
Source: SWP Bulletin 132-11, CDWR 2013

# 4. Data

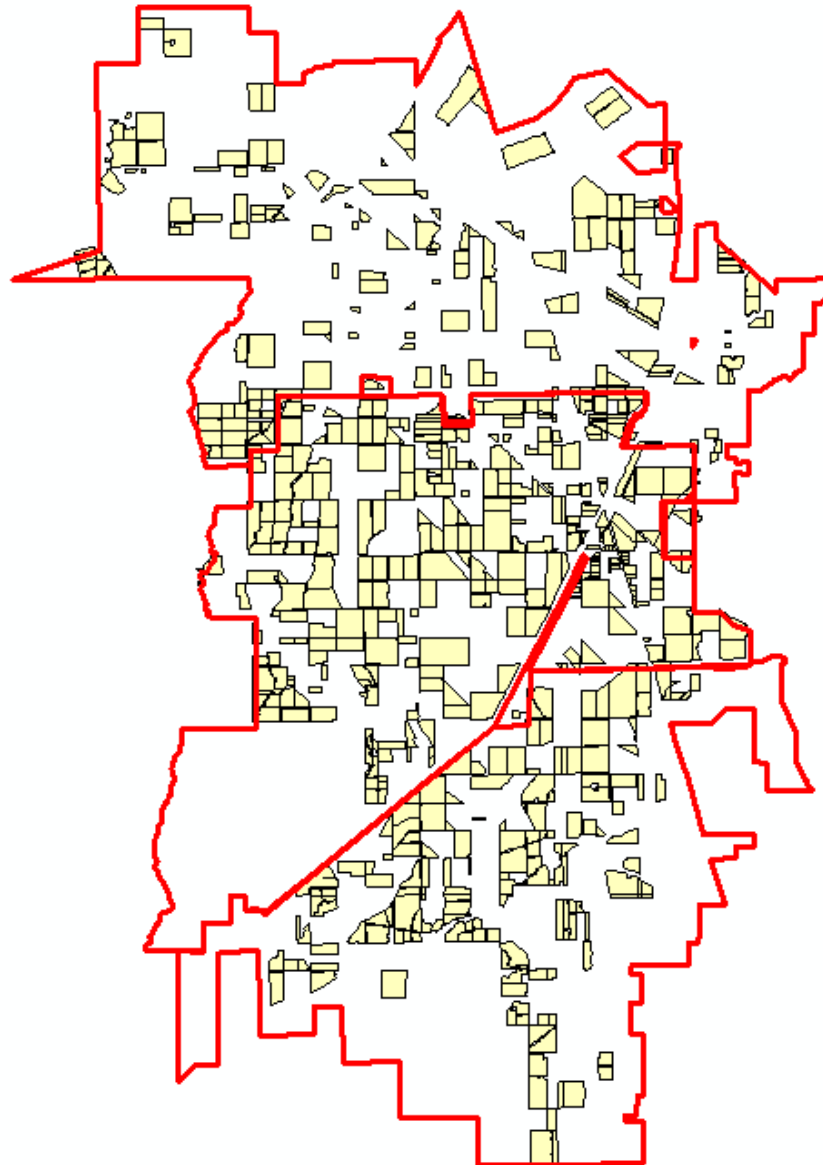
- GIS database of all publicly available data covering 3 irrigation districts for 1984-2014
  1. CA Department of Water Resources (CDWR) land use survey data: rice field location
  2. August Landsat TM 30m resolution satellite imagery: identify growing rice and fallow rice fields
  3. Tax parcel data from County Assessor: aggregated fields into parcels for each landowner
    - **A parcel is a contiguous agricultural area owned by an owner.**
- Conversations with ID Managers to ground truth the spatial data
- Compiled drought data, institutional detail of water transfers from CDWR

## Rice fields aggregated into tax parcels

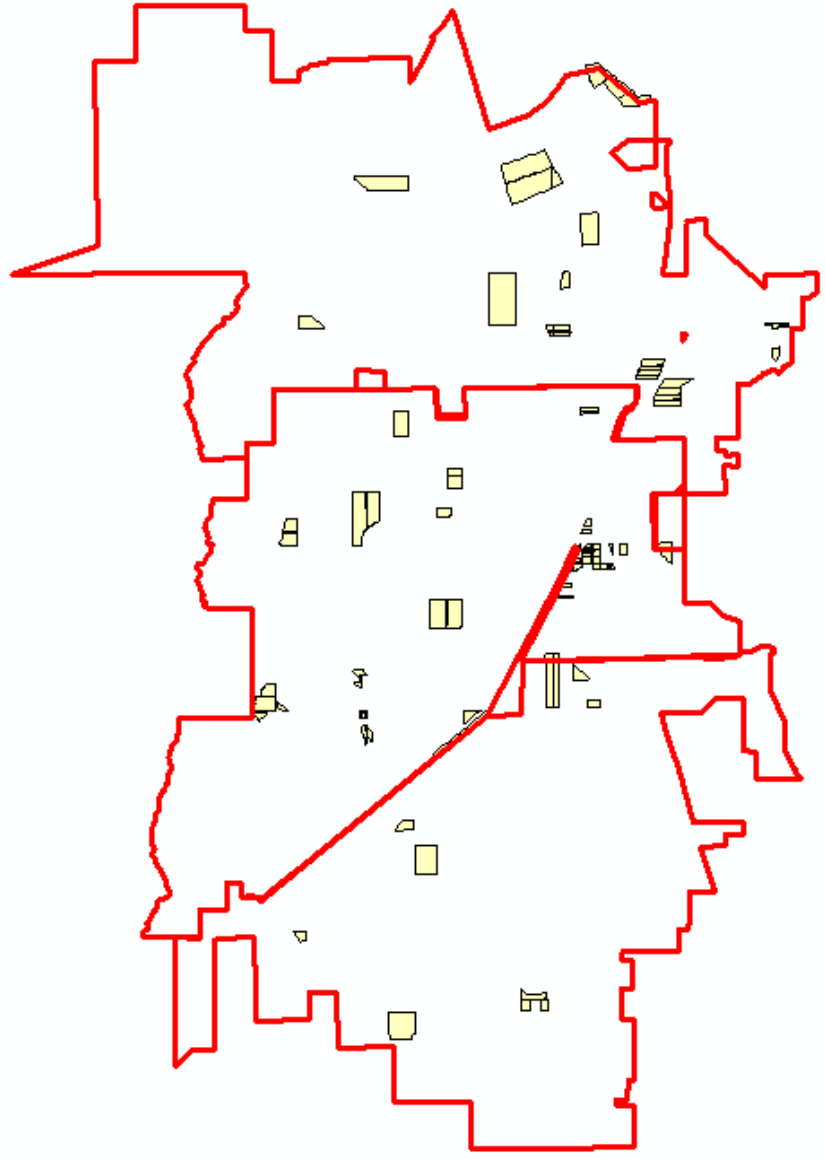
- 773 tax parcels
- Observed for each year in 1984-2014
- Fallow status and fraction fallowed observed for each year



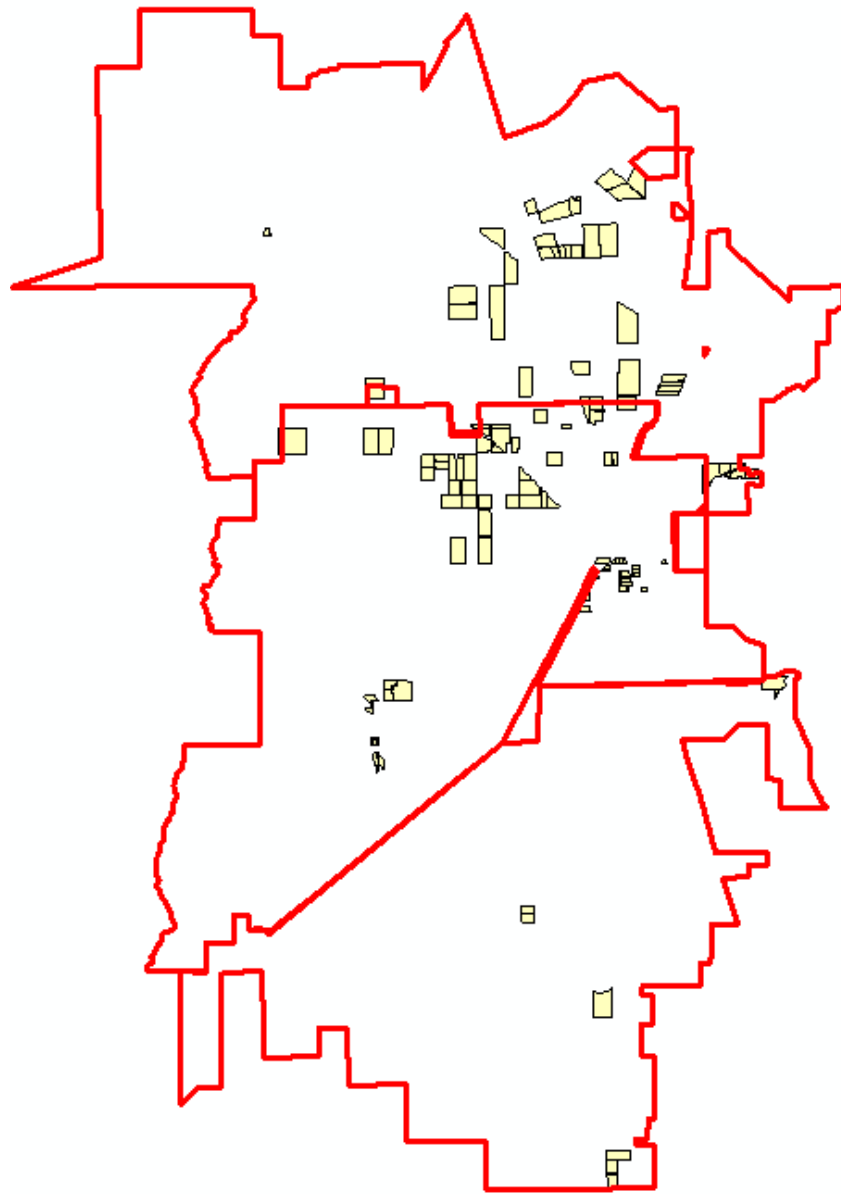
1991  
designated as  
'Critical'  
First Drought  
Water Bank



2000  
designated as  
'Above Normal'  
No Drought  
Water Bank



2009  
designated as  
'Dry'. Drought  
Water Bank



## 2014 Fallow

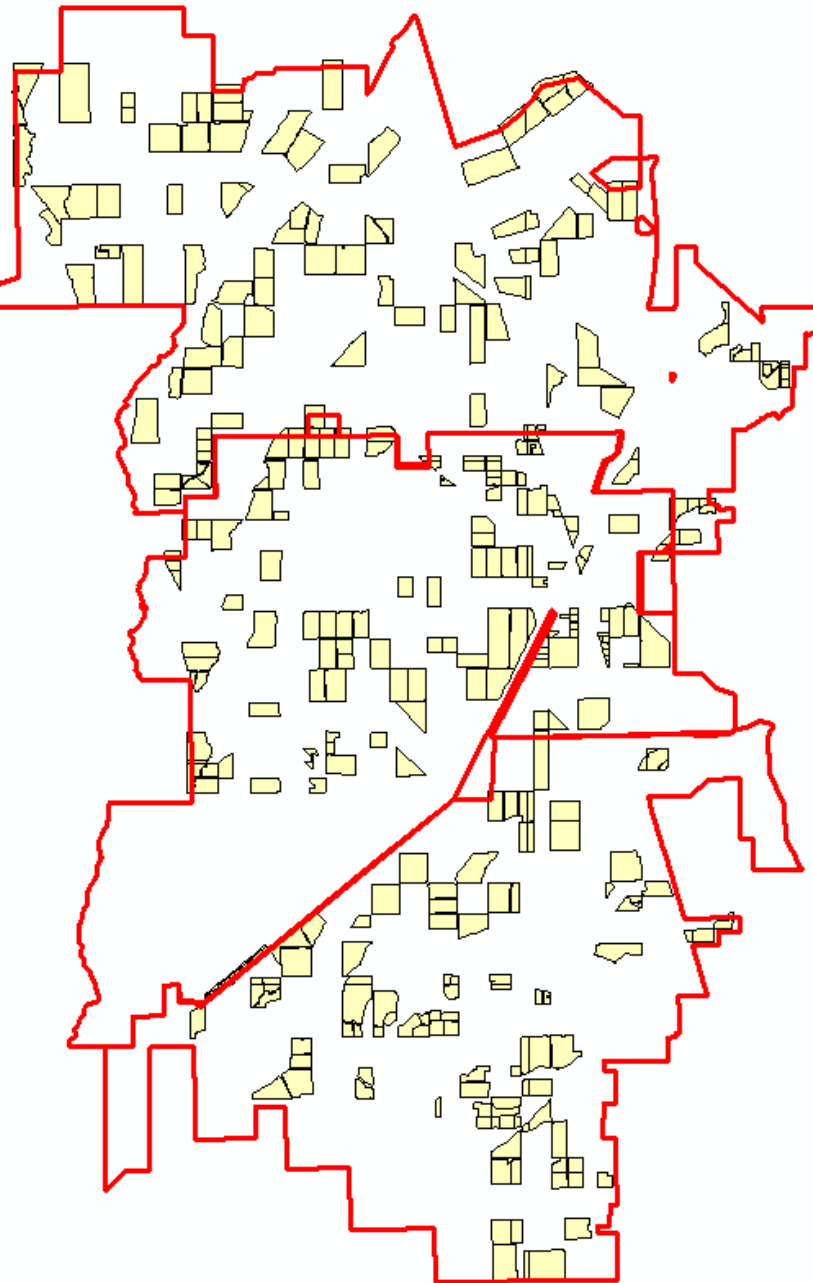
A major drought year with no formal DWB (DWR has given up on managing DWBs) instead the DWR *encouraged* the districts to sell water to needy users in the south.

Sold water at **\$500** per acre foot

Which then was actioned in the San Joaquin Valley Westlands irrigation district for **\$1200-1400** per acre foot.

Fallowed Acreage from imagery:

Western Canal ID – 9194.7ac  
Richvale ID – 6411.5ac  
Biggs-West Gridley ID – 5738.1ac





16 drought years in SJV  
2 years when water allocation was cut

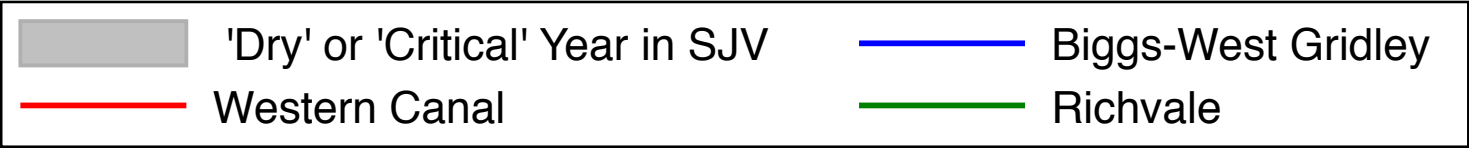
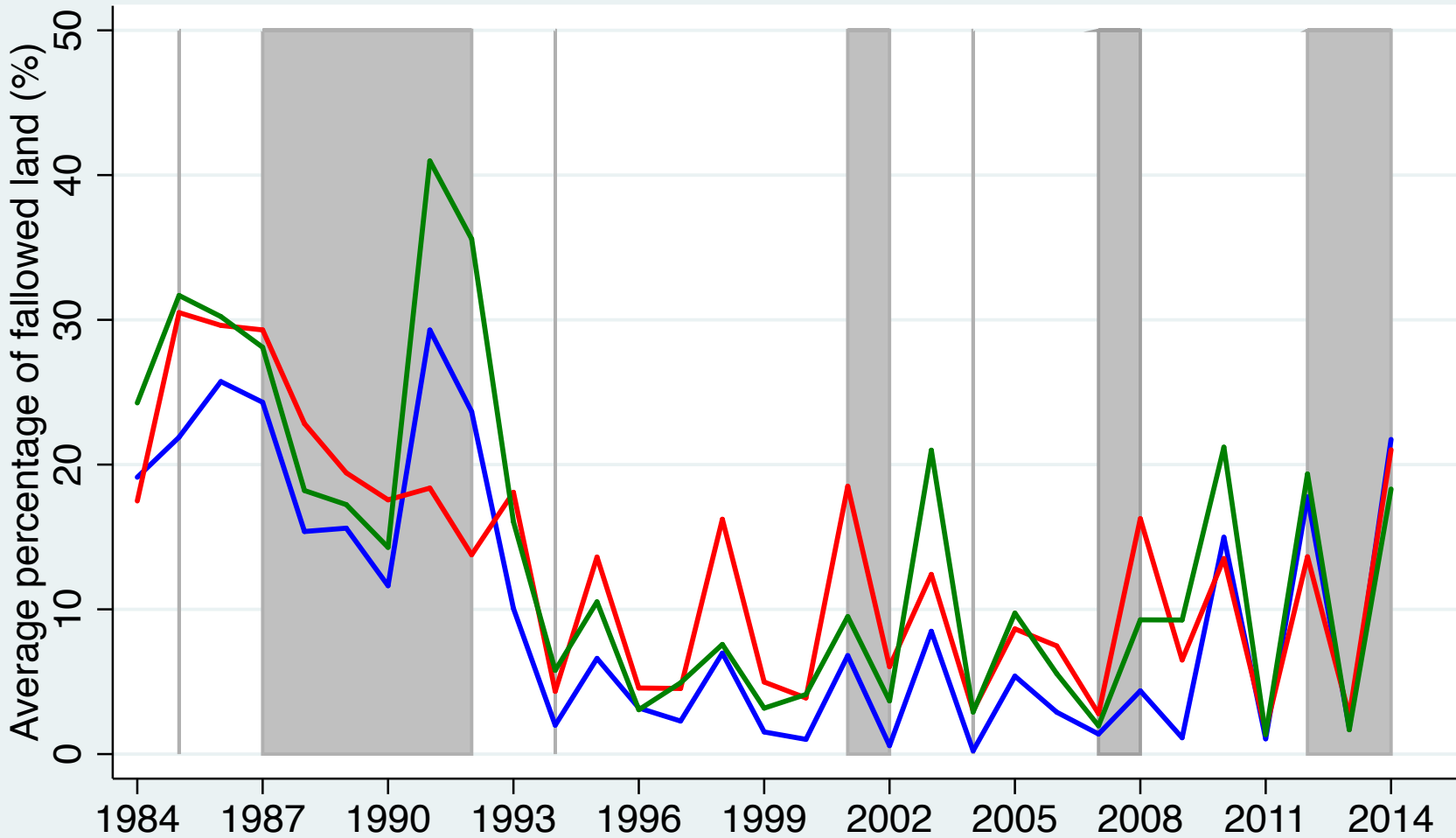
No permit needed

Permit needed for gw substitution

Year	Sacramento Valley	Water Sales from Sample IDs	San Joaquin Valley
1984	Wet		Above Normal
1985	Dry		Dry
1986	Wet		Wet
1987	Dry		Critical
1988	Critical		Critical
1989	Dry		Critical
1990	Critical		Critical
1991	Critical	DWB	Critical
1992	Critical	DWB	Critical
1993	Above Normal		Wet
1994	Critical	DWB	Critical
1995	Wet		Wet
1996	Wet		Wet
1997	Wet		Wet
1998	Wet		Wet
1999	Wet		Above Normal
2000	Above Normal		Above Normal
2001	Dry	DYWPP	Dry
2002	Dry	DYWPP	Dry
2003	Above Normal	transfers	Below Normal
2004	Below Normal		Dry
2005	Above Normal		Wet
2006	Wet		Wet
2007	Dry		Critical
2008	Critical		Critical
2009	Dry	DWB	Below Normal
2010	Below Normal	transfers	Above Normal
2011	Wet		Wet
2012	Below Normal	transfers	Dry
2013	Dry		Critical
2014	Critical	transfers	Critical

- 1984-2014: structural break at 1996
- Since 1996, no groundwater exports or surface water exports based on on groundwater substitution without permit from county.
- Therefore, observed fallow in water transfer years is for water sales.

Average Fraction of Parcel Followed in Sample Irrigation Districts



# 5. Conceptual Model

- Economic model predicts that following will be higher when:
  - Price of rice is lower
  - Price received from water sold is higher (presence of a drought)
  - Previous year is not fallowed
  - Groundwater substitution is not restricted
- Dynamic panel data methods used to test the economic model

# 6. Key Results

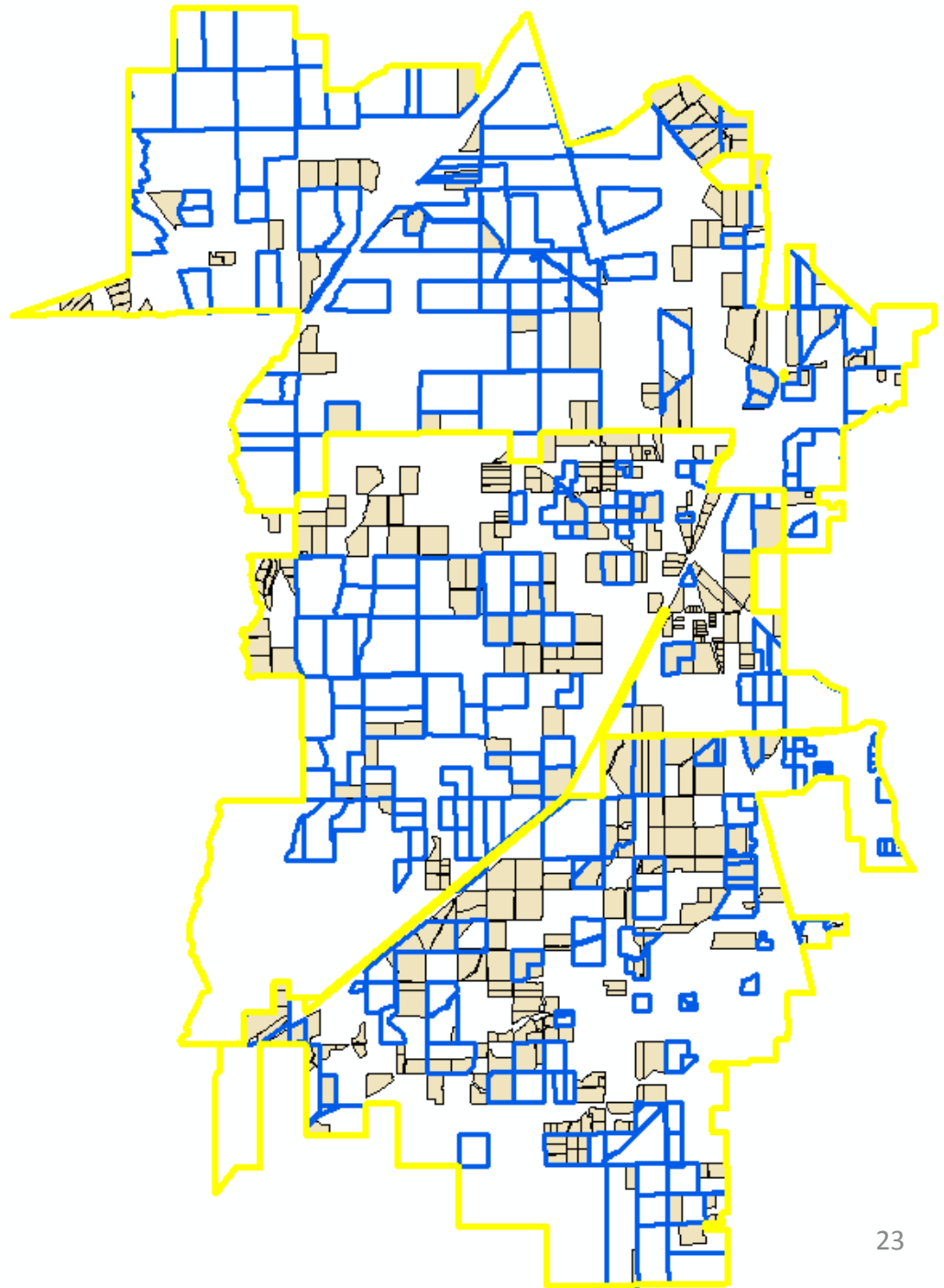
- Fallow area has increased in recent years. Learning-by-doing
  - 20% cap on area fallowed is a binding constraint
- Fallow in alternate years.
  - Perhaps not a source for long droughts.
- Lower participation in transfers when price of rice is higher.
- Smaller parcels before 1996; All parcels fallow now
- So far, no change in irrigation technology, or permanent water sales.
  - No incentive to do so as long as water rights are secure or gains from fallowing are not taxed or charges for conveyance costs very low

# Policy Implications

- 20% rule should apply to irrigators who can fallow and sell only.
  - Cap makes sense at the district-level rather than at county level
  - Cap should be linked to longer term hydro-climatic steady state → more research needed
- More comprehensive regulation of water transfers needed in light of SGMA versus Measure G.

# 2015 Fallow

- ID's water delivery cut by 25% each
- Tan = Fallow
- Blue = parcel with well according to DWR



# Comparing Data on Fallowed Acres in Biggs-West Gridley WD

