Analyzing California Agricultural Water Efficiency Potential

Water Efficiency, Water Productivity, and Steps Forward

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Water-Use Efficiency Definitions

- How much water is required to satisfy a particular demand?
  - Many definitions
  - Long academic history
  - Well understood, in theory
  - Long field experience
  - Poorly measured, in practice

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Agricultural Efficiency: Good News

- Remarkable movement in past few years; growing number of “success stories.”
- New appreciation for the potential for improvements.
- Better understanding of the definitions, complexities, and possibilities.
- Growing efforts to understand and address barriers to implementation of improvements.
- Still some serious misunderstandings, misrepresentations, constraints on implementation.

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Water Efficiency Potential

- Some believe that WUE potential is small and that the only real options are fallowing and crop shifting.
- The good news is that this is wrong: Strong evidence that the potential for improving agricultural water-use efficiency is substantial.
- This allows us to maintain a sustainable and strong (and more productive) agricultural sector.

Beyond the Definitions: Additional Factors to Consider

- Theory versus Measurement
- Co-benefits (traditionally ignored or discounted)
- Water-Use "Productivity" (versus "Efficiency")
  - Yield per unit water
  - Dollars per unit water
  - Employment per unit water
  - Other measures

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Theory versus Measurement -1-

- The State doesn't know how much water is actually applied or productively used, with few local, specific exceptions (Kings River).
- "Field" efficiencies are not consistently or completely monitored, measured, and reported.
- The same is true for basin efficiencies, which require detailed, long-term observations on:
  - Basin precipitation
  - Evaporation and transpiration, separately
  - Soil moisture
  - Return flows
  - Groundwater flows in and out of basins or to sinks
  - Actual withdrawals and actual applied water...

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Theory versus Measurement -2-

- We don't typically measure unproductive evaporation.
- We don't know many rates or locations of groundwater withdrawals, recharge, or dynamics.
- We don't know current distribution of irrigation technologies or practices.
- We have few complete or accurate public "water balances" by district or basin or hydrologic region.
- More data are *collected* than *reported*. State has legal authority to know these things.

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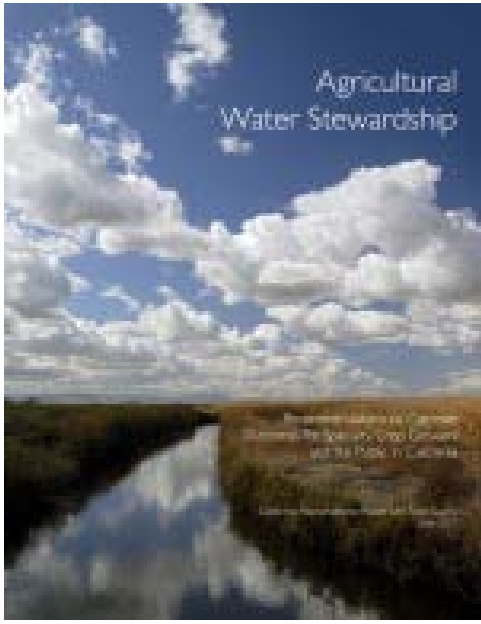

1 Recommendation:

Create a stronger knowledge base

"Collect better data for understanding basin-scale water balances, ***particularly empirical measurements of water use, return flows, and groundwater percolation.*** These data are necessary to comprehend the risks and benefits of management practices…"

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Finding “New” Water is Not the Only Goal

- Some analysts focus on “new water.” If a policy doesn’t produce water that can be “reallocated” or “marketed,” they discount it.
- This results from a confusion between “consumptive and non-consumptive” and “beneficial and non-beneficial” uses.
- And this focus ignores critical and valuable co-benefits.

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Consumptive v. Non-Consumptive?
Beneficial v. Non-Beneficial?

	Consumptive Use	Nonconsumptive Use
Beneficial	Crop evapotranspiration Evaporation for cooling Evaporation for frost protection	Water for leaching
Nonbeneficial	Phreatophyte evapotranspiration Weed evapotranspiration Spray evaporation Evaporation from soil Reservoir and canal evaporation	Excess deep percolation Excess surface runoff Operational spill

Consumptive/Non-consumptive distinction is important; but so is "Beneficial/Non-beneficial" distinction. And State law reflects this.

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Importance of Reducing Non-Beneficial Water Use

- Improve Water Quality
- Increase Instream Flows
- Improve Timing of Instream Flows
- Ecosystem Benefits
- Delay or Eliminate Spending on New Water Supply Infrastructure
- Improve Crop Quality and Yield
- Reduce Energy Use
- Decrease Soil Salinity

Source: Christian-Smith, Cooley, Gleick 2011, Water Policy (in press)

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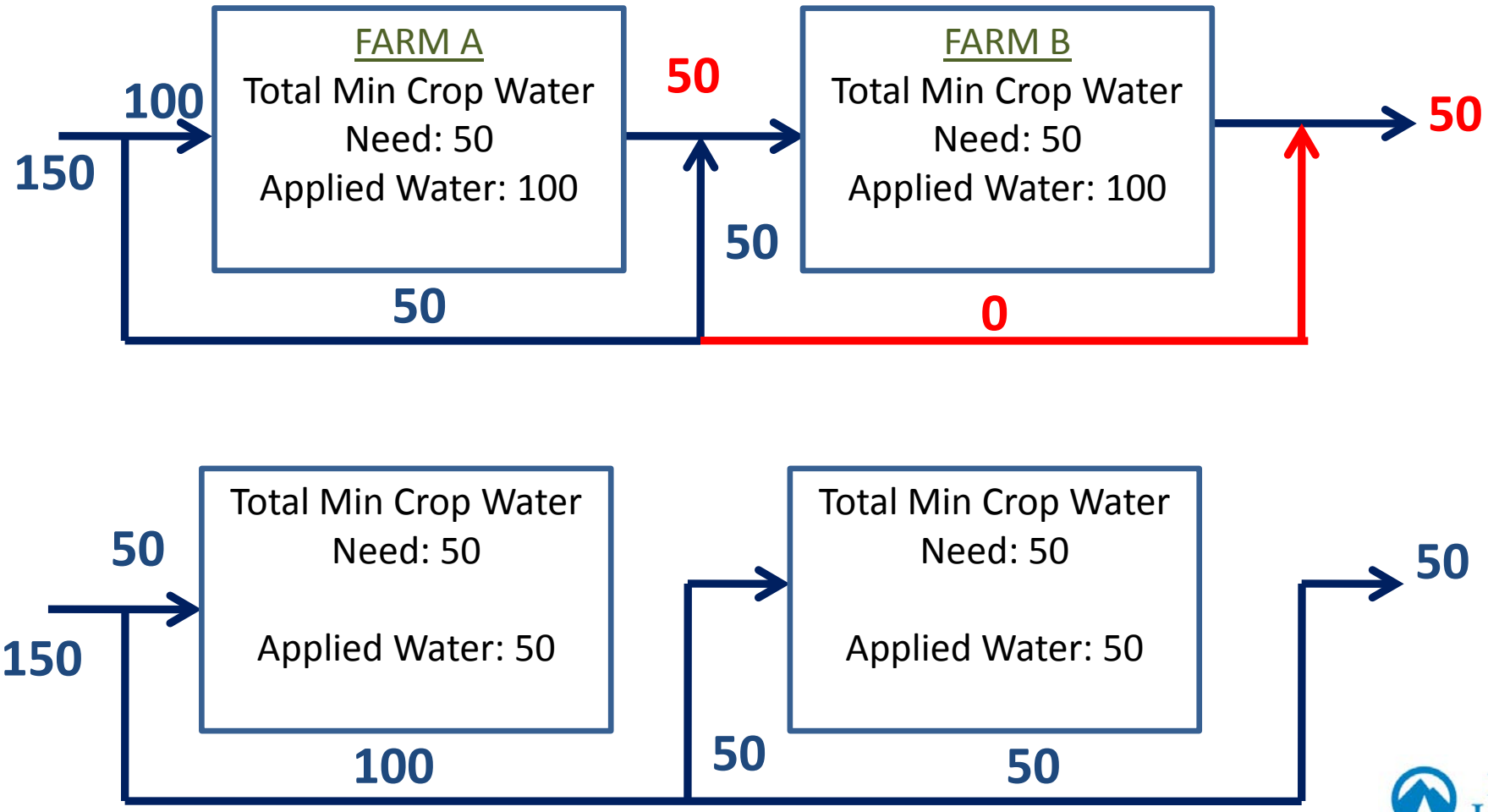
Improved Quality; Increased Instream Flow; Reduced Energy Costs



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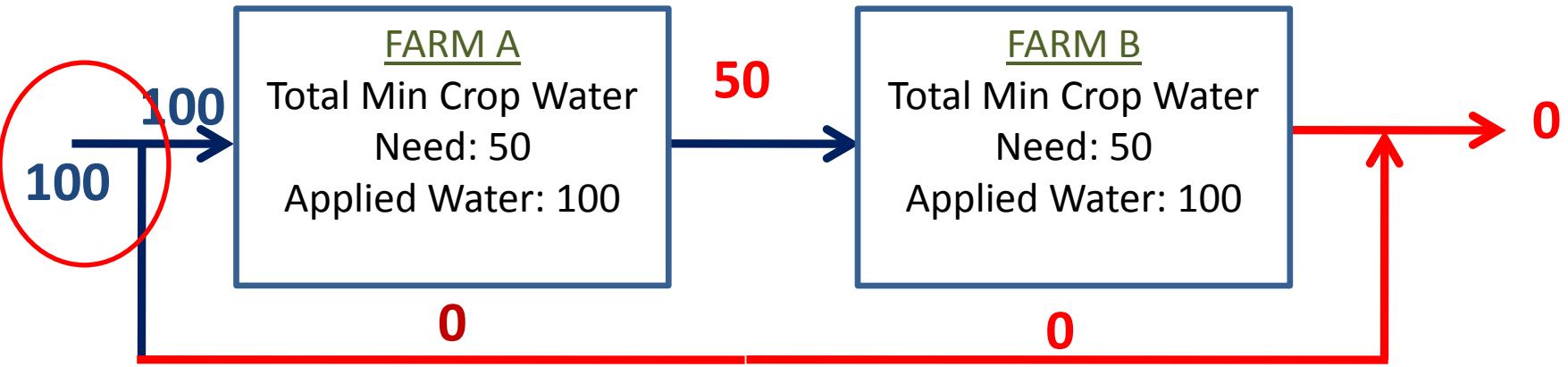
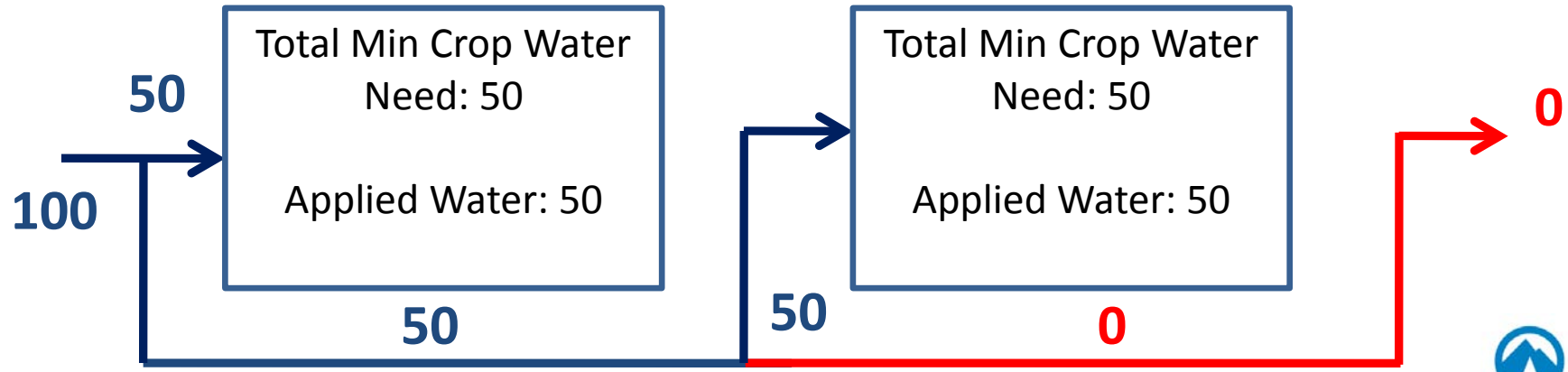
Improved Efficiency also Improves Drought Resilience





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Productivity versus Efficiency

What is our "goal"?

Maximize economic return?

Maximize total yield of food and fiber?

Save and reallocate water?

Boost employment?

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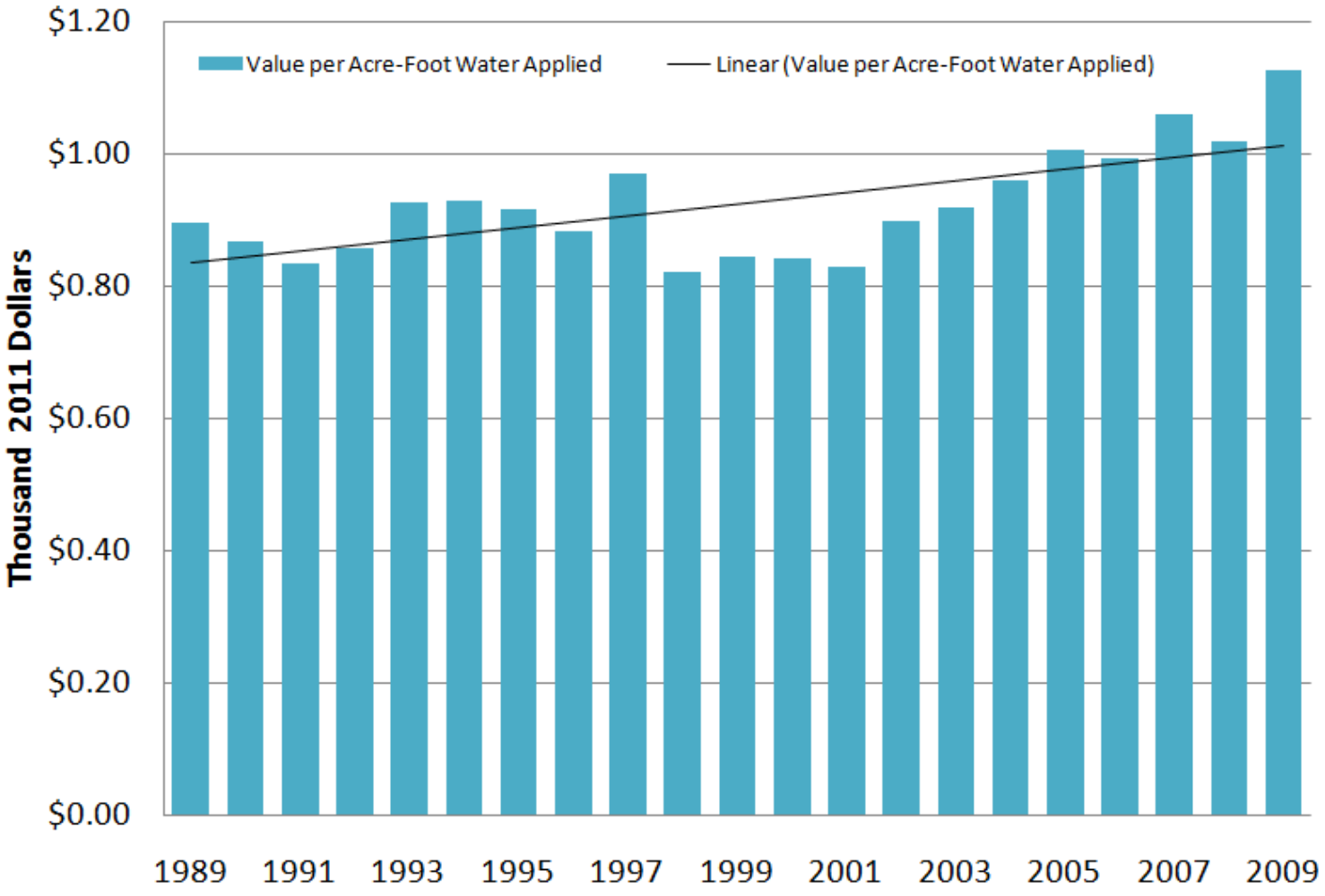
Economic Productivity: $ Value per AF



USDA NASS CA Historical Data(1989-2008) and CA Agricultural Statistics Report (2009)

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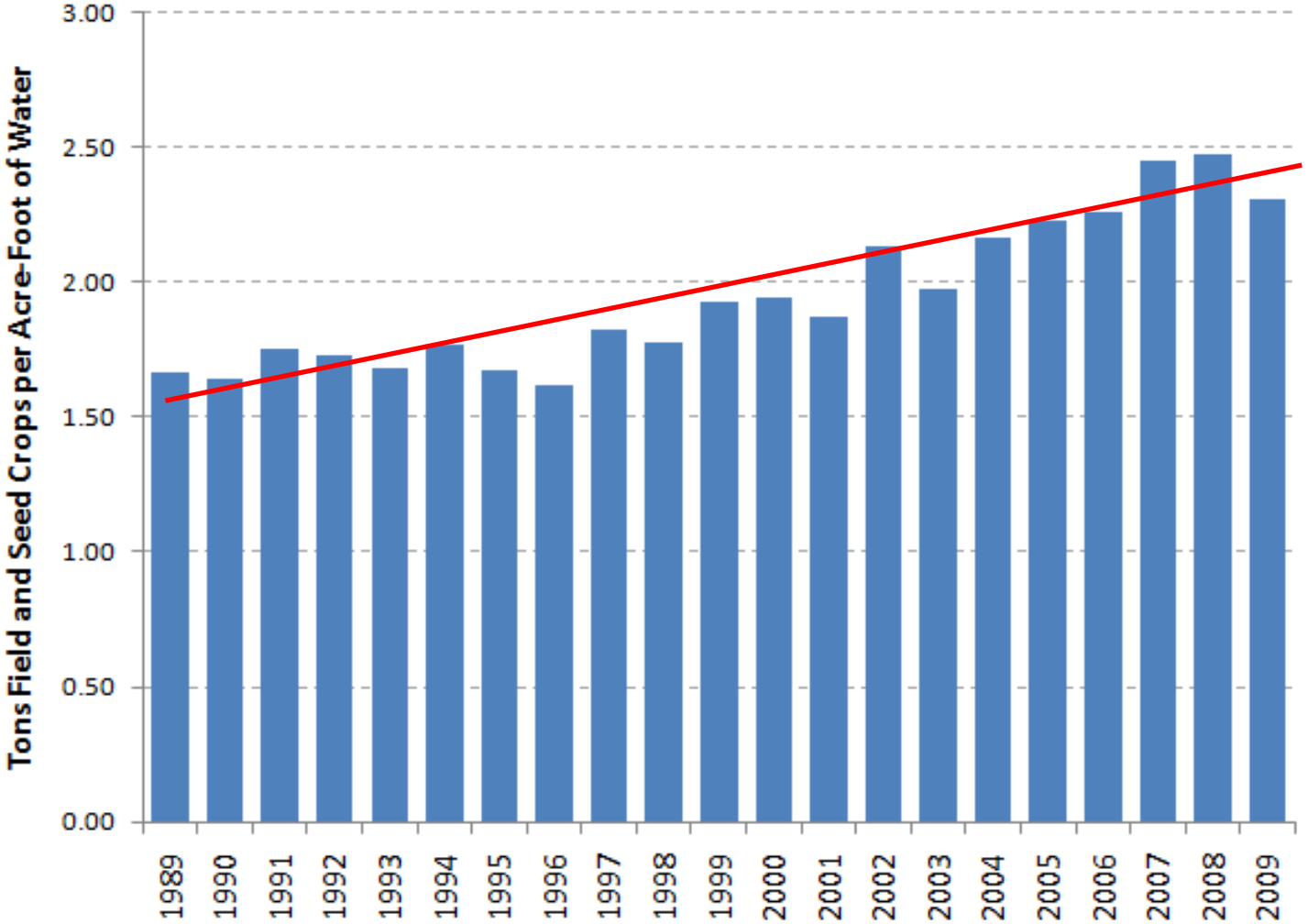
Crop Productivity: Field/Seed Crops
Tons per Acre-Foot of Water



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Productivity versus Efficiency

- The purpose of improving "efficiency" is NOT just to free up "new" water for reallocation.
- Efficiency improvements can lead to "productivity," "quality," and financial improvements. These are *real* benefits.
- What happens with "saved water" is a POLICY decision (Transfer it? Market it? Reallocate it? Expand on-field production?)
- New discussion is needed on capturing co-benefits.

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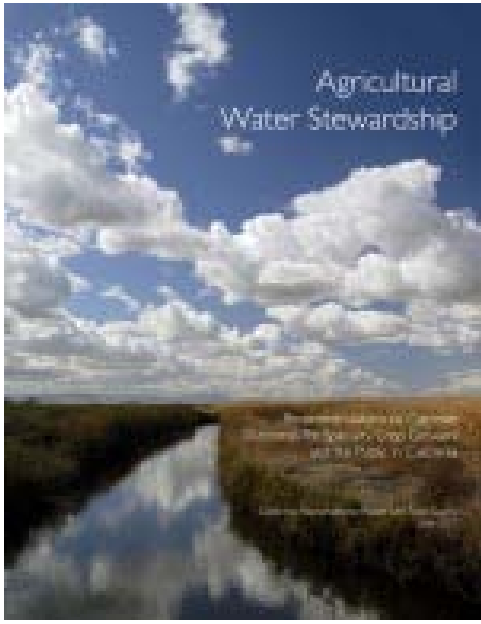

Addressing "co-benefits"

"Agricultural water stewardship can be defined as the use of water in a manner that optimizes agricultural water use **while addressing the co-benefits** of water for food production, the environment, and human health."

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Conclusions/Summary

- Significant potential for improving efficiency in California agriculture remains untapped.
- Significant potential for improving productivity in California agriculture remains untapped.
- There is healthy debate about the magnitude of this potential; but this is a diversion.
- Put in place diverse policies (regulation, markets, pricing, education, technology development…) to support and encourage efficiency improvements, especially those with "co-benefits."
- Serious data problems constrain both policy development and understanding.

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Additional Recommendations/Needs

- Improve data collection and public disclosure for all water use and balances.
- Define and enforce “beneficial use” provisions.
- Resolve water rights confusions.
- Sustainable funding for SWRCB operations.
- Possible long-term target? 1-2% per year improvement in efficiency/productivity combined.

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