THE ECONOMIC EFFECTS ON AGRICULTURE OF WATER EXPORT SALINITY SOUTH OF THE DELTA

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Outline

- Introduction
- Model and Methods
- Results
- Limitations
- Conclusions

Introduction

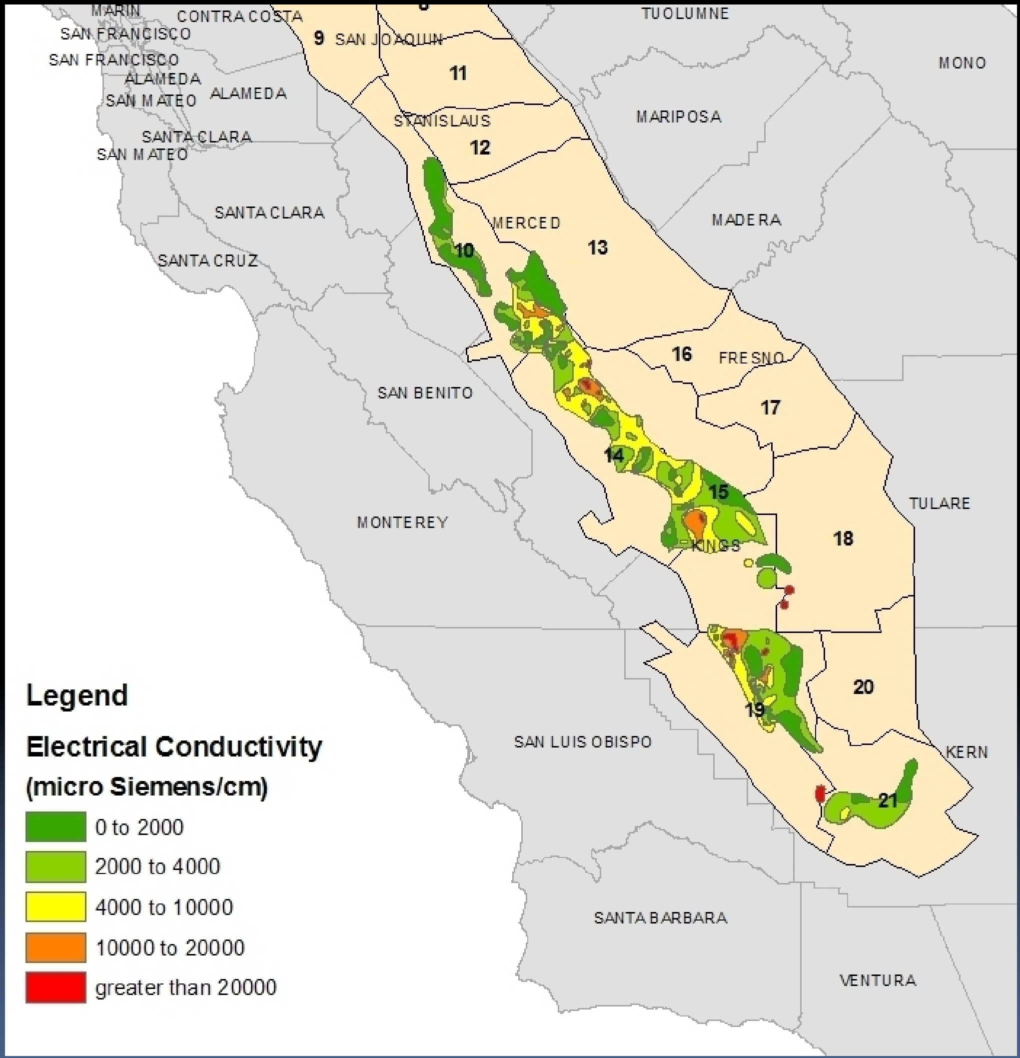
- Soil salinization a long standing issue
  - Mesopotamia
  - Nile Delta
  - The Sacramento-San Joaquin Delta
- Delta salinity model (in Lund et al. 2007)
- California problems with salinity and drainage (Howitt et al. 2008)

Model and Methods

- Extension of Howitt *et al.* 2008 considering…
  - Agricultural yields are reduced, salinity root zone
  - Salinity in shallow groundwater is correlated to that in the root zone
  - Saline soil areas are likely to increase with saline water exports
- Regional income effects
  - Employment
  - Income
  - Total output

Model and Methods

- GIS-based data
  - DWR land use surveys
  - USBR EC in shallow groundwater
- Saline zones distributed within each CVPM



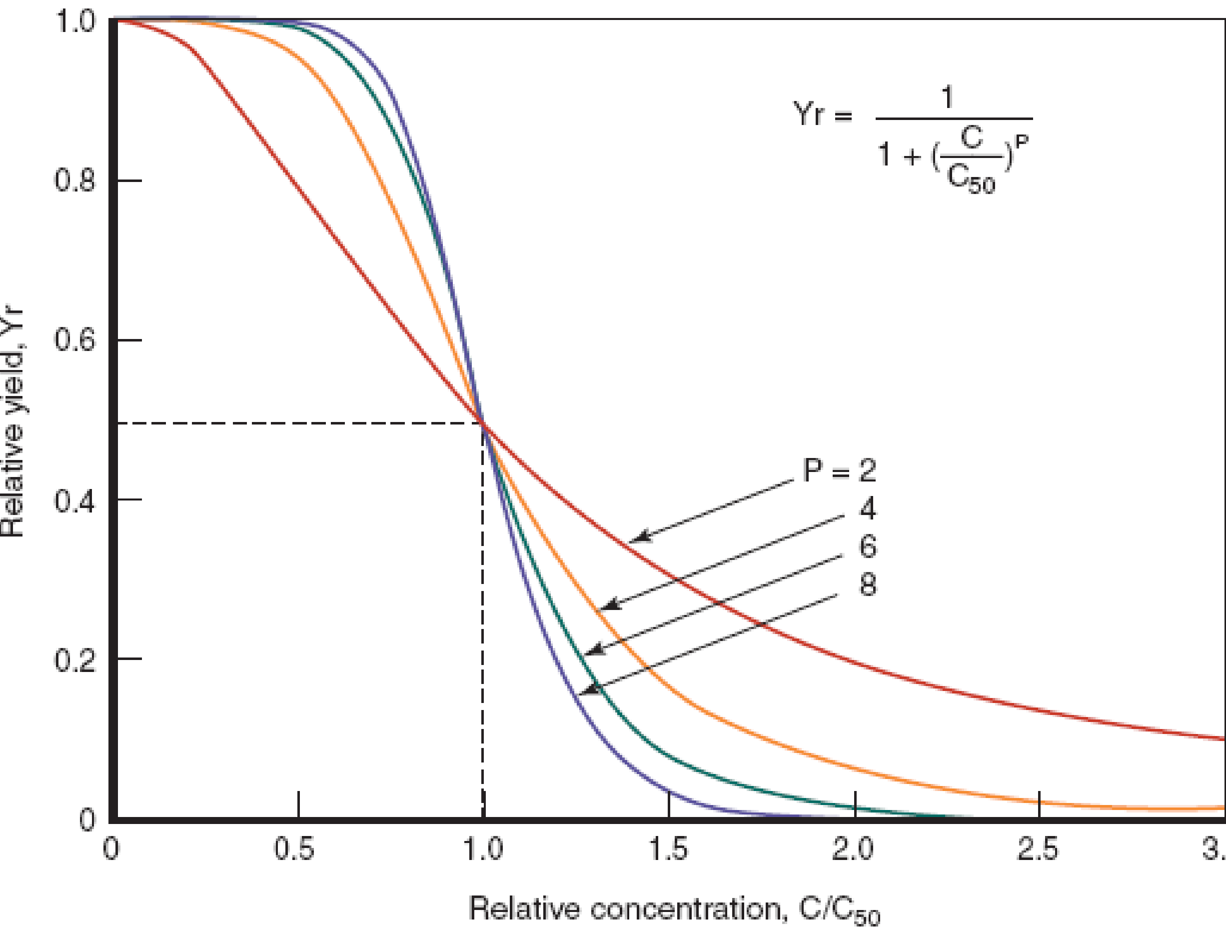
Howitt *et al.* (2008)

- Analyze socioeconomic impact of inaction with respect to salinity problems in the Central Valley by 2030.
  - Crops and animal feeding operations
  - Residential, food processing and industrial uses
  - System-wide effects income, employment and total output
  - Non-market costs and benefits

Howitt *et al.* (2008)

- Howitt took the Van Genuchten and Hoffman (1984) model on yield reductions due to salinized soils for a crop mix in the Central Valley
- GIS referenced information on salinity
- Land use surveys from DWR and agricultural commissioners reports
- Revenue losses were calculated for year 2030

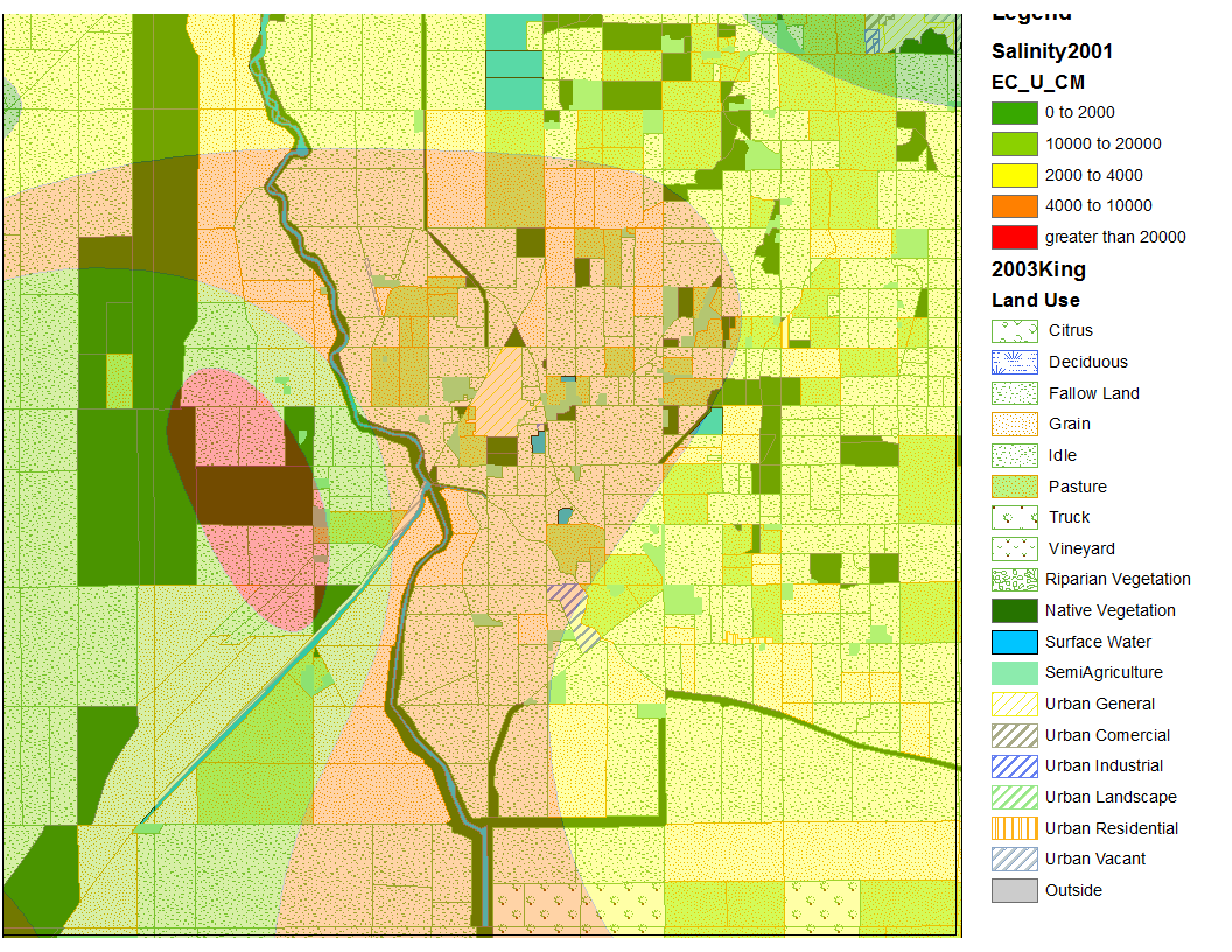
Van Genuchten and Hoffman (1984), yield reduction and salinity



Crop	C_{50} (mS/cm)
Alfalfa	6.85
Field corn	6.85
Grain	13.04
Orchard	4.13
Pasture	8.85
Rice	18.00
Sugar beet	13.04
Tomato	6.85
Truck crop	6.50
Wine grape	8.85

Here we used P=2.5 based on the crop mix empirical average.

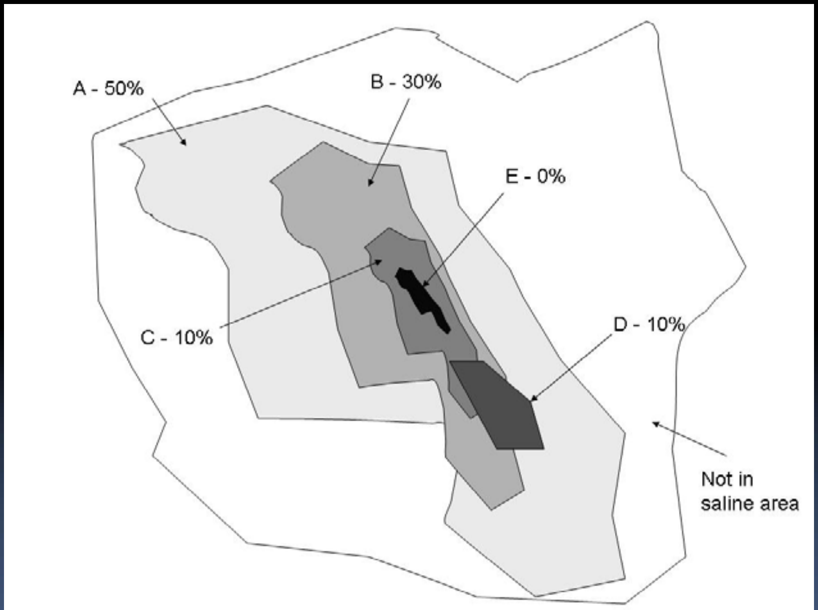
Assumed salinity in shallow groundwater lowers yields half as much as salinity in root zone.


Legend
Salinity2001
EC_U_CM
0 to 2000
10000 to 20000
2000 to 4000
4000 to 10000
greater than 20000
2003King
Land Use
Citrus
Deciduous
Fallow Land
Grain
Idle
Pasture
Truck
Vineyard
Riparian Vegetation
Native Vegetation
Surface Water
SemiAgriculture
Urban General
Urban Comercial
Urban Industrial
Urban Landscape
Urban Residential
Urban Vacant
Outside

Model and Methods

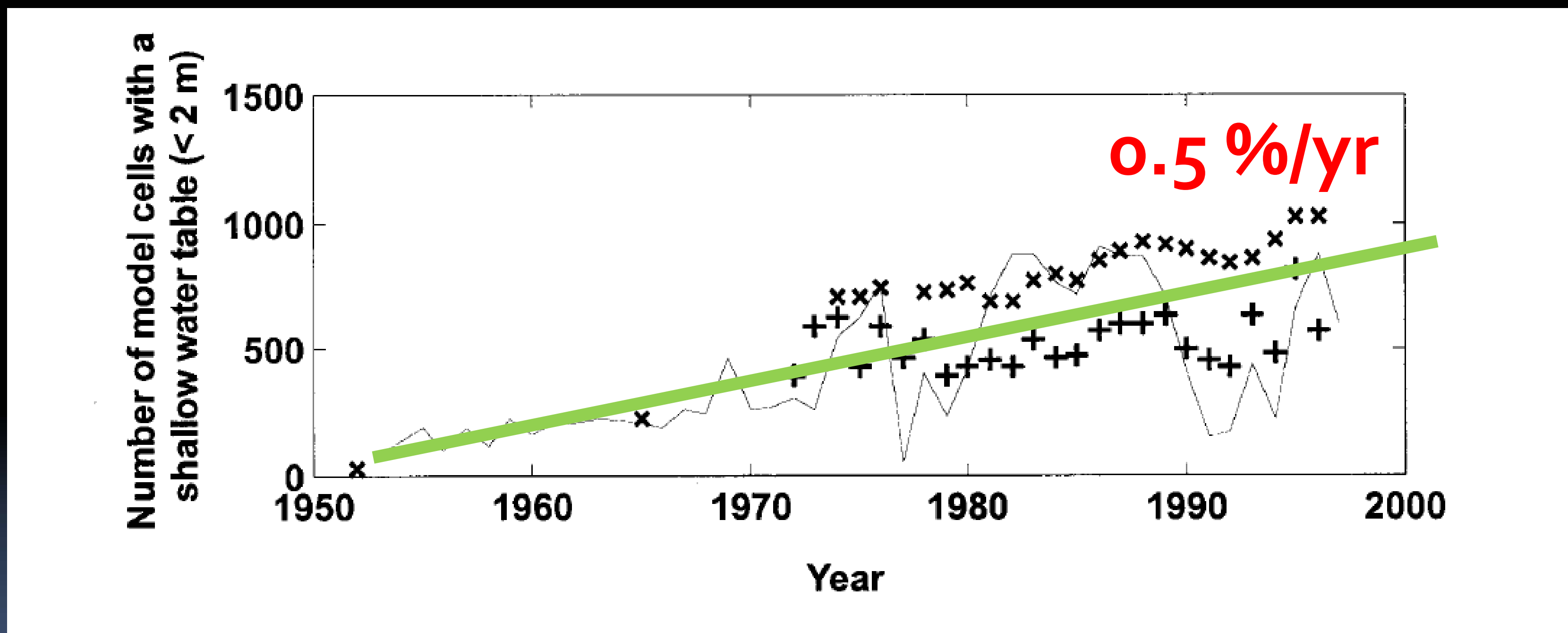
- More saline areas grow over time

Zone	Salinity level (EC in shallow groundwater (µS/cm))	Share of non-saline acres transferred to the saline zone (%)
A	0-2000	50
B	2000-4000	30
C	4000-10000	10
D	10000-20000	10
E	above 20000	0



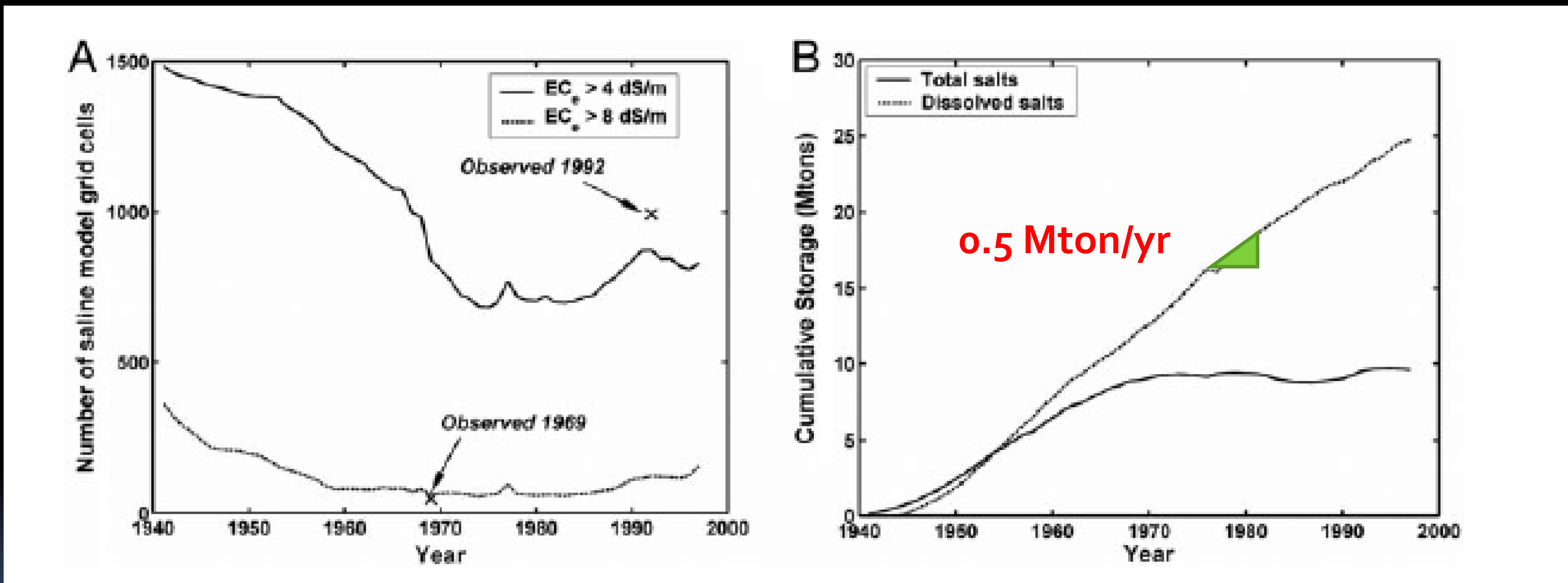
Continued salt exports expand saline soil areas

- From Shoups (2004)…



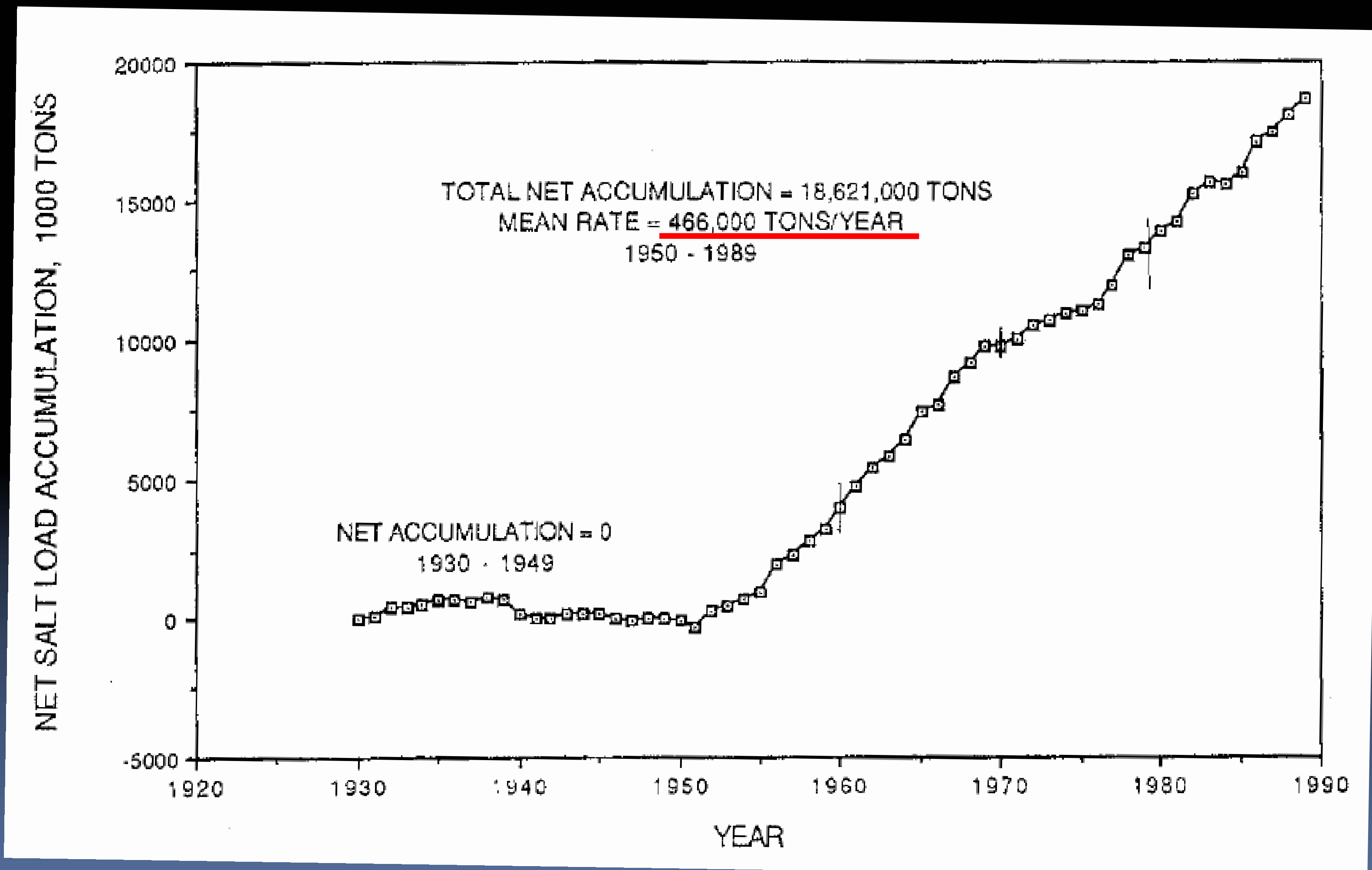
Following historic trends, area of saline groundwater is likely to increase by roughly 13 percent

Annual salt accumulation close to half a million tons



From Shoups et al. (2005)

Orlob (1991) found similar net salt accumulation rates



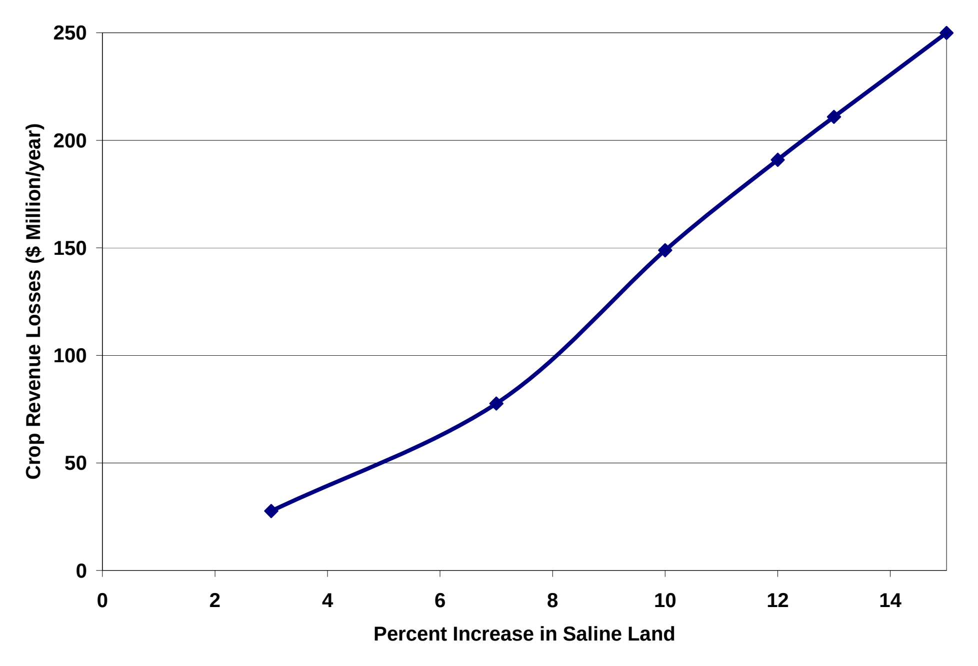
Model and Methods

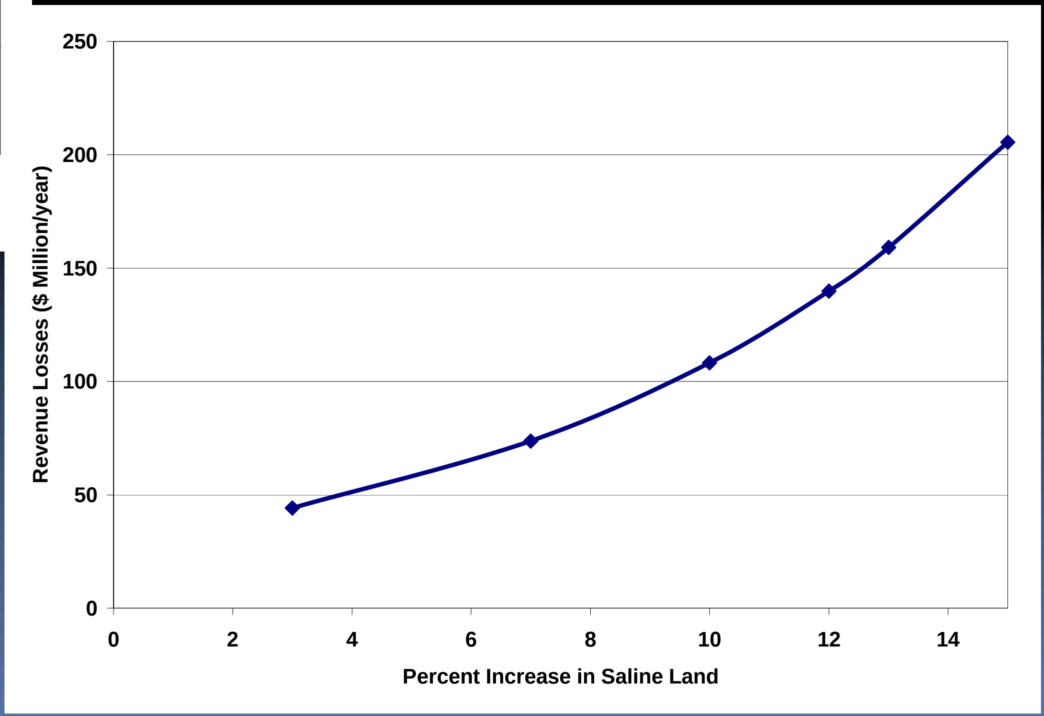
- GIS along with cost and price data used to calibrate a profit maximization model
- 2030 land conversion from urban to agriculture, shifts in crop demand and endogenous prices are considered.

Model and Methods

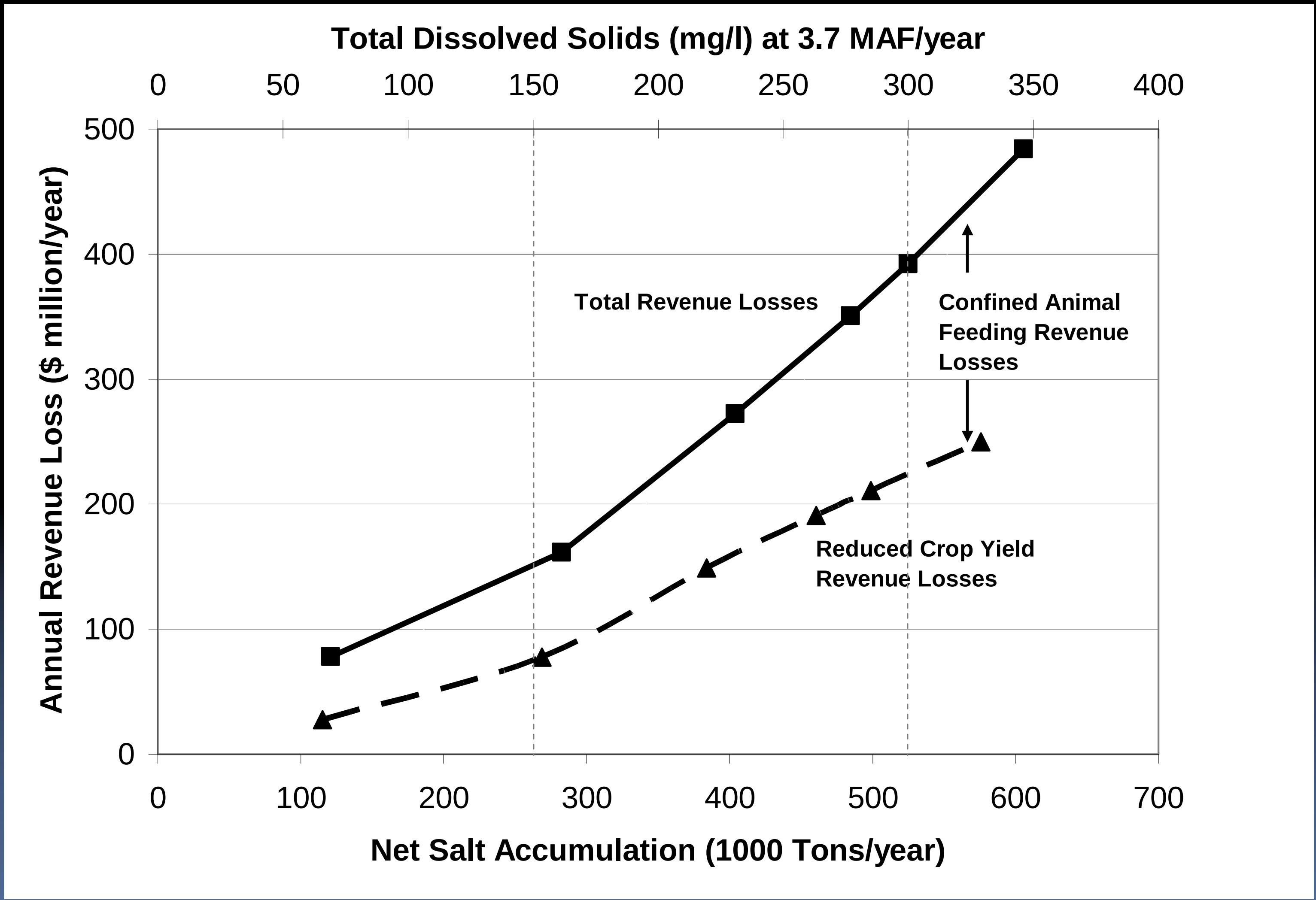
- Each saline area within a CVPM represents a production region
- Area of production region was changed to mimic assumed soil salinization trends
- A similar model followed for Confined Animal Operations (CAFO)
- Six levels of increase in saline area were assumed from 3 to 15 percent

Crops and Confined Animal Operations Results



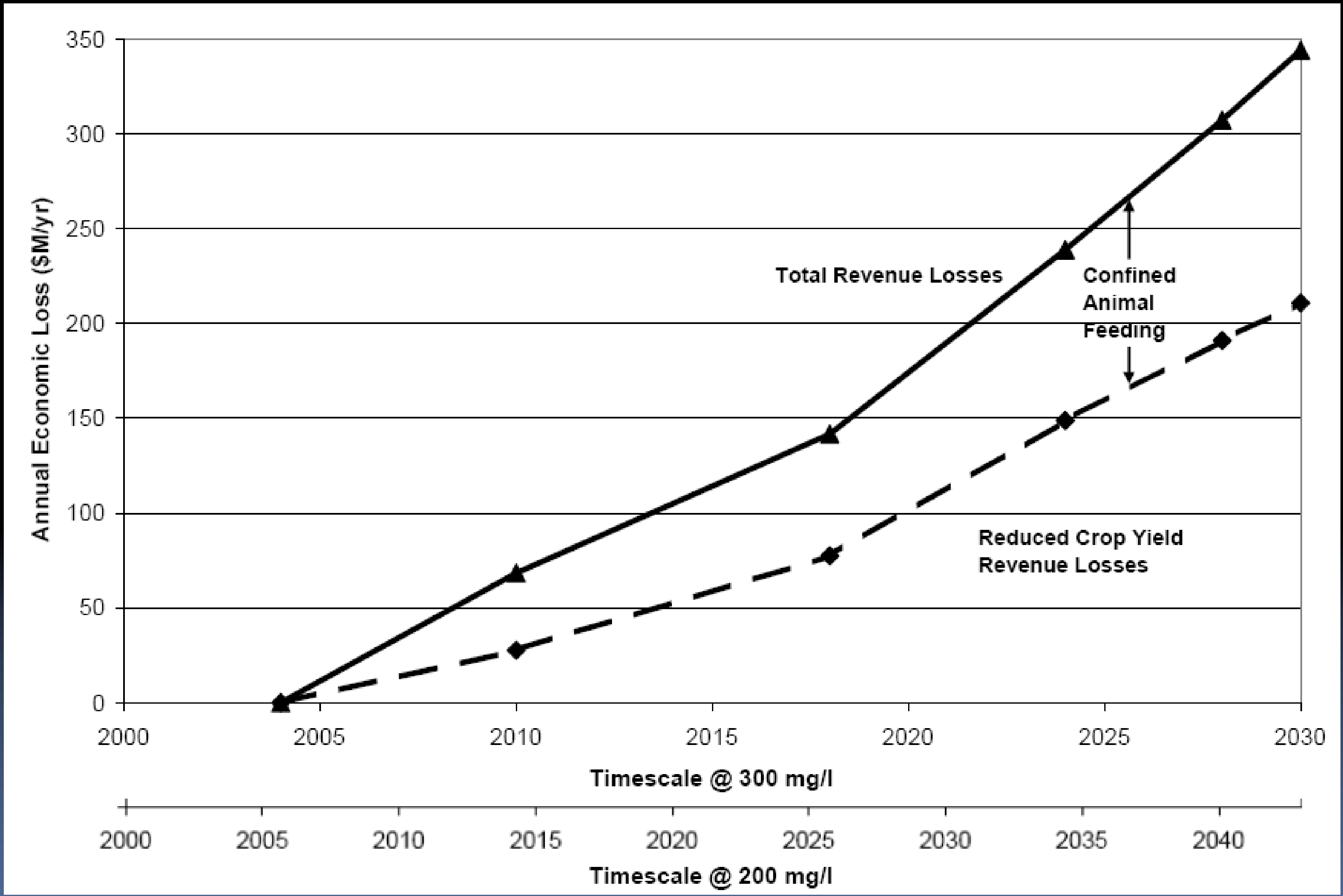


Revenue losses with and without export salinity reductions



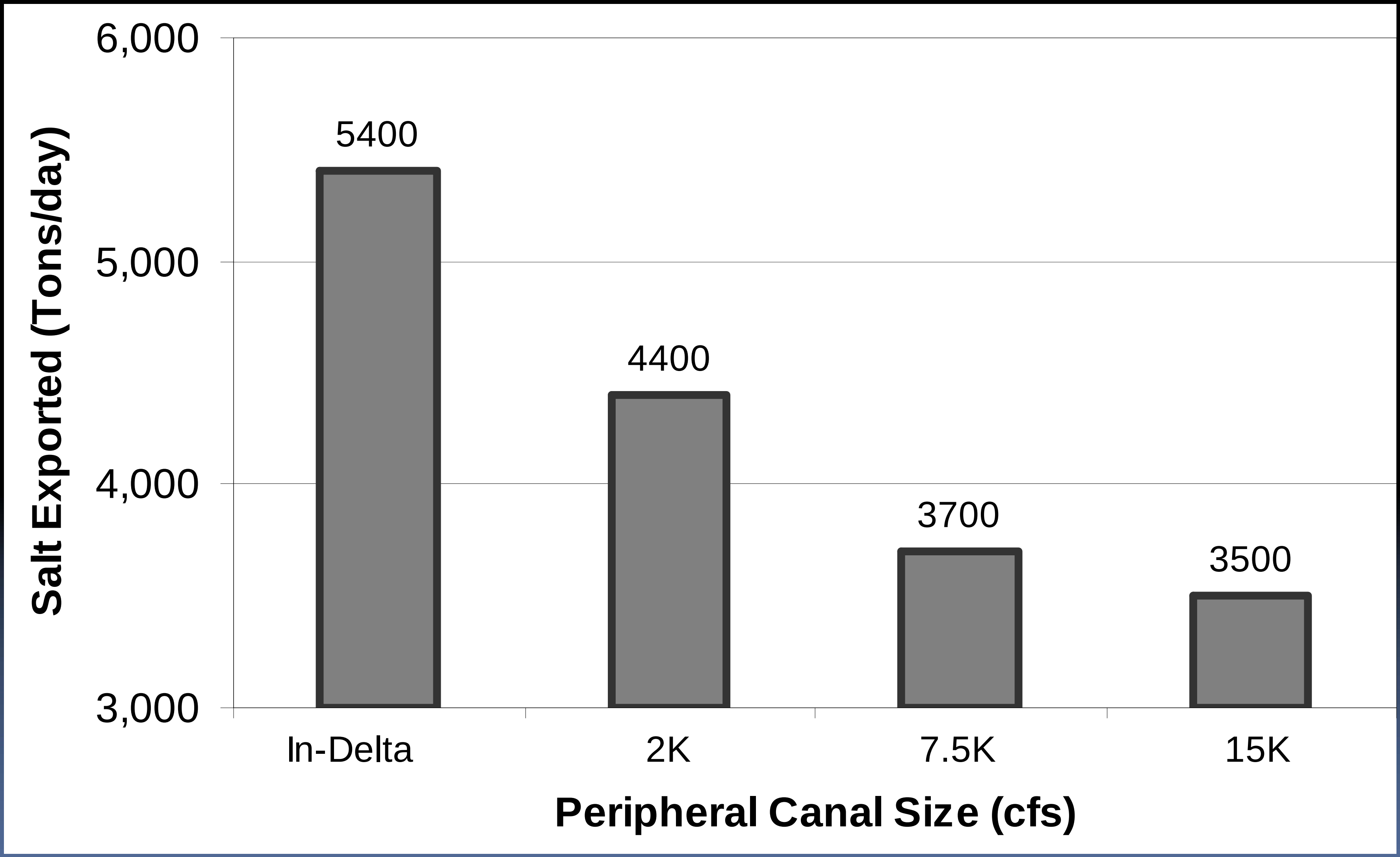
Water quality improvements from 300 mg/l to 150 mg/l would decrease losses By $241 million per year by 2030

Revenue losses over time with and without export salinity reductions

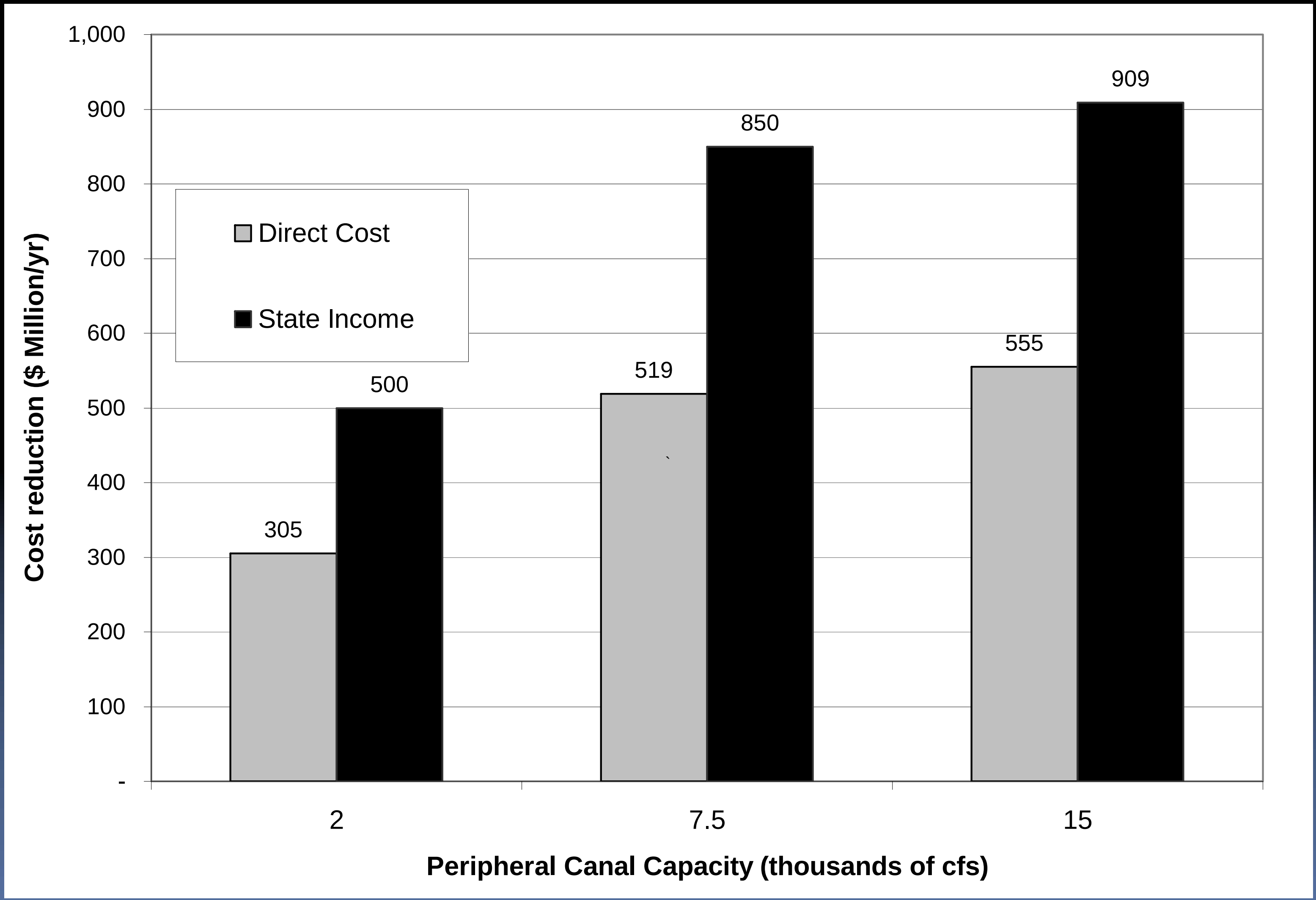


With Water quality improvements from 300 to 200 mg/l, total losses of $392 million Could be postponed from 2030 to 2043, thirteen years

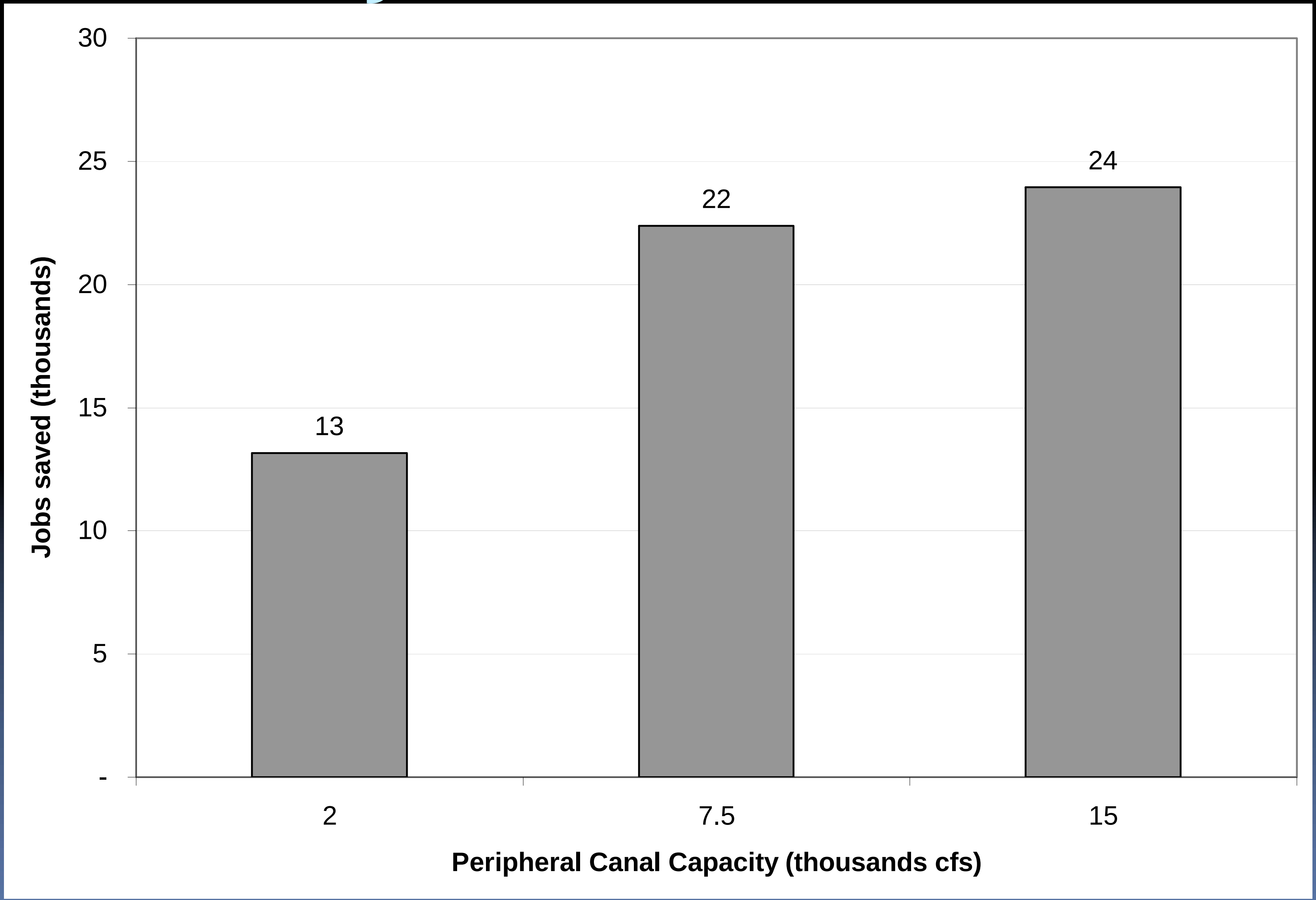
Daily Exports for different PC sizes



Regional income losses from export salinity



Jobs lost from export salinity



Limitations

- More geohydrology studies needed for salt loads and relationship between groundwater and soil salinization
- Departure from historic operation conditions could change levels of salinity, with or without a peripheral canal
- Better water quality may attract higher value crops to increase benefits from a peripheral canal.

Conclusions

- Substantial long term economic costs from Delta salt exports to agriculture in Central Valley
- Revenue losses may range between $341 and $440 million per year for crops and CAFO (2030)
- Even a small (2000 cfs) peripheral facility can reduce exported salts by nearly 20 percent
- The smaller the canal, the larger the share of economic benefits for urban uses