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2012 Water Division Webinar Series

Agricultural Water Usage

Trends, Indicators, and What It All Means

February 16, 2012
1:30 – 3:00 PM EST

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About This Webinar

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Webinar Overview

Today's Agenda

- 📅 Meet Today's Featured Presenter
- 📅 Main Presentation
- 📅 Moderated and Audience Q & A
- 📅 Additional Resources
- 📅 Stay Tuned...

Meet Today's Featured Presenter



Dr. Noel Gollehon

Senior Economist
Natural Resources Conservation Service
U.S. Department of Agriculture

Featured Presentation

Agricultural Water Usage ***Trends, Indicators, and What It All Means***

Dr. Noel Gollehon

Natural Resources Conservation Service, USDA

Presentation for The Horinko Group

February 16, 2012

Washington, DC

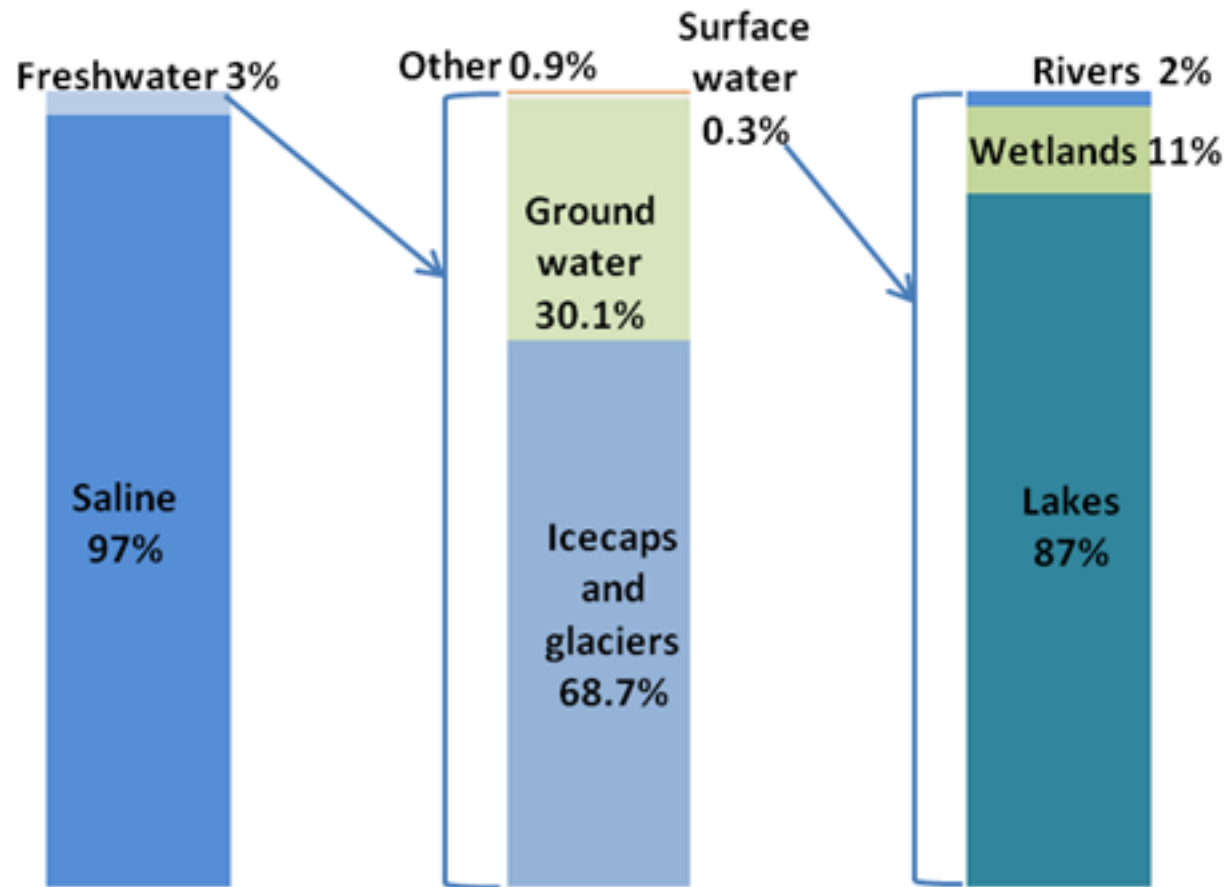


Disclaimer

Thoughts and opinions presented today are those of the author and do not represent those of USDA or the Natural Resources Conservation Service.



Distribution of Earth's water, by source



Source: adapted from USGS Water Science, <http://ga.water.usgs.gov/edu/earthwherewater.html>

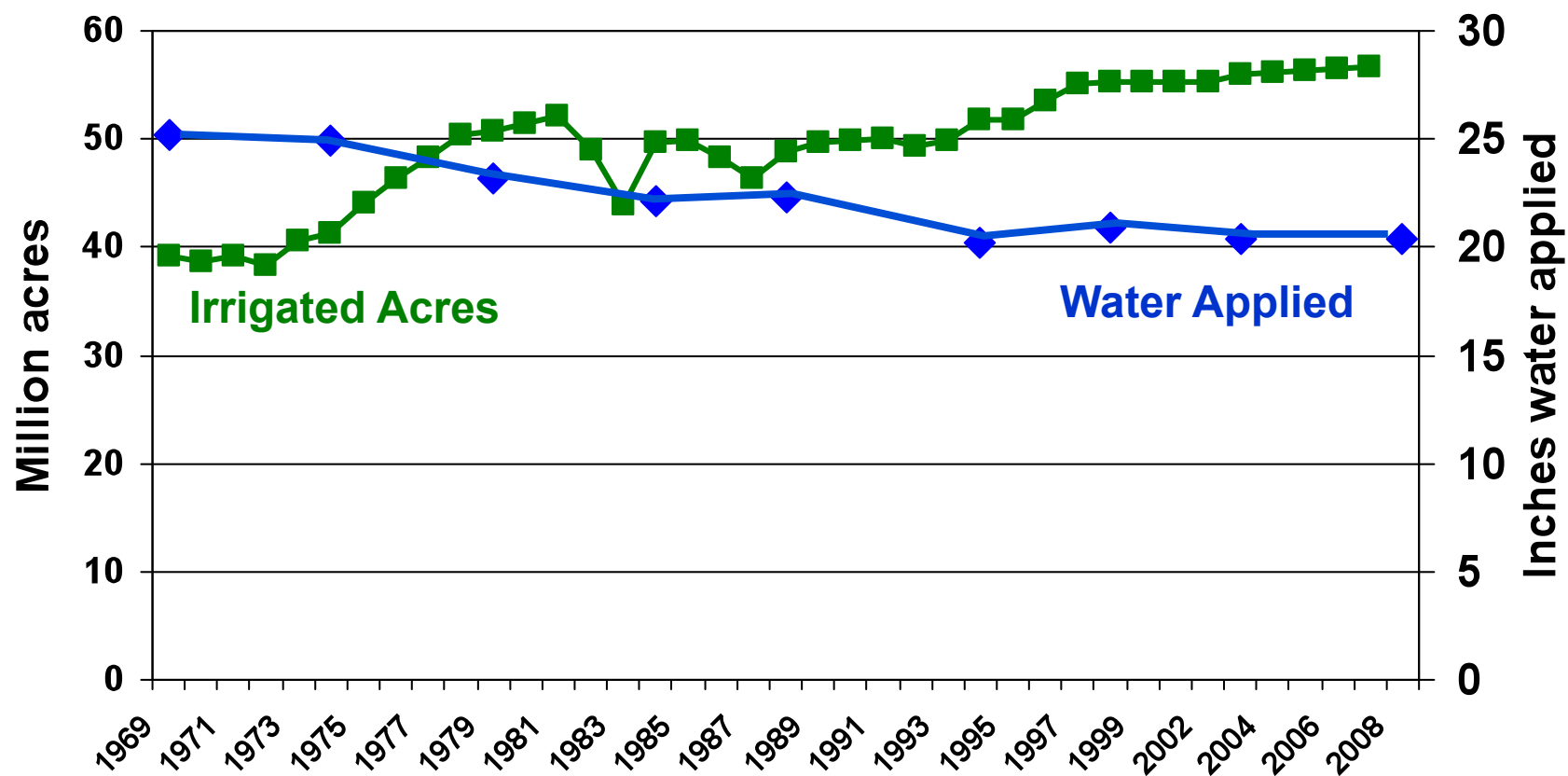


Goals of presentation

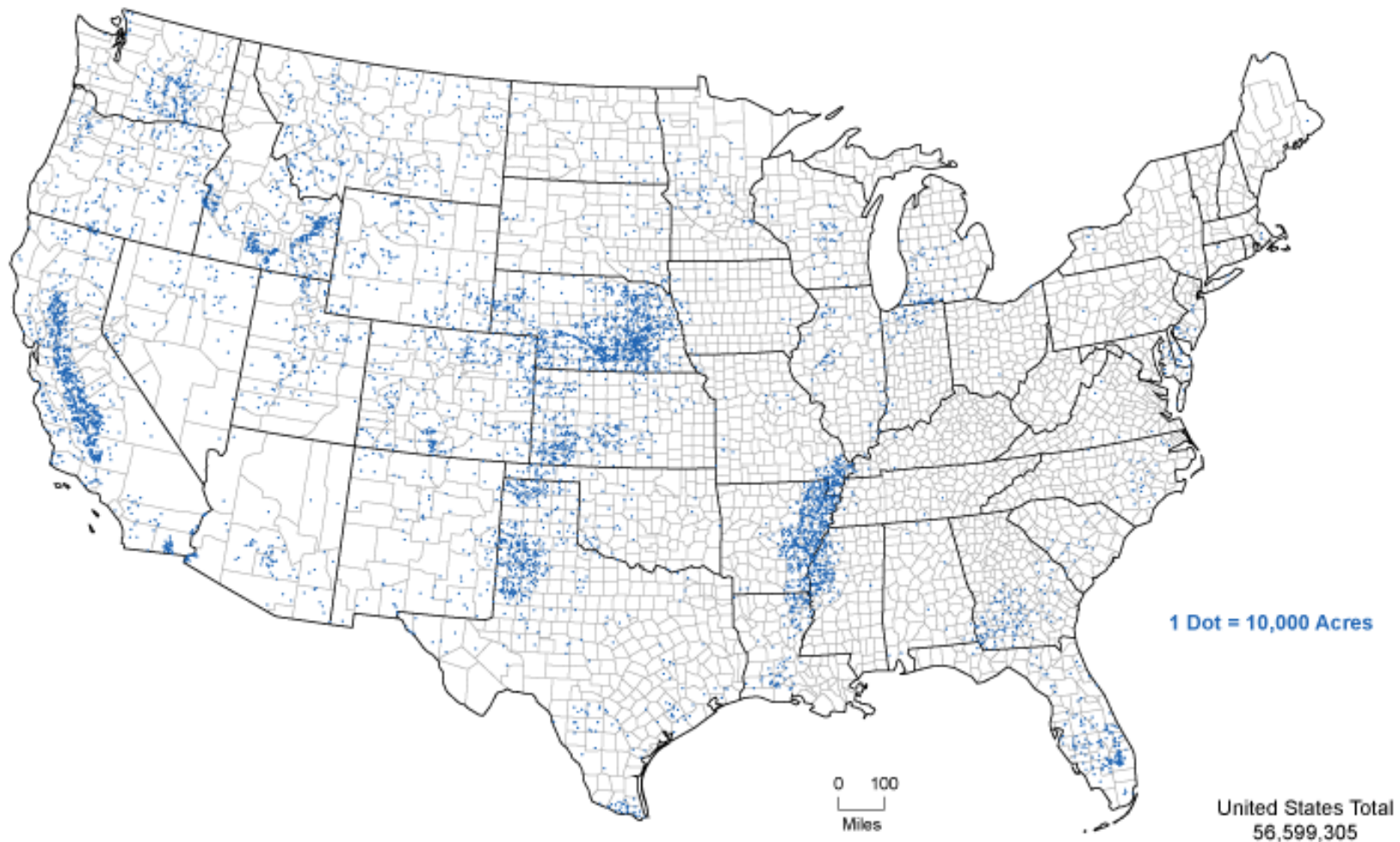
- Provide a National perspective water demands from irrigated agriculture
 - Acres
 - Water use
 - Crops
- The scale challenge
 - Field view
 - Basin view
- Conclusions



U.S. irrigated acres & water applications



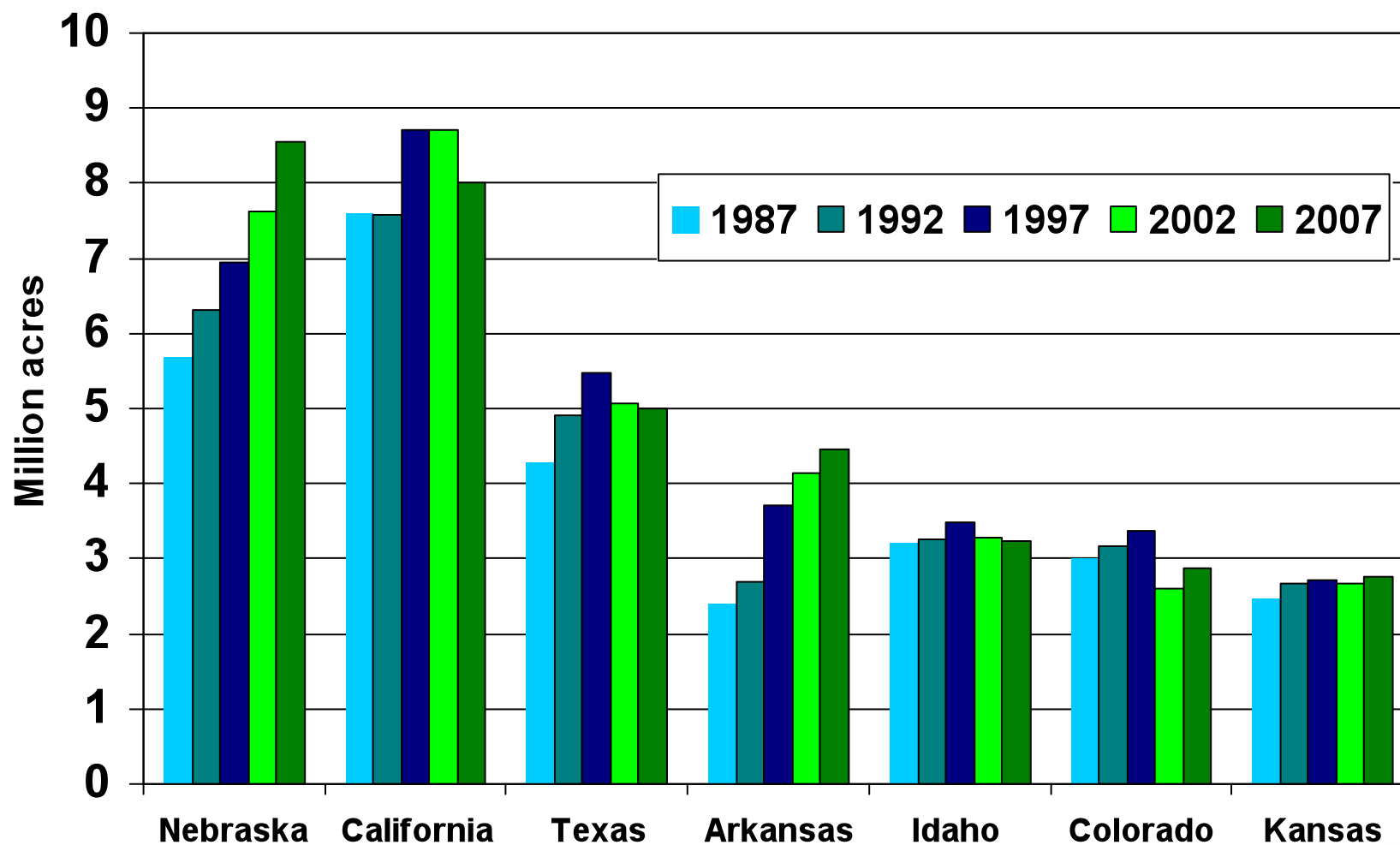
Irrigation overview: Acres location, 2007



Source: USDA, 2007 Census of Agriculture



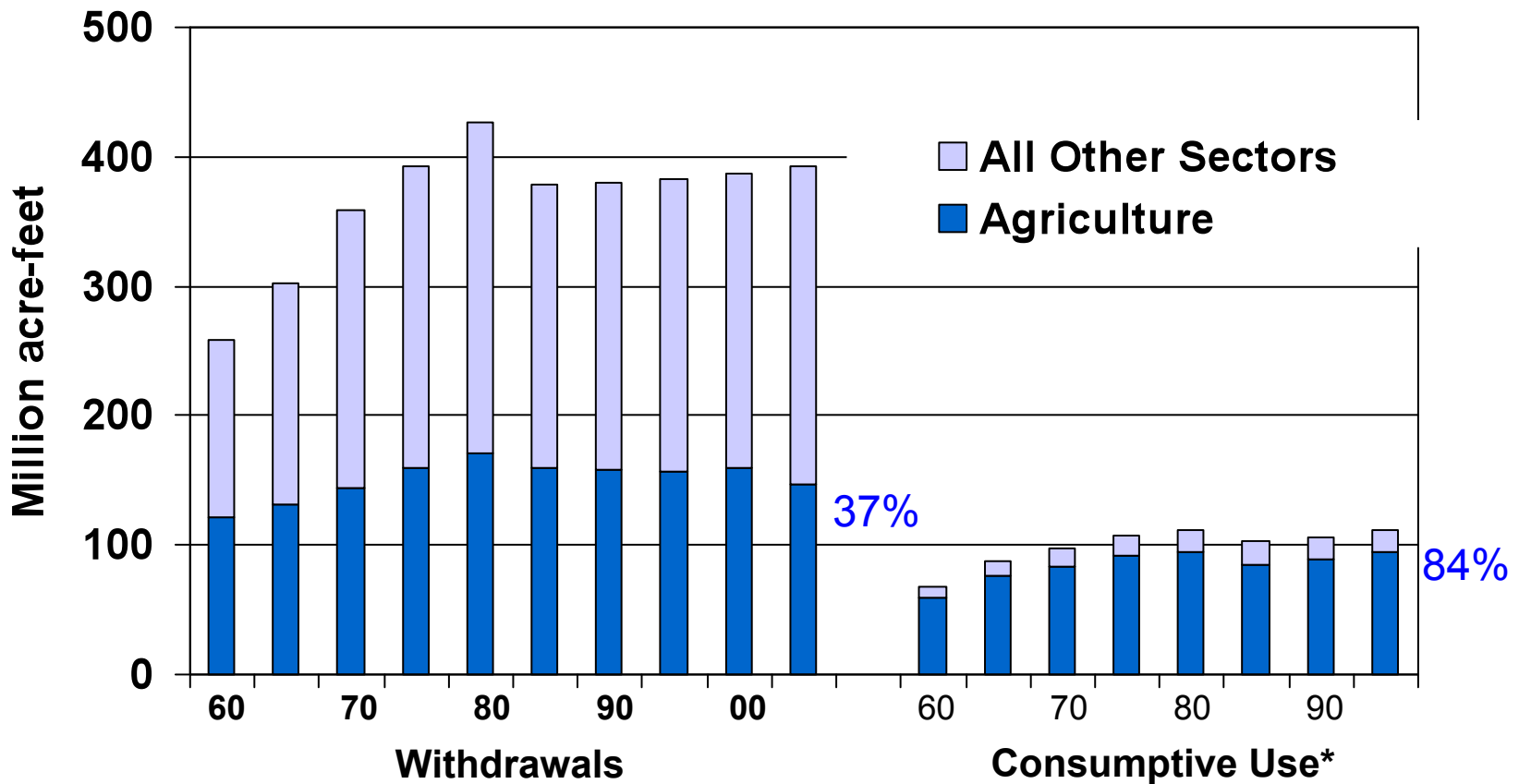
U.S. Irrigated acres, leading states



Source: USDA, NRCS, based Census of Agriculture Data



Total and agricultural water withdrawals (1960-2005) and consumptive use estimates (1960-1995)



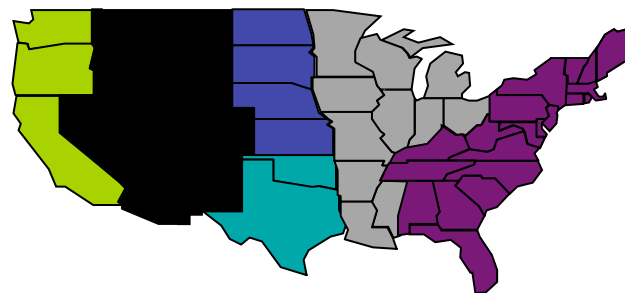
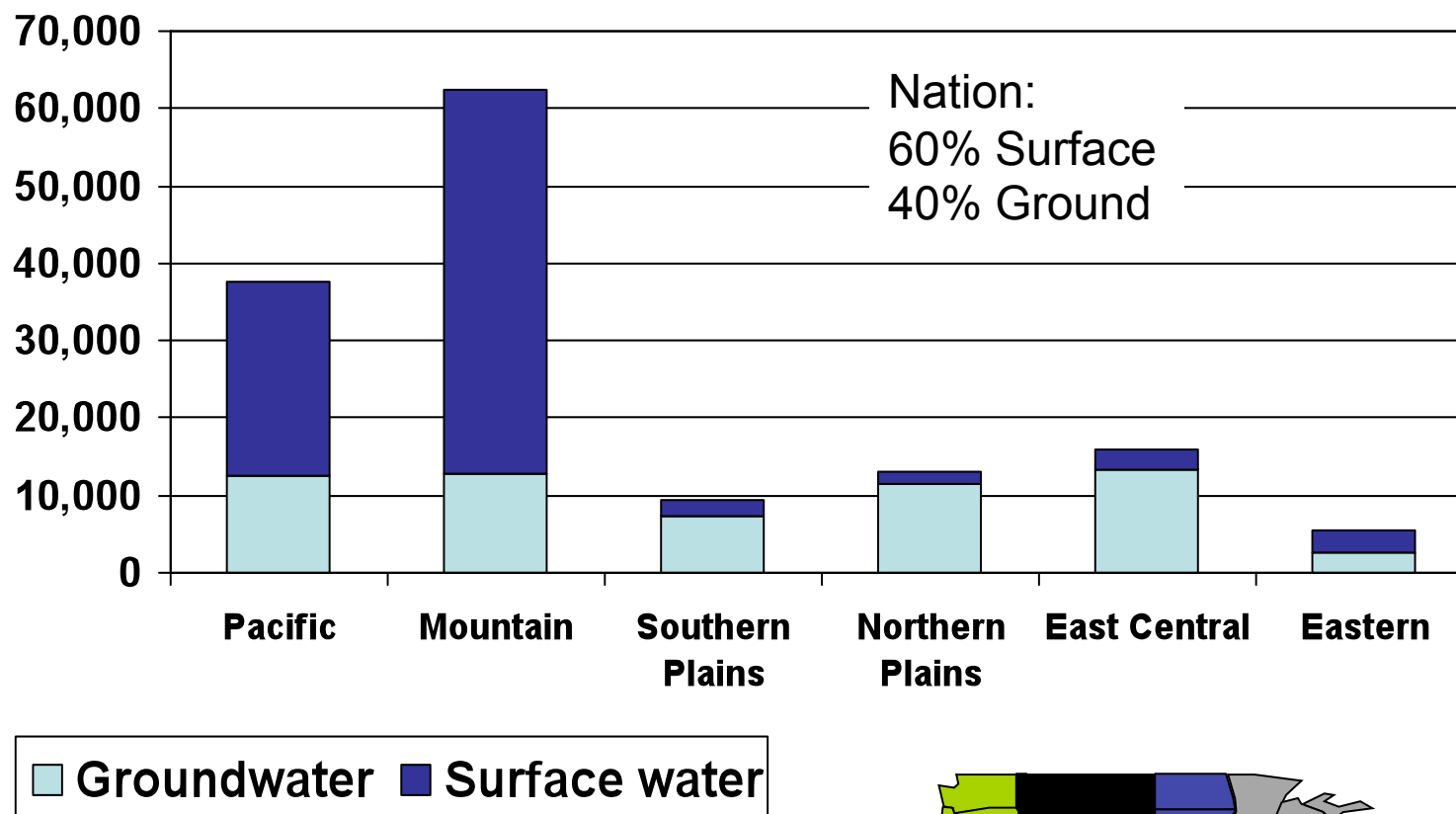
Source: USDA, NRCS, based on Kenny, et al, 2009

* Data limitations do not allow estimation of consumptive use in 2000.



U.S. Irrigation water withdrawals, 2005

Acre-feet (1,000)



Source: NRCS analysis of USGS Water Use data

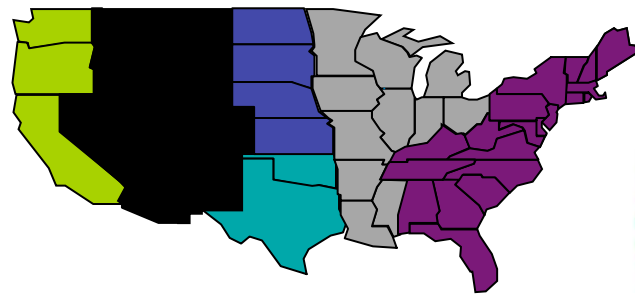
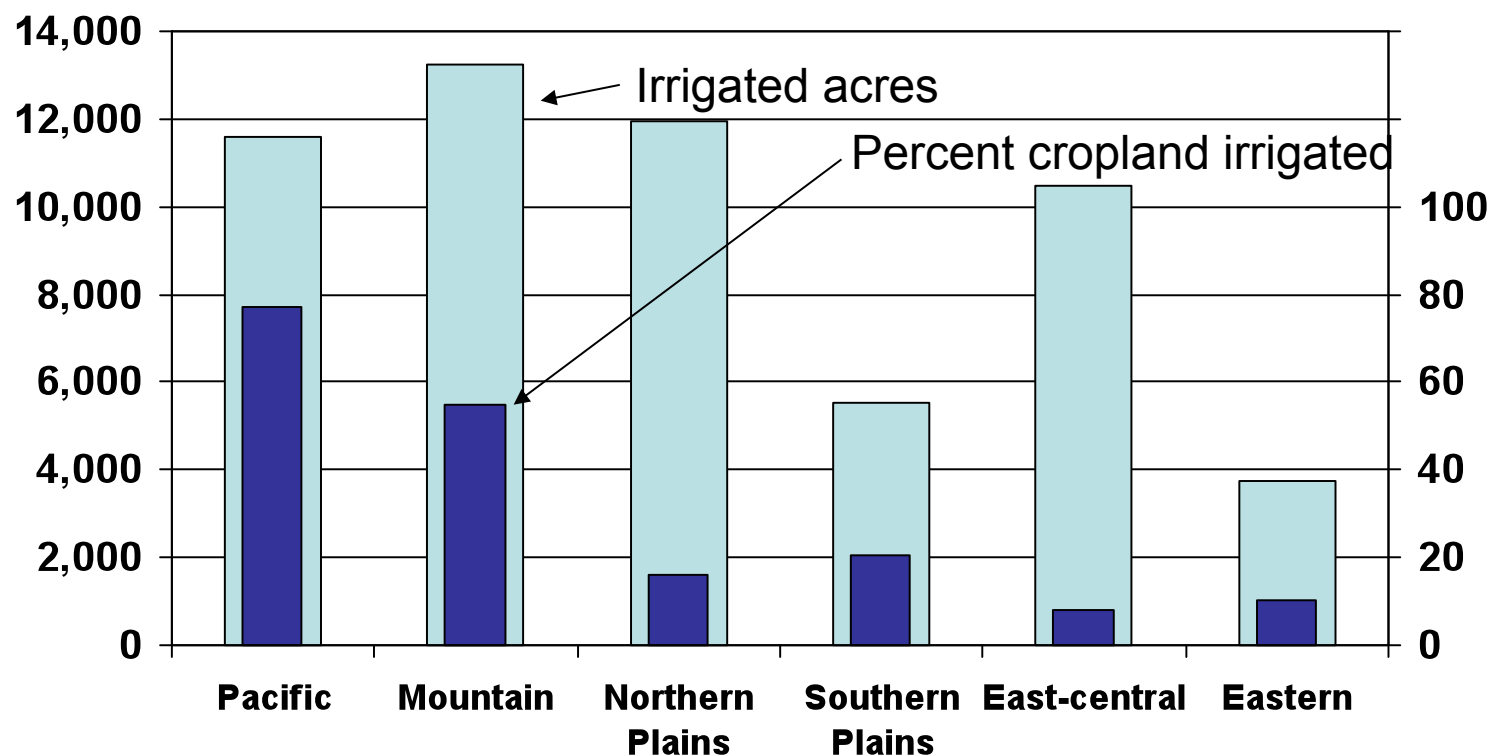


What is all that irrigation water used for?



U.S. irrigated acreage, 2007

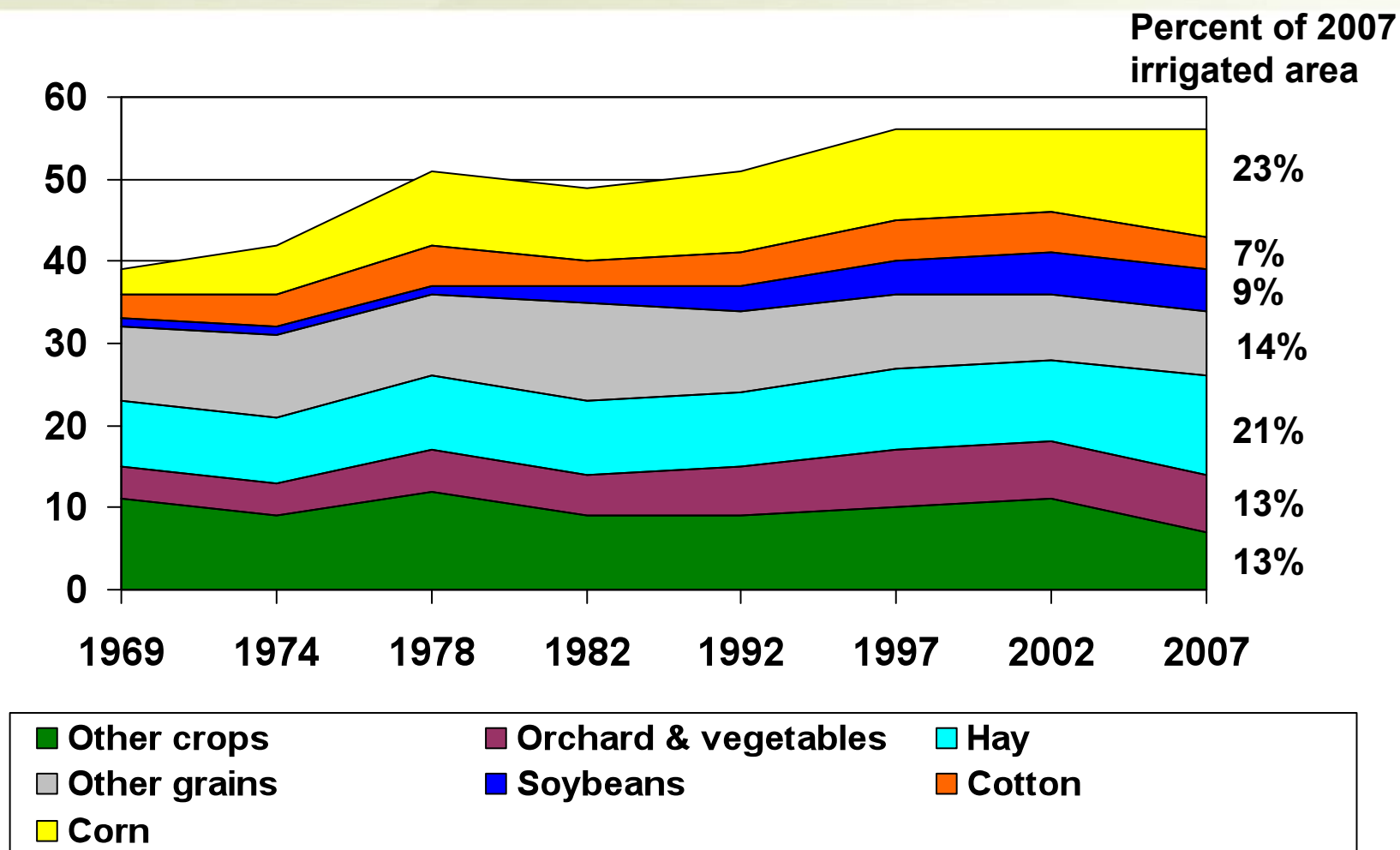
Acres (1,000) Cropland irrigated (%)



Source: NRCS analysis of Census of Agriculture Data



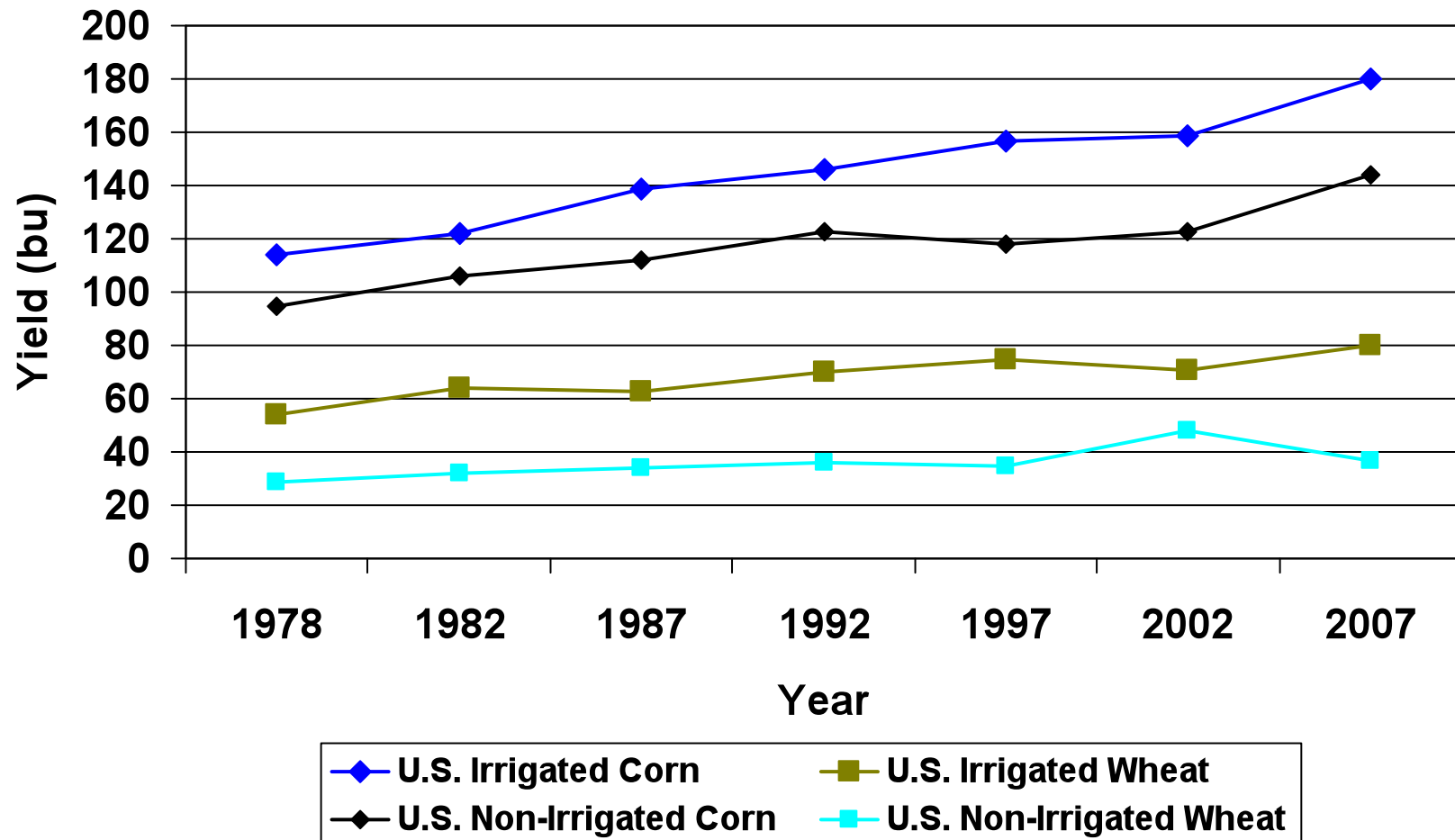
U.S. irrigated crops, 1969 - 2007



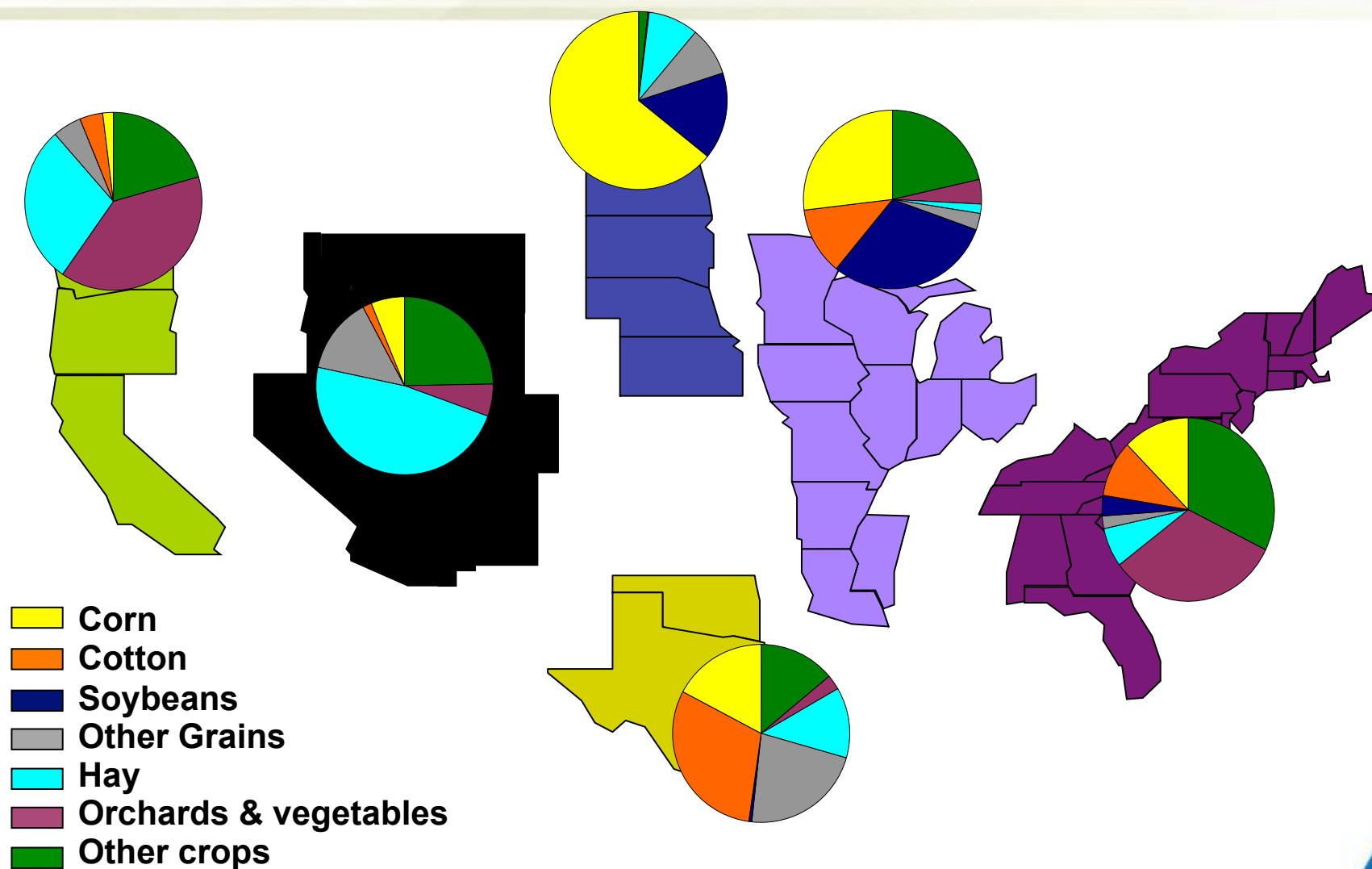
Source: NRCS analysis of Census of Agriculture Data



Corn & Wheat Yields, Irrigated & Non-irrigated



Regional irrigated cropping patterns, 2007



Source: NRCS analysis of Census of Agriculture Data



How much water is applied for irrigation?



How much water for an “average” corn field?

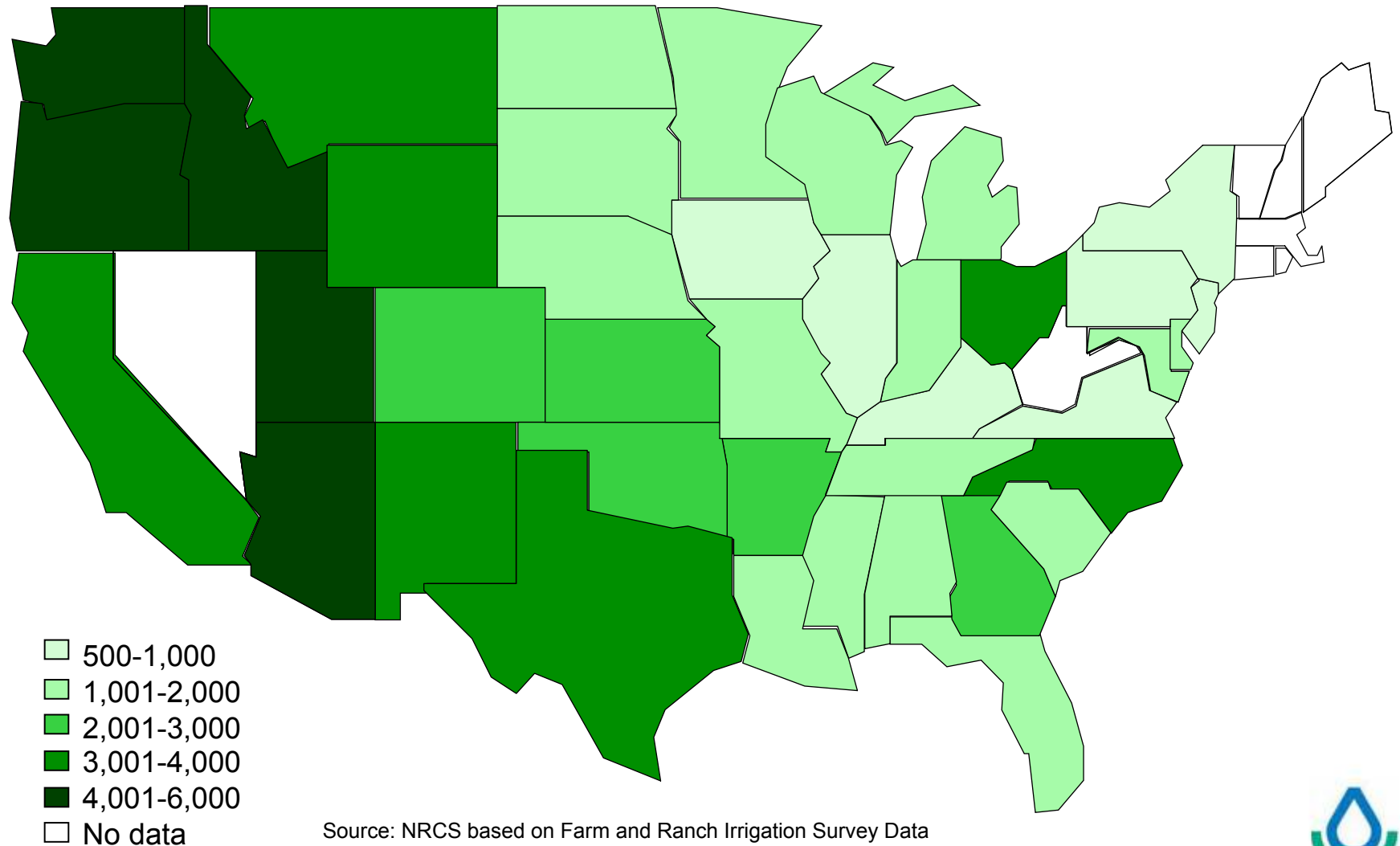


- 130 acre center-pivot field
- 12 inch application in 2008 (reduction from 14 in 2003)
- 42,357,120 gallons applied per year per field ($27,152 * 12 * 130$)
- States with >100,000 acres range from 21 to 85 million gallons per field
- 1,800 gallons /bu (based on average irrigated corn yield in 2008 of 181 bu/acre)

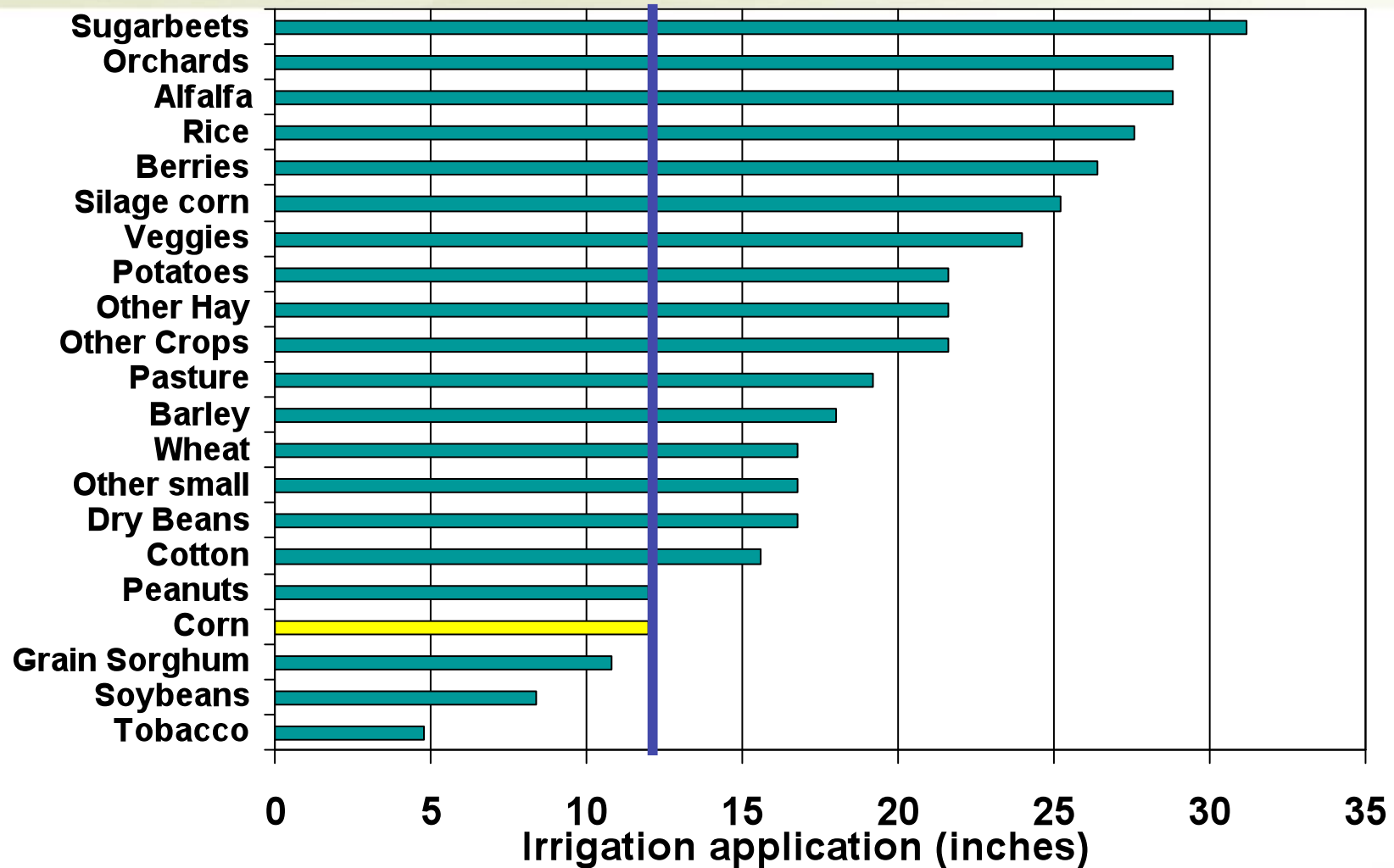
Source: USDA, NASS, Farm and Ranch Irrigation Survey



Gallons of irrigation water per bushel of irrigated corn, 2008



Average irrigation water applications levels for selected crops, U.S., 2008



Source: ERS based on 2003 Farm and Ranch Irrigation Survey data.



Summary of irrigation overview

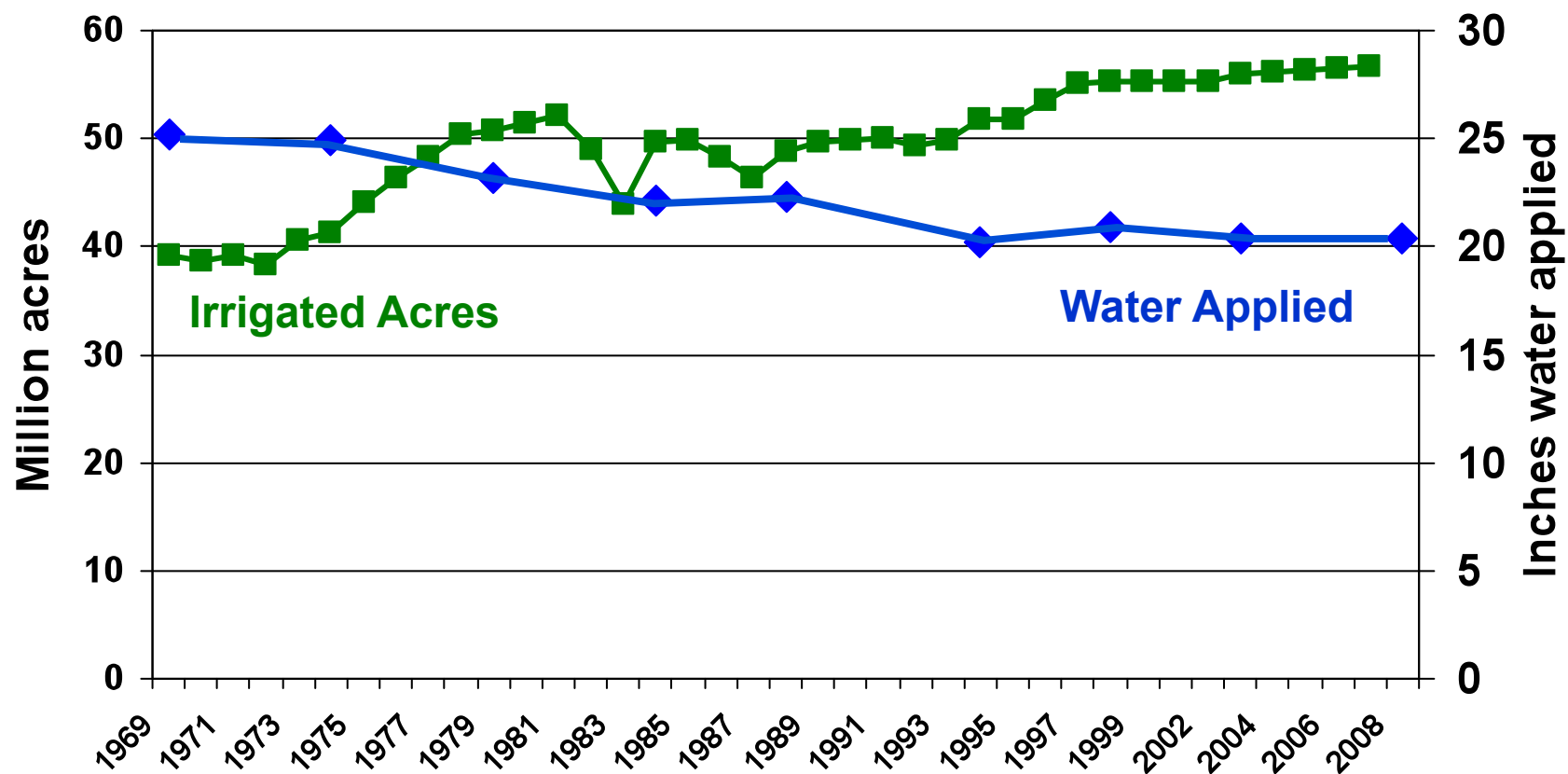
- Irrigated agriculture is the 800 pound gorilla in the water use world
 - Withdrawals: Major (stable to slow decline)
 - Consumptive use: Dominant sector (continue role)
- Irrigation is a national production practice
- Surface water – Major Western supply
- Ground water – Important supply source in all regions
- Per acre application levels are highly variable by crop and location
- Per field quantities are shocking large in the volume of water applied



The scale challenge and irrigation: Field View



U.S. irrigated acres & water applications

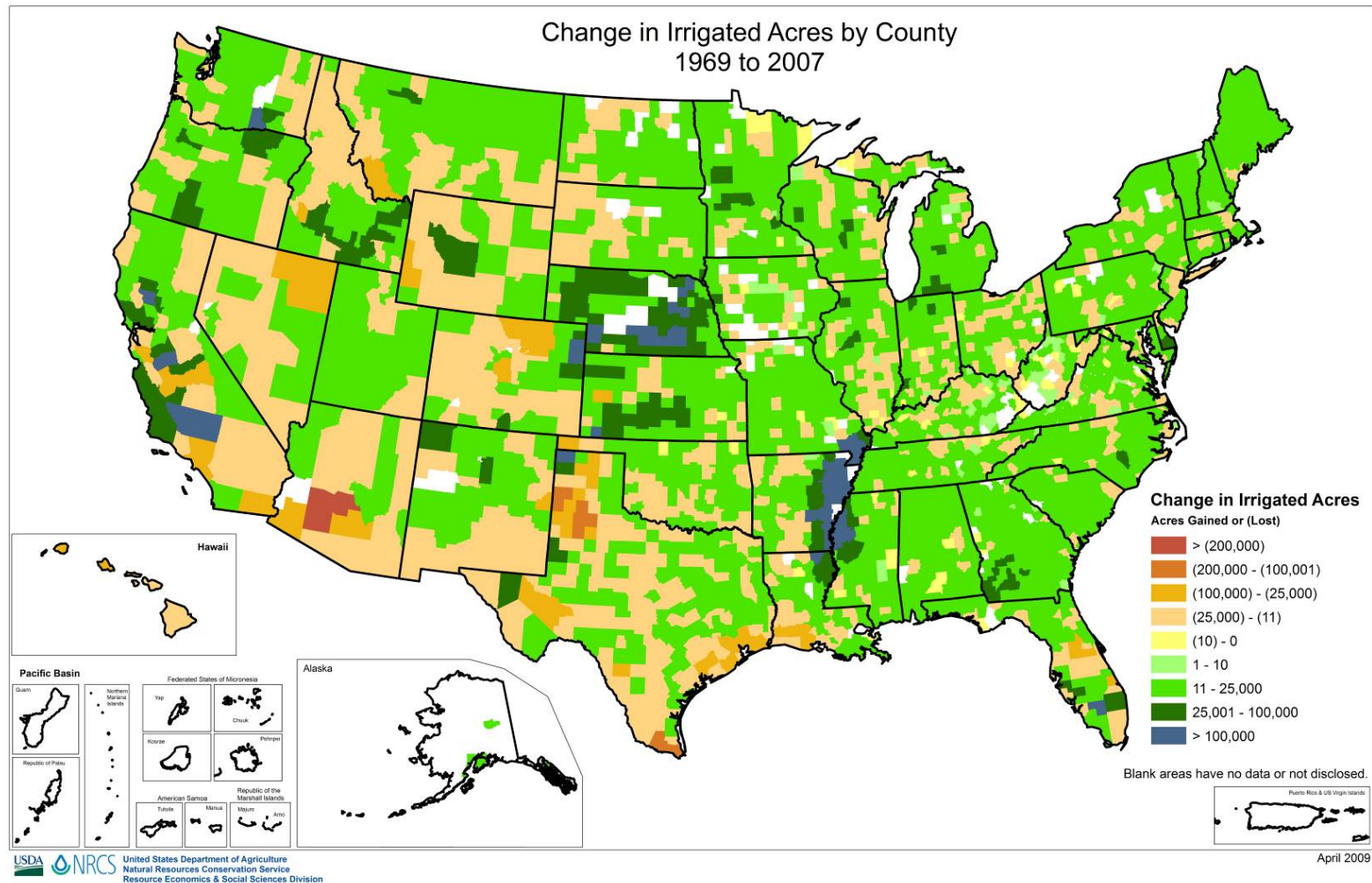


How was reduction in applied water accomplished?

- Location, Location, Location
 - Reduced acres in higher application areas (Southwest)
 - Increased acres in lower application areas (Southeast & Northern Plains)
- Improved, more efficient management and technology
 - Environmental Externalities
 - Irrigation Externalities



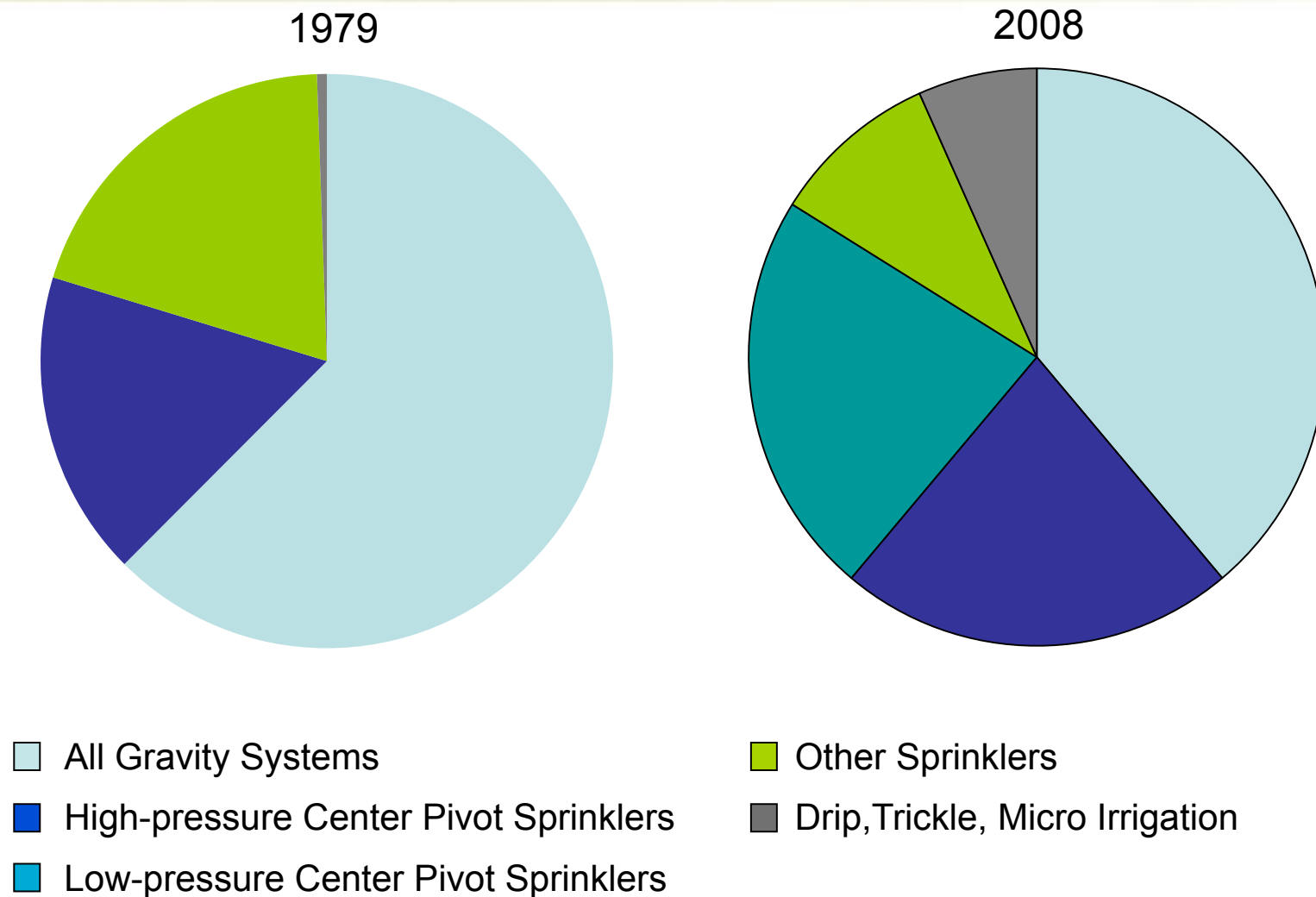
Change in U.S. Irrigated Acres location, 69-07



Source: NRCS based on 1969 and 2007 Census of Agriculture data



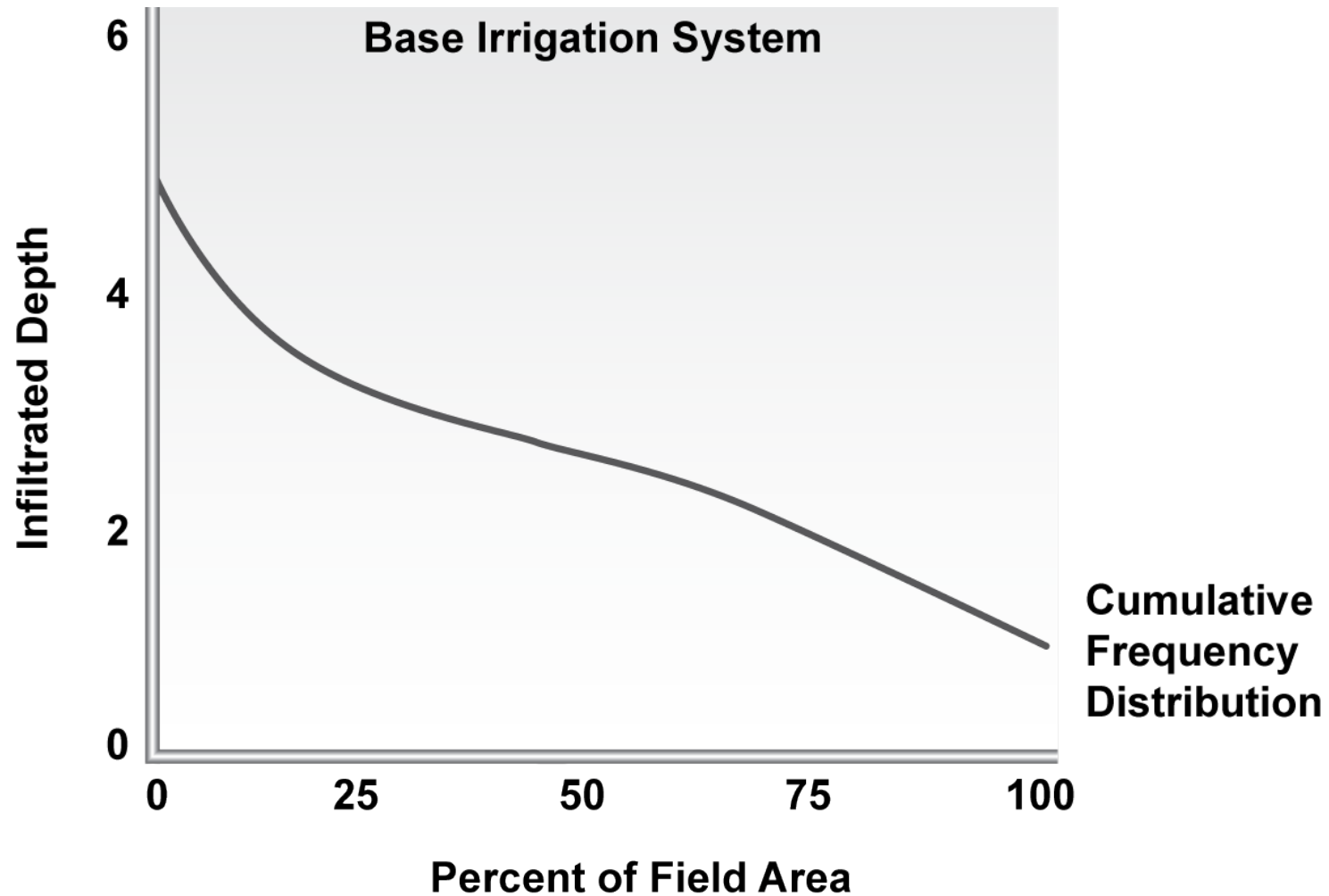
Changing Irrigation Application Technology



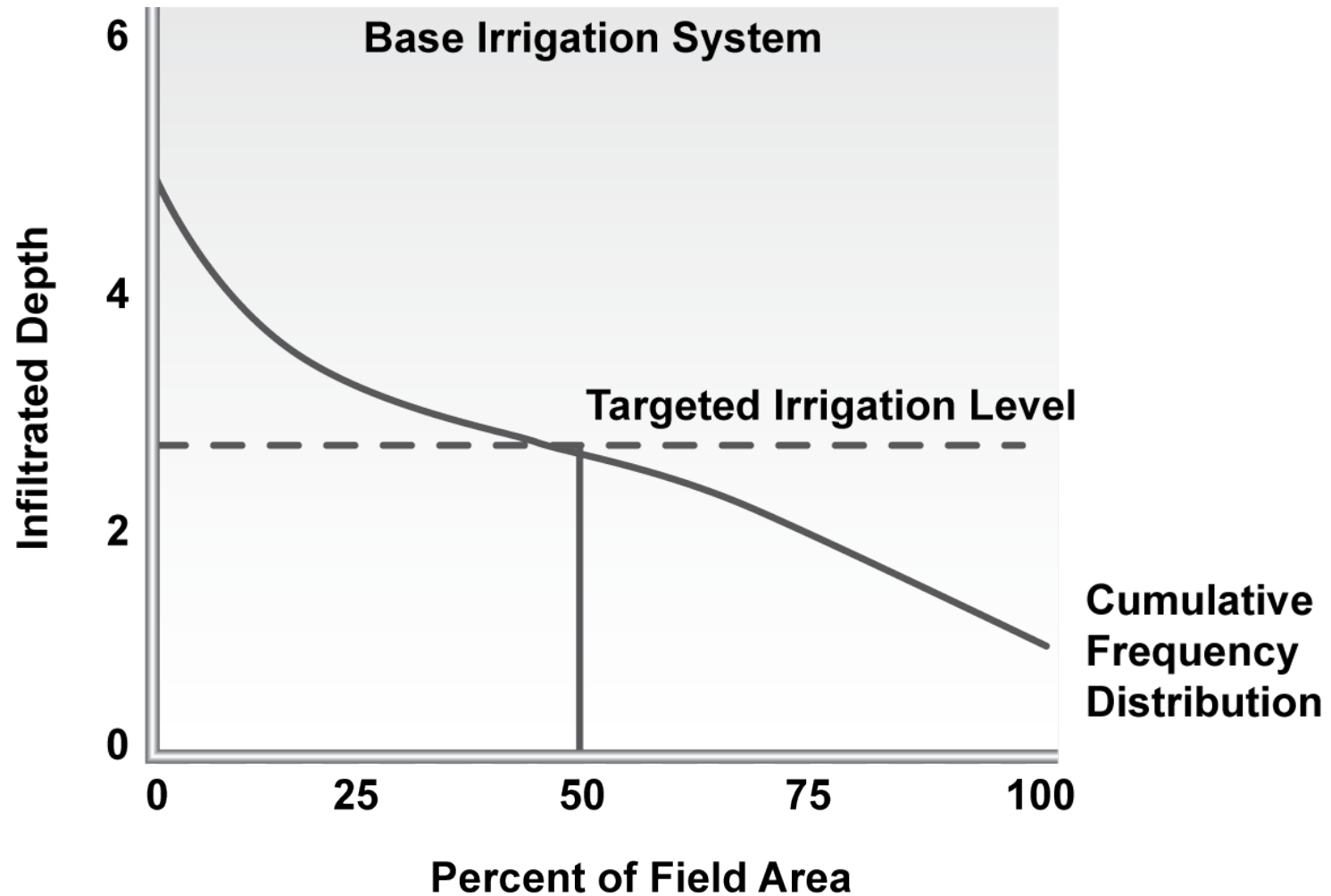
Source: USDA based on Farm and Ranch Irrigation Survey Data



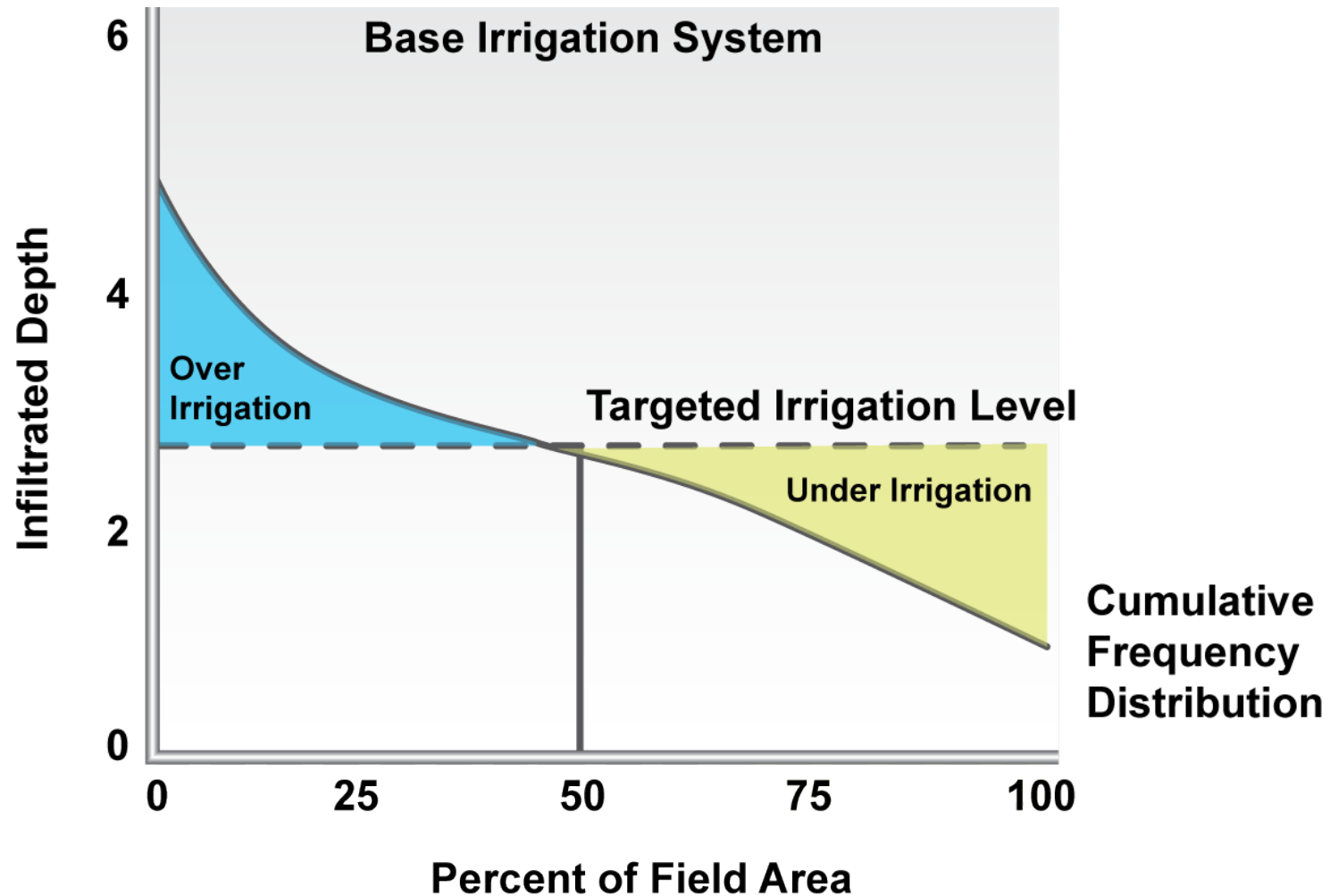
Impact of Improved Efficiency



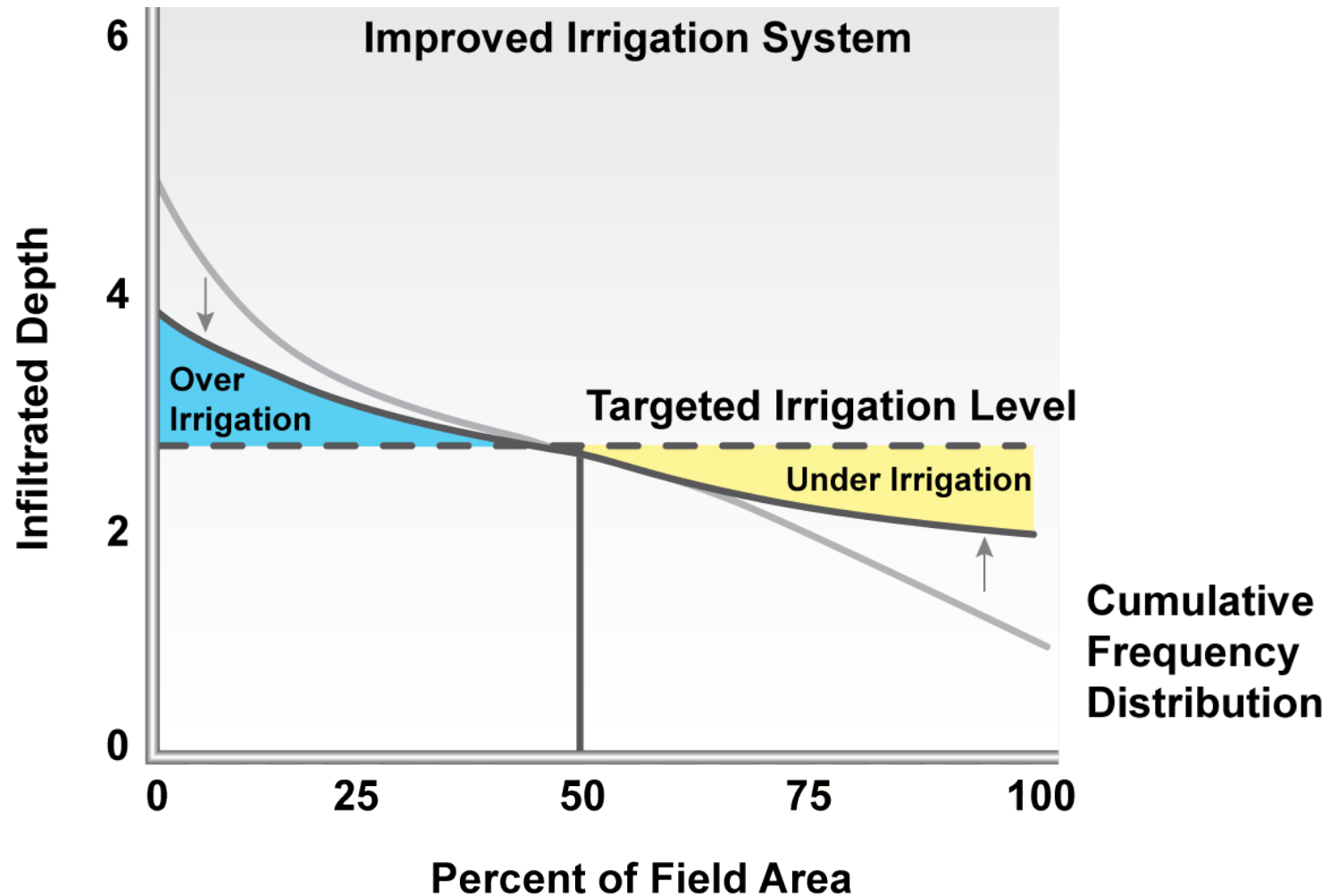
Impact of Improved Efficiency



Impact of Improved Efficiency



Impact of Improved Efficiency



Irrigation Efficiency (IE)

BENEFICIAL USES Crop Evapotranspiration (ET_c) Water Harvested with Crop Salt Removal Soil Preparation Seed/Weed Germination Climate Control (frost protection, cooling)	IRRIGATION WATER APPLIED
NON-BENEFICIAL USES (*: unrecoverable) Evaporation* (sprinklers, wet soil) Deep Percolation (non-uniformity, management) Filter Flushing Water required for WQ in Drains/Wetlands Excess Tailwater/Runoff	

$$IE = \frac{\text{Water Beneficially Used}}{\text{Water Applied}}$$



Improved Efficiency: Field View

- Improved accomplishment of target irrigation
 - The infiltration depth for a low-pressure, under-canopy, center pivot (or subsurface drip) approaches the target irrigation level
- Decline in the area of field with over & under irrigation
 - Increase in yield
 - Increase in water consumed by crop ET because improved uniformity decreases water stress from over/under irrigation
 - Reduction in runoff & deep percolation with impact on return flows and groundwater recharge
- Increased water use and reduced deep percolation can create environmental & irrigation externalities because
 - Institutions operate on water withdrawals (also termed diversions or water duty or allocation)
 - Hydrologic system operates on consumptive use

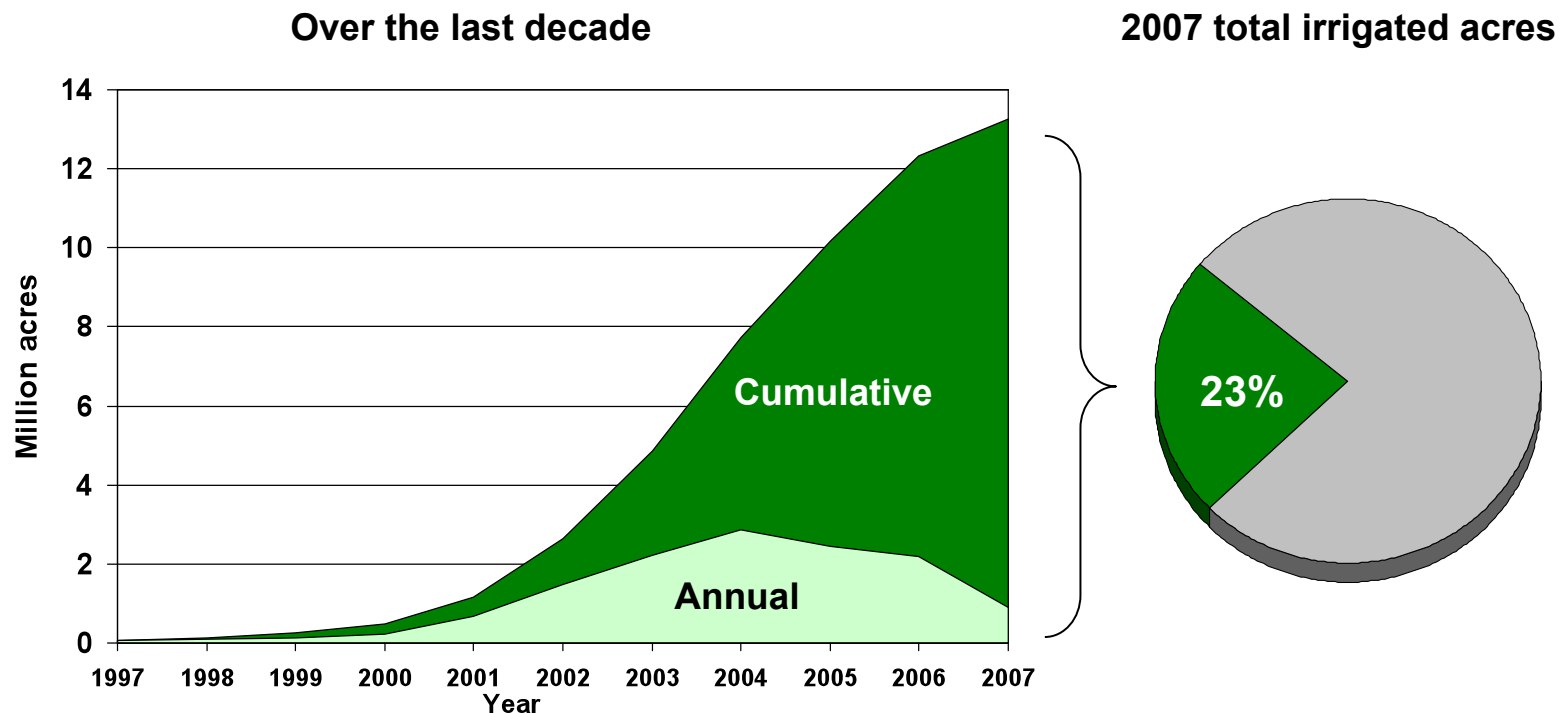


Improved Efficiency: Field View

- Why improve on-farm efficiency?
 - Save energy!
 - Improve farm profitability.
 - Potentially improve water quality.
 - Potentially increase commodity production.
 - Indirect land effect by decreasing pressure on marginal lands
 - Necessary for improved water management
 - Requires management improvement too
 - Save water when:
 - Return flow goes to a sink or are non-recoverable
 - Withdrawals are from aquifers such that reductions slow drawdown and extend aquifer life (fossil water)



Acres impacted with improved water management and application technology practices from USDA's Environmental Quality Incentives Program (EQIP)



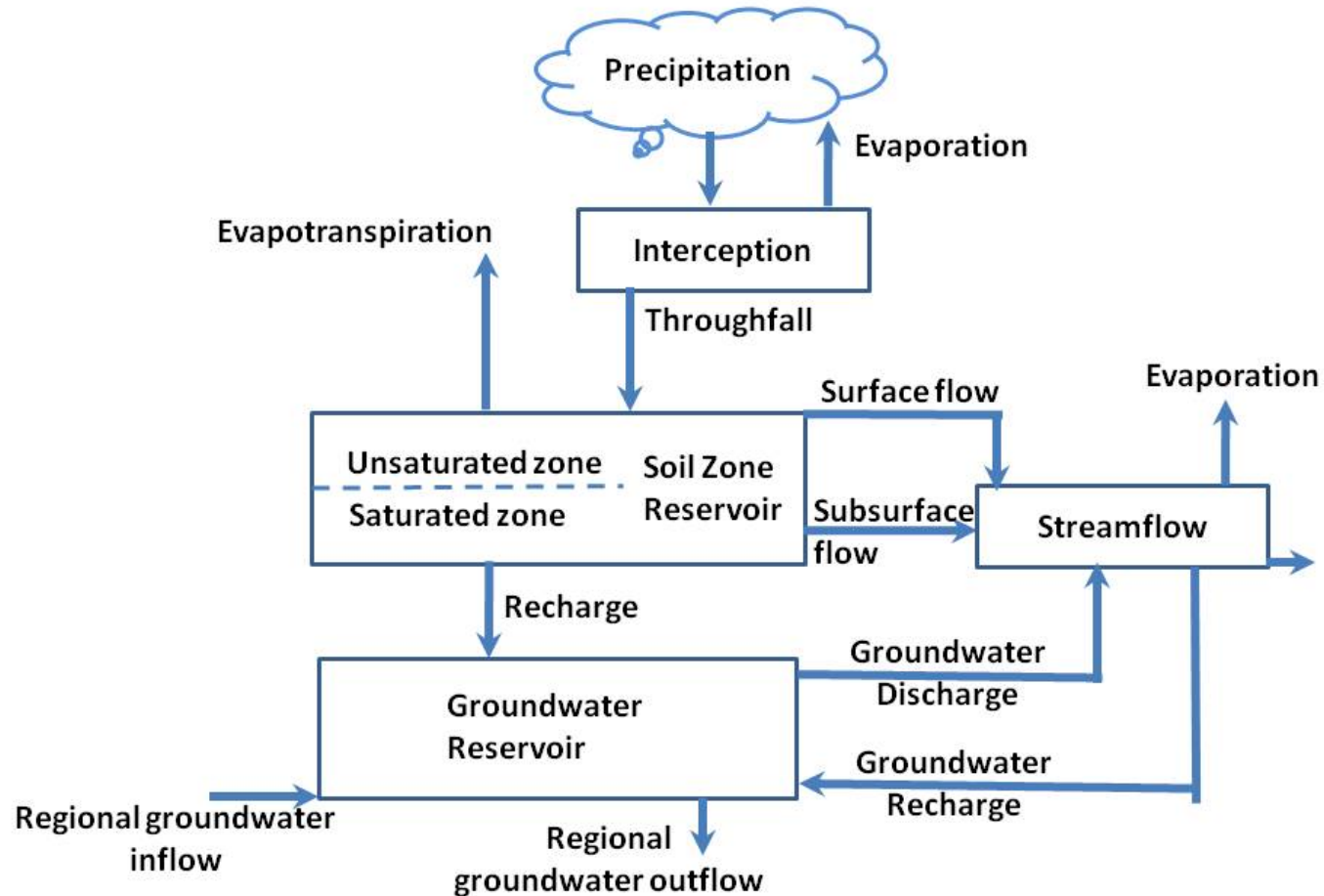
Source: USDA, NRCS, based EQIP data



The scale challenge and irrigation: Basin View



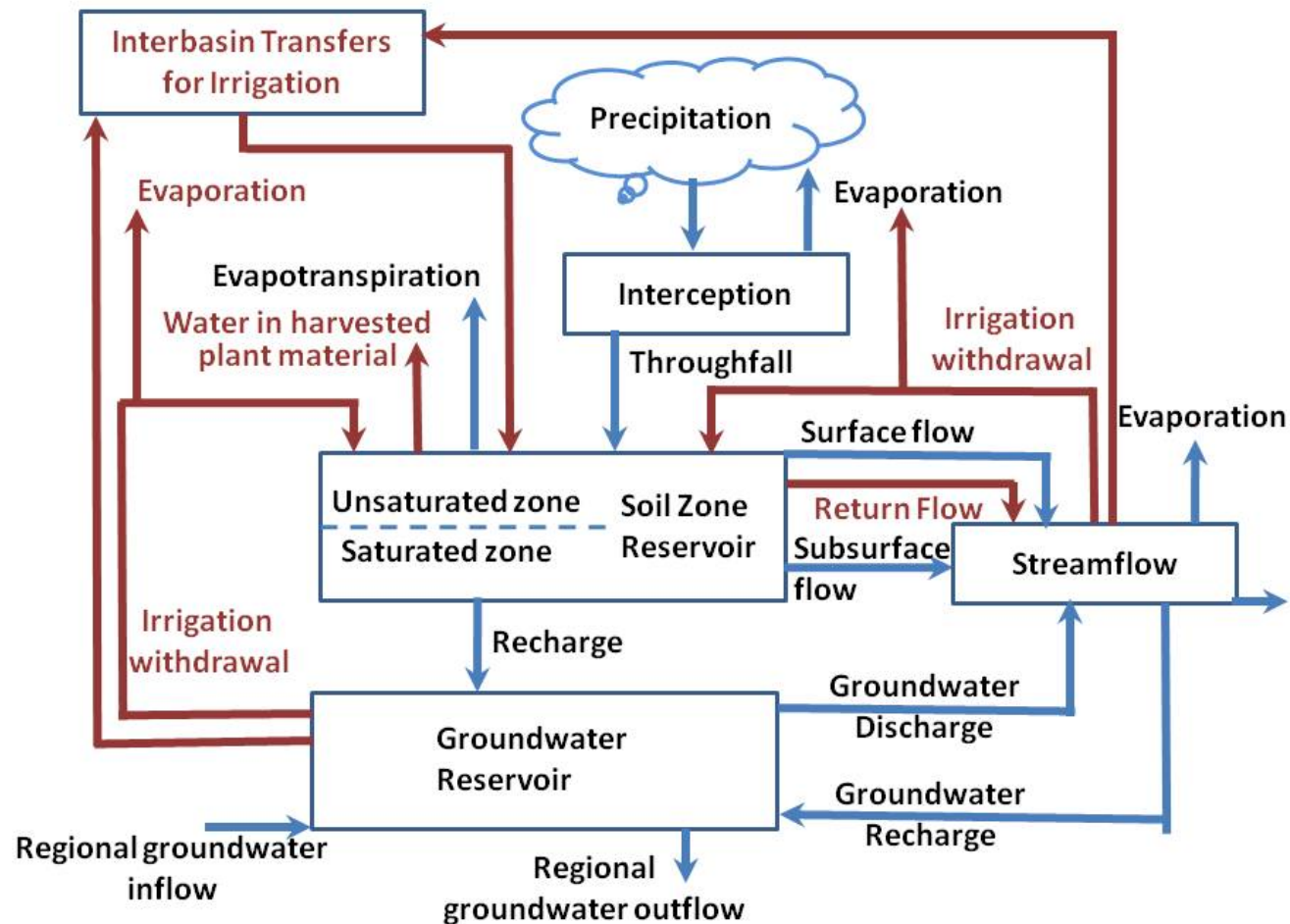
Generalized & simplified basin water budget (no withdrawals or return flows)



Source: Bales, Gollehon and Bernacchi, 2010



Generalized basin water budget with irrigation

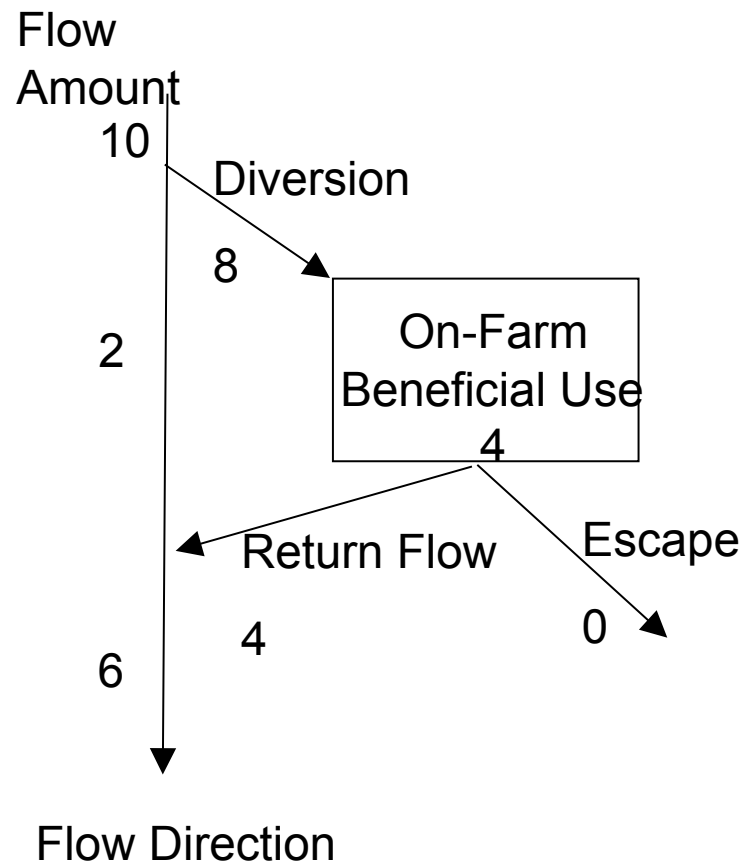


Source: Bales, Gollehon and Bernacchi, 2010

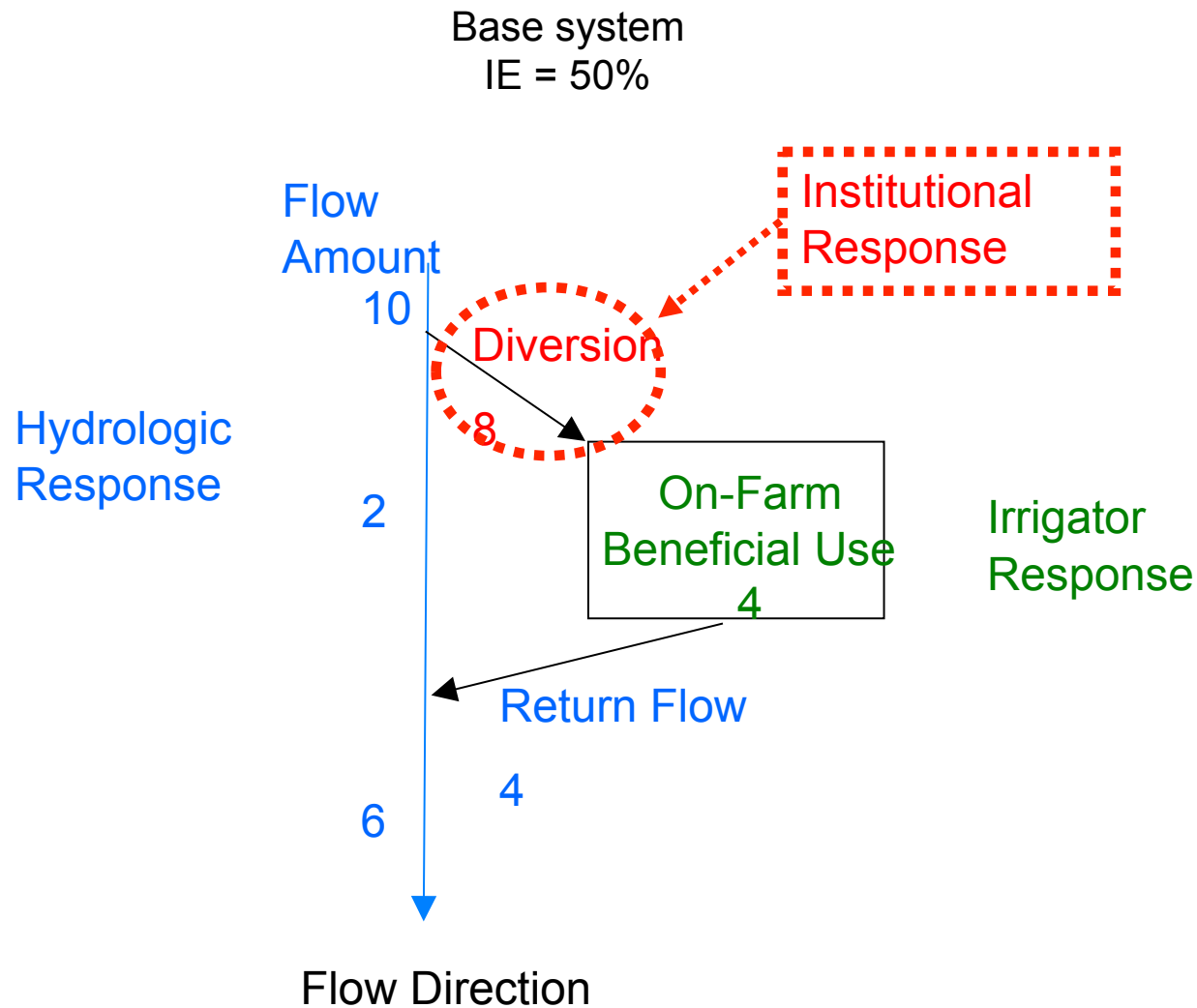


Basin Hydrologic View of Improved Irrigation Efficiency

Base system
IE = 50%

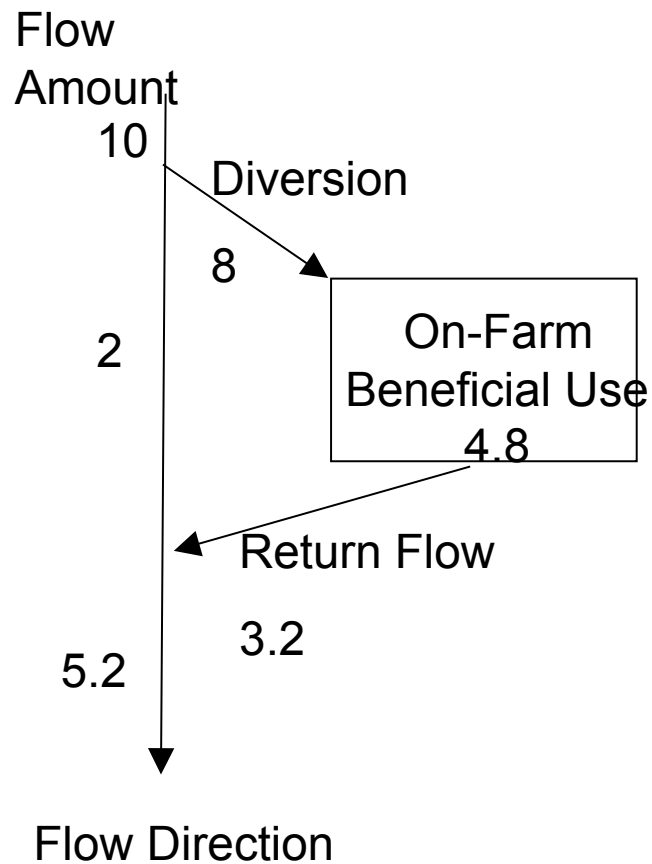


Basin Hydrologic View of Improved Irrigation Efficiency – Three systems involved

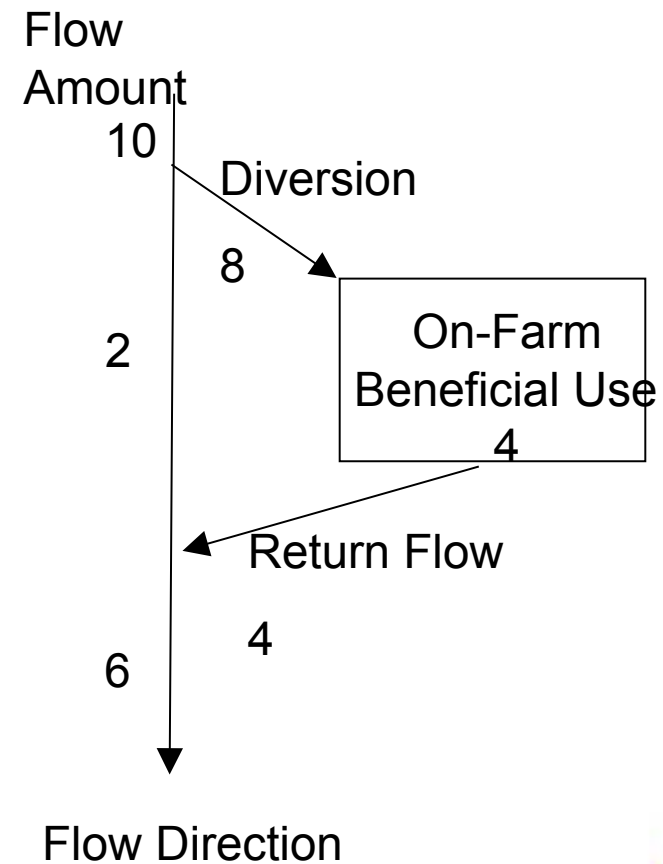


Basin Hydrologic View of Improved Irrigation Efficiency: A Possible Outcome

Improved system
IE = 60%

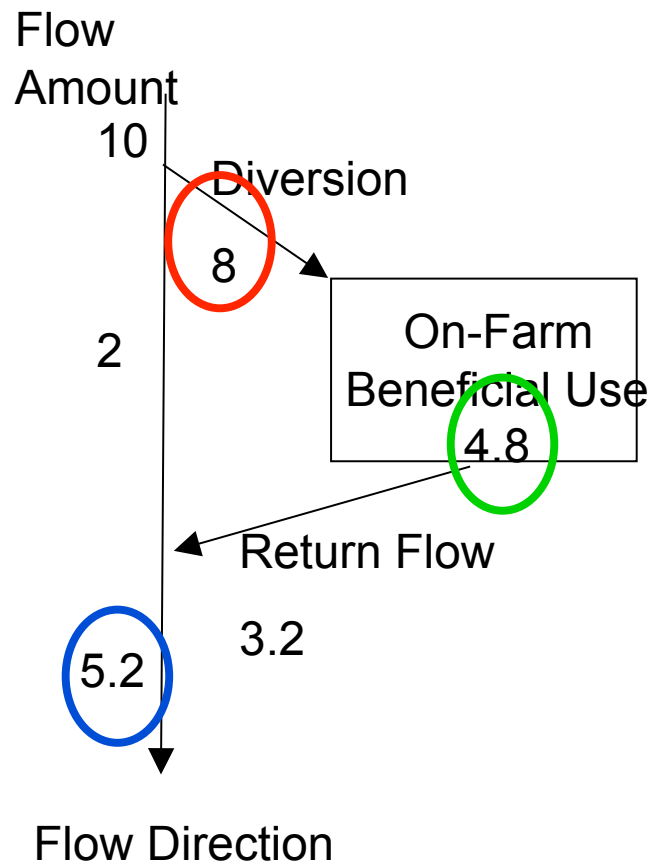


Base system
IE = 50%

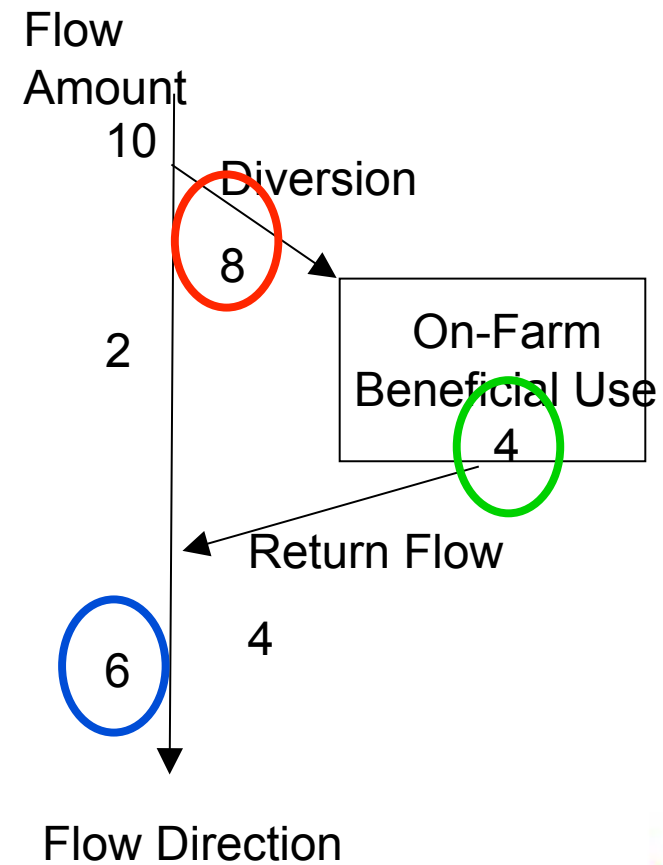


Basin Hydrologic View of Improved Irrigation Efficiency: A Possible Outcome

Improved system
IE = 60%



Base system
IE = 50%



Improved efficiency: Basin View

- Improved irrigation efficiency does not assure an increase in downstream flow
 - Carefully define the goal
- Motivation to reduce withdrawals depends on the water source and institutional circumstance
- Reducing hydrologic water use (ET) usually reduces production
- NRCS programs move toward “conservation goals” of increased stream flow and reduced aquifer use but must balance producer returns and the institutional framework (water law & contract requirements).



Examples of “improved” irrigation activities



Furrow Irrigation – Poorly managed advance



Furrow Irrigation – Poorly managed tailwater



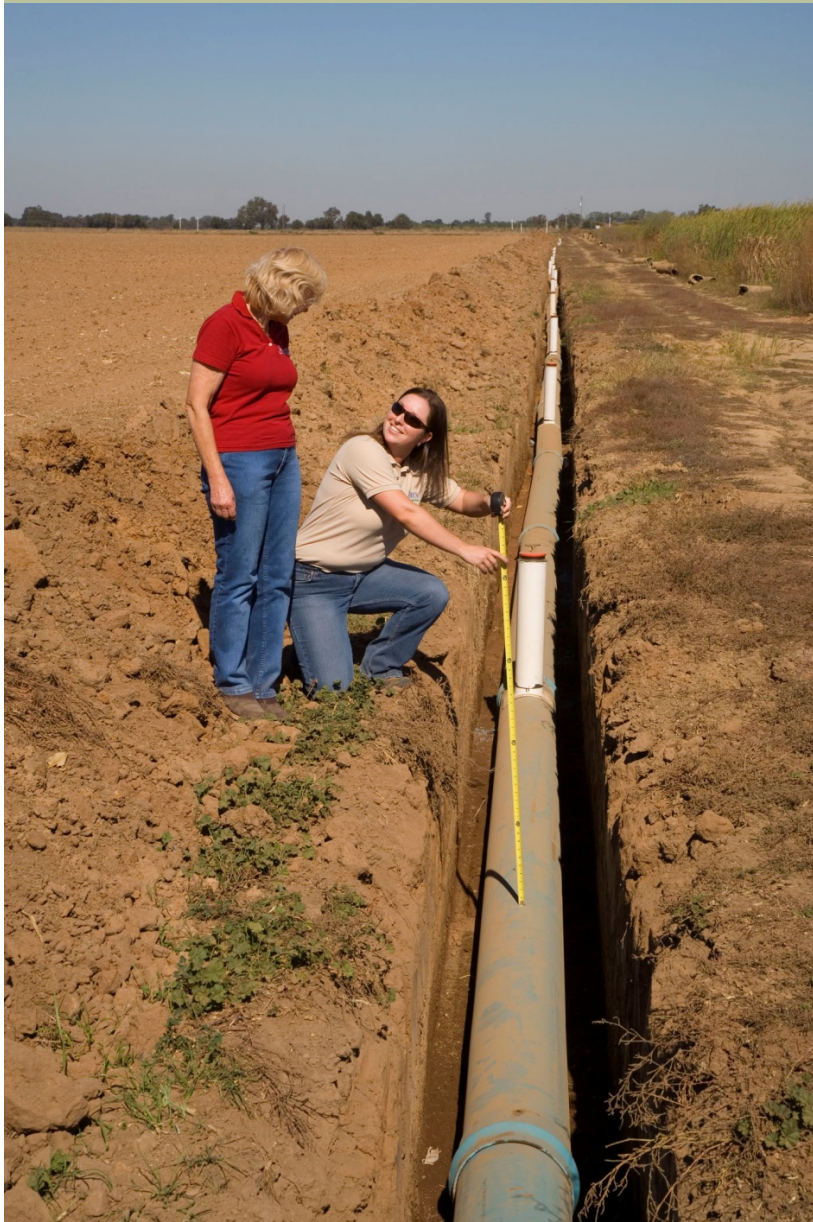
Laser leveled fields – Improved water management



Improving onfarm conveyance



Subsurface Drip Irrigation Conveyance



Subsurface Drip Irrigation on annual crop



Drip Irrigation in Perennial Crops



Precision Spray Irrigation



Early High-Pressure Center Pivot Sprinkler



Early Valley center pivot irrigation system. The pipes are 9½ feet above the ground, so the towers are over 20 feet tall.

http://www.livinghistoryfarm.org/farminginthe50s/water_01.html



Modern High-Pressure Center Pivot Sprinkler



Low-Pressure Center Pivot Irrigation Sprinkler



Sprinkler on a Low-Pressure Center Pivot



Low-Energy Precision Application Sprinkler



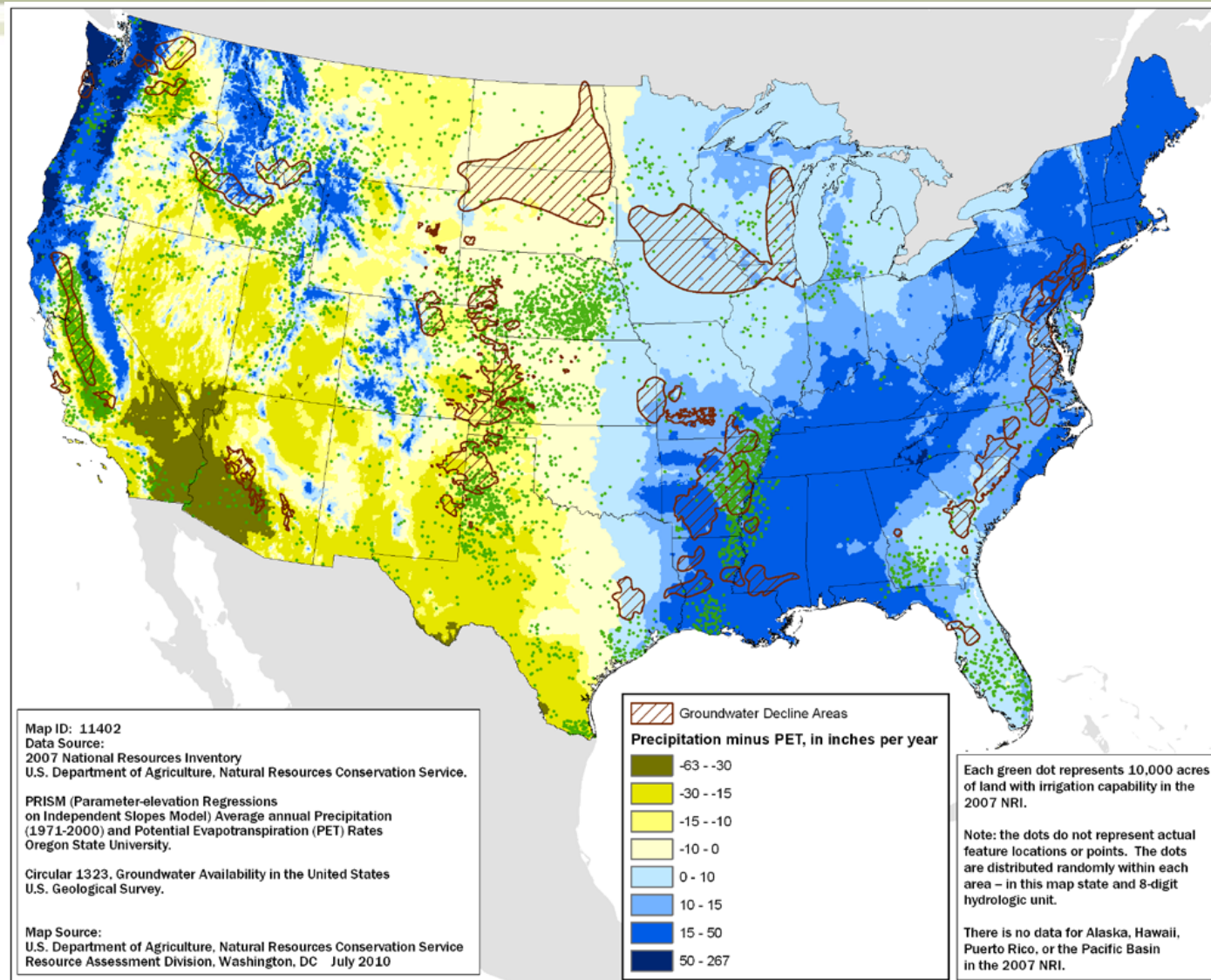
Precision Application requires Precision Management



The wrap-up



Indicators of water availability and the location of irrigated land



Source: RCA, USDA, NRCS, 2011



Conclusions – Part 1

- Irrigation “water conservation” is complex because water used for irrigation is
 - Mostly renewable,
 - Mobile,
 - Supplied from alternative sources,
 - Includes return flow linkages, and
 - Governed by alternative laws and institutions.
- “Water conservation” is a broad term that represents a range of actions to use less water:
 - In absolute terms (water use reduction);
 - To achieve the goal (water efficiency); and
 - Per unit of output (water productivity).



Conclusions – Part 2

- Reducing consumptive water use on irrigated agricultural land (water use reduction) usually involves a decline in irrigated area or production.
 - Can be expensive
- Improving “water productivity” through better irrigation management and technology:
 - Increases output with the same or reduced levels of water application.
 - Rarely increases downstream water availability.
 - Is a significant accomplishment, given the domestic and international demand for the products from irrigated agriculture.



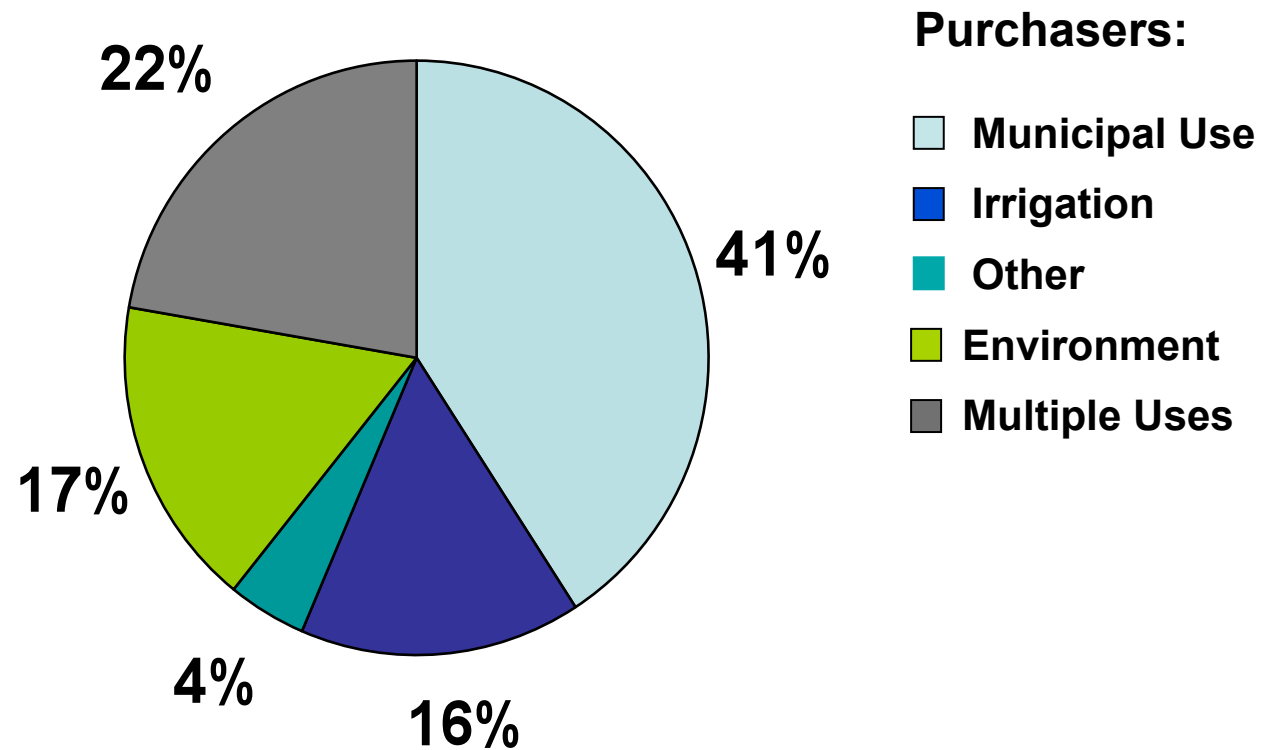
Conclusions – Part 3

- Continued and increasing pressure on irrigation water supplies:
 - to meet growing demands for other water uses (municipal and industrial supplies, environmental flows, and increasingly, energy production);
 - from climate induced pressures on water quantities and runoff timing, faster spring runoff, shift from snow to rain, or reduced precipitation.;
 - increased pressure on crop production and stable crop yields to meet food, fiber, feed, and fuel demands, both domestically and internationally
- More areas will face limited water supplied for irrigation.
 - How will these needs be met....????



Western Water Market Activity 1990-2003

Annualized average “new” exchange volume
1.7 million acre-feet



Source: NRCS based on Brown, *Water Resources Research*, 2006



Balance the Objectives

- There are **many reasons to support improved irrigation management & technology**, water “conserved” for increased basin stream flow is not one of them.
 - Save Energy!!
 - Improved water quality (runoff & drainage water often carries nutrients or chemicals)
 - Increase yield
 - Potentially increases profits for producer
 - Potentially decreases pressure to convert land to production in other areas (indirect land effect) to supply world markets
 - Reduce yield variability
 - Stable production leading to more stable markets



Thank you!

Noel Gollehon

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Questions & Answers

Questions & Answers

Our Q&A begins with a moderated session between today's host and presenter, followed by questions from the audience.

We thank you for submitting your questions throughout today's webcast.

Please feel free to continue to ask questions during the duration of the Q&A session by using the chat window in your browser.

Additional Resources

Future Webinars

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Contact Information

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The Horinko Group

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USDA's 2012 Agricultural Outlook Forum

February 23 - 25 2012 / Arlington, Virginia

Register Now – <http://www.usda.gov/oce/forum>

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Promoting Innovative Environmental Technologies

EPA's New 'Path Forward' Strategy

Part of Vita Nuova's Free Sustainability Webinar Series

March 30, 2012 / 12:00 - 1:15 PM EST

Registration coming soon at <http://www.vitanuova.net>

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