# Water and Ecosystems

## Critical Issues for Water Management

for meeting of Iranian-U.S. Workshop on Water Management
National Academy of Sciences
Irvine, California

PACIFIC INSTITUTE

Research for People and the Planet

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# Overview

- Presentation of Concept Paper by Uriel Safriel, Hebrew University, Israel.
- Water and ecosystems in the United States
- Some thoughts about water, ecosystems, and policy in California.
- New results on agricultural efficiency potential for California.

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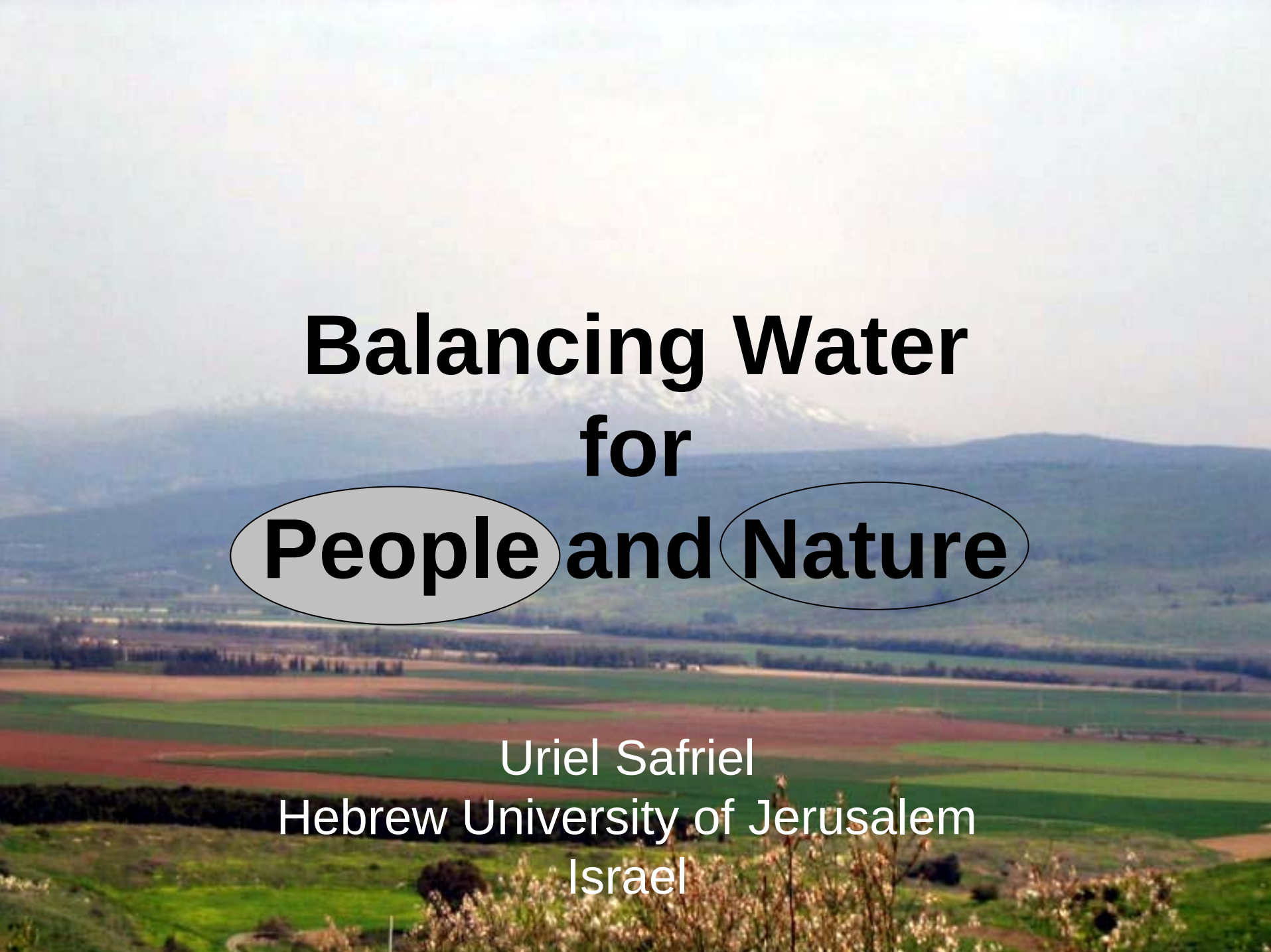
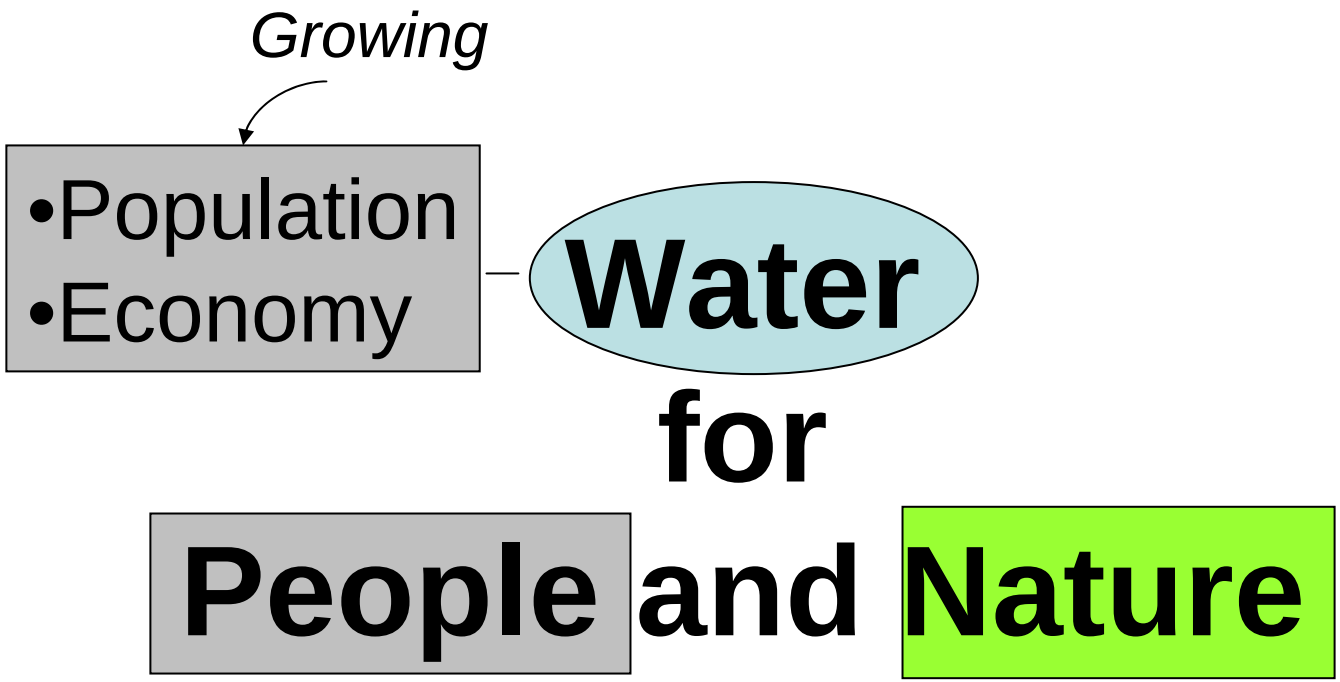


# Balancing Water for People and Nature

Uriel Safriel
Hebrew University of Jerusalem
Israel



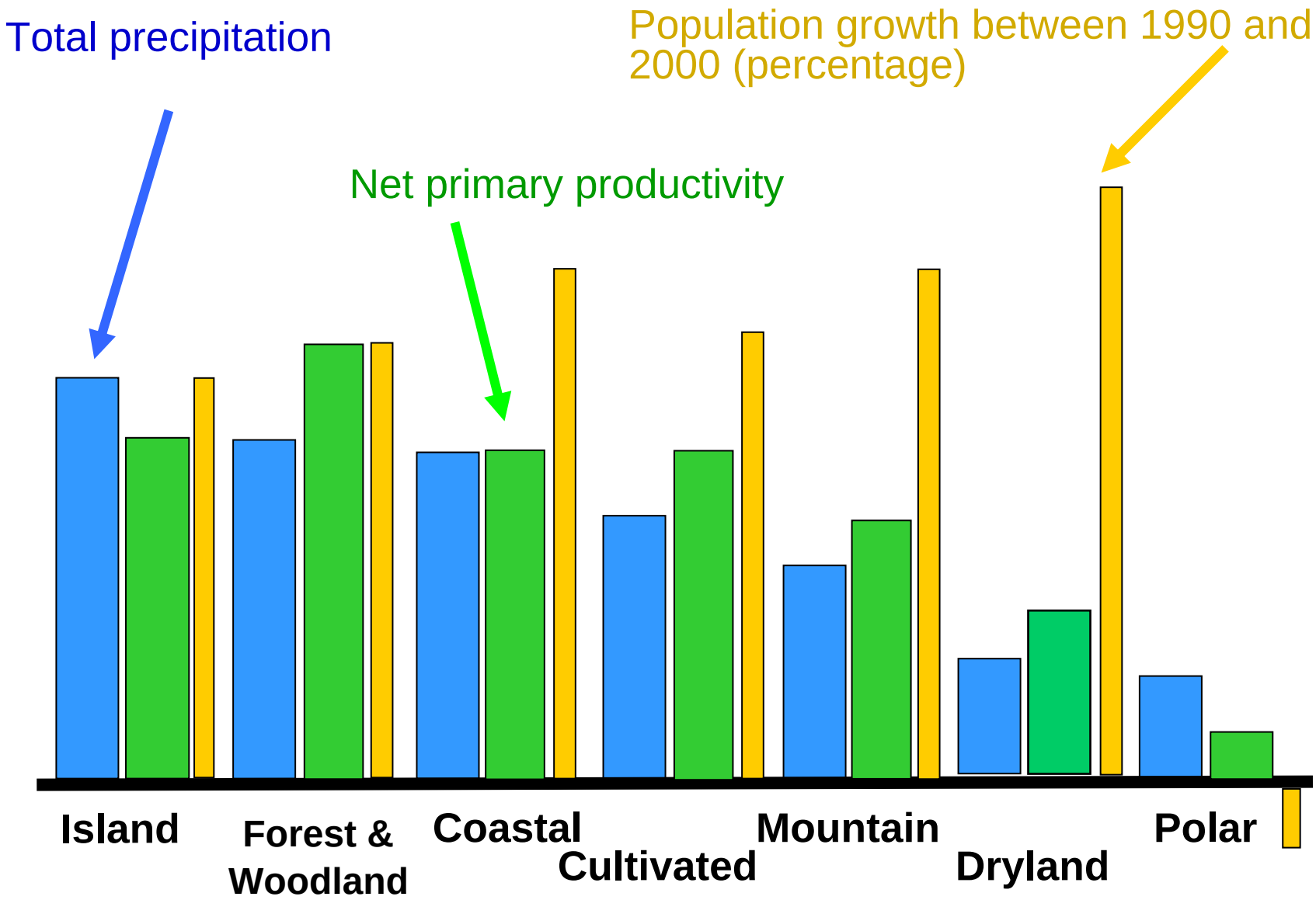

Competition for limiting resource

| Providing Goods | Regulating Services | Cultural Benefits |
| --- | --- | --- |
| • food<br>• water provision<br>• woodfuel<br>• timber<br>• fiber<br>• biochemicals | • water regulation<br>• climate regulation<br>• disease regulation<br>• flood regulation<br>• water purification | • spiritual<br>• inspirational<br>• aesthetic<br>• educational<br>• recreational |

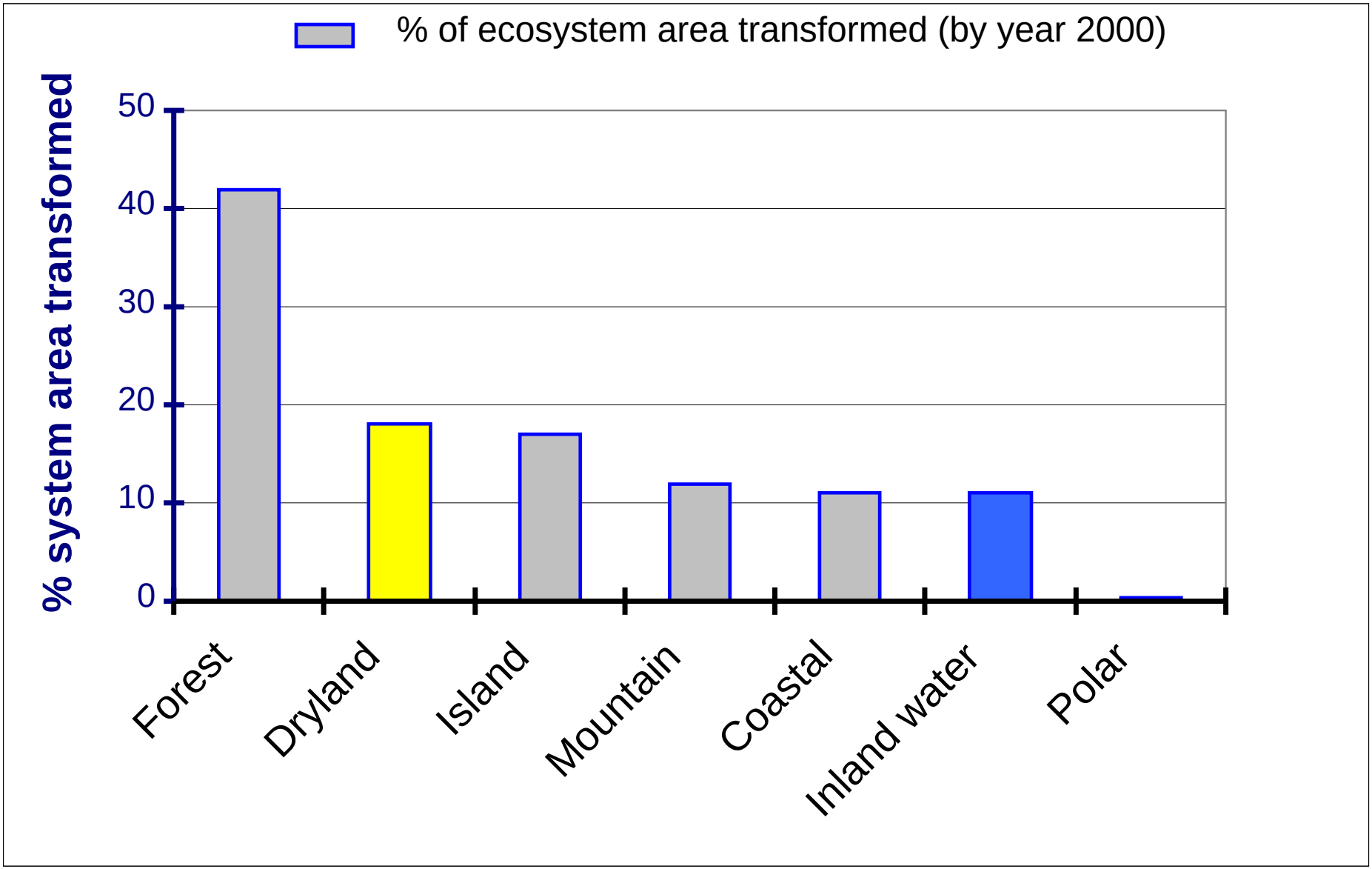
## Supporting

- soil conservation
- nutrient cycling
- primary production
- biodiversity

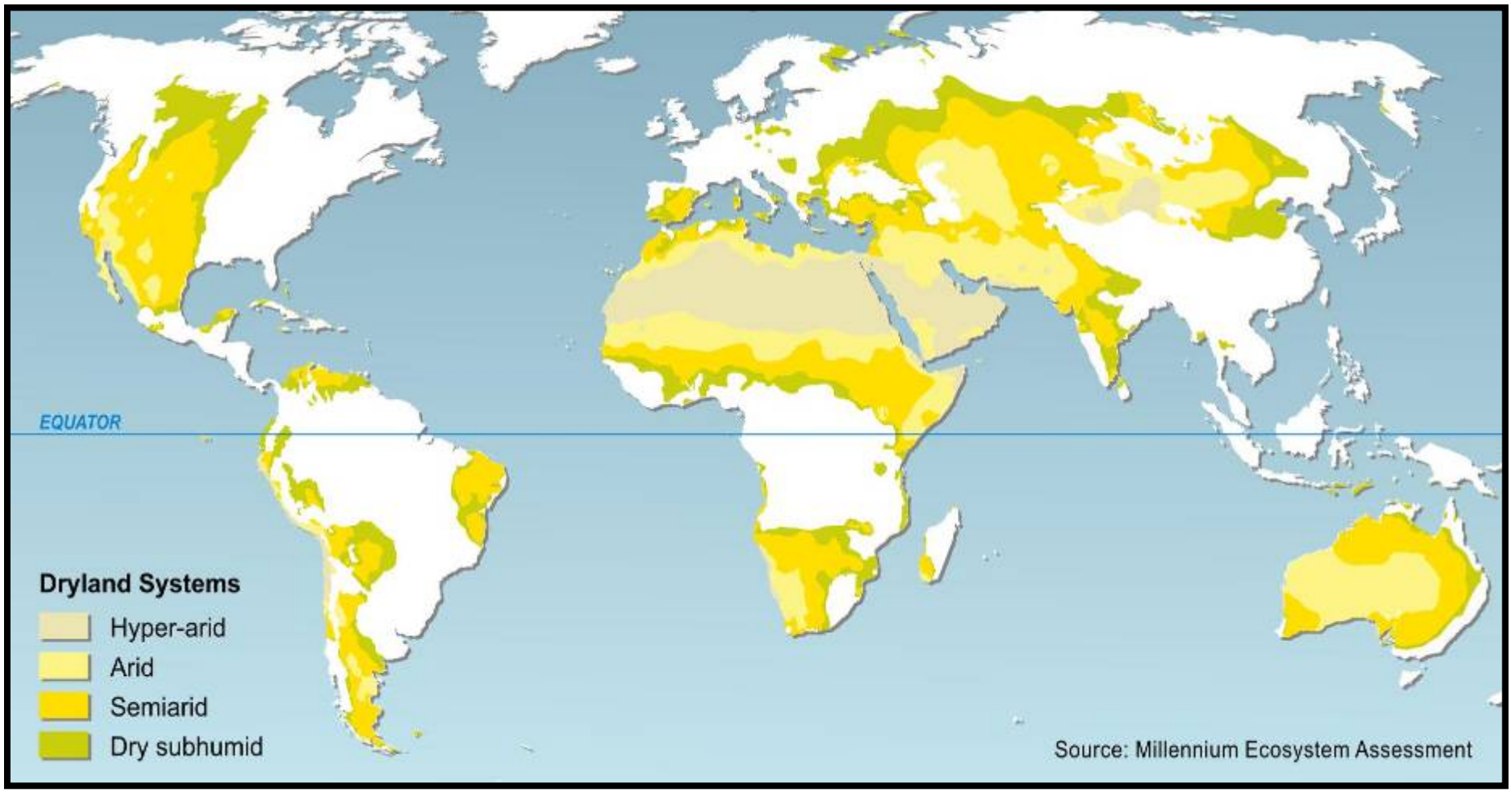
# Population is growing rapidly in driest regions



# Ecosystem transformation



# Forty percent of nature is limited by water
# Third of humanity competes with nature on water?



# Human Use of Water Affects Ecosystems Services

**Provisioning services**

- Crops, livestock
- Capture fisheries
- Wild food
- **Timber**
- Woodfuel
- Biochemicals

**Regulating services**

- Global climate regulation
- Local climate regulation
- **Water regulation**
- Water purification
- Flood regulation
- **Disease regulation**
- Pollination

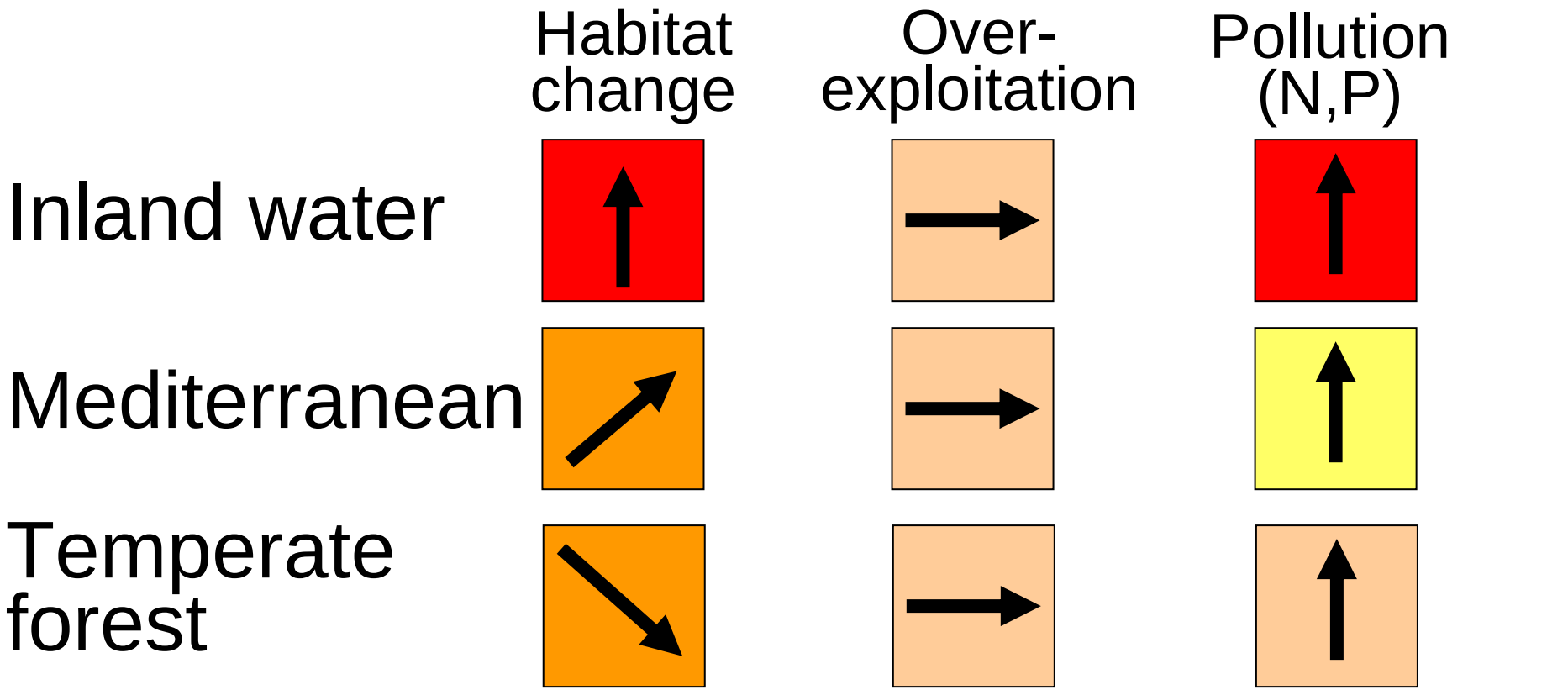
**Cultural services**

- Spiritual & religious
- Aesthetic
- Recreation

**Supporting services**

- Soil conservation
- Supporting biodiversity

# Water “transformations” affect biodiversity



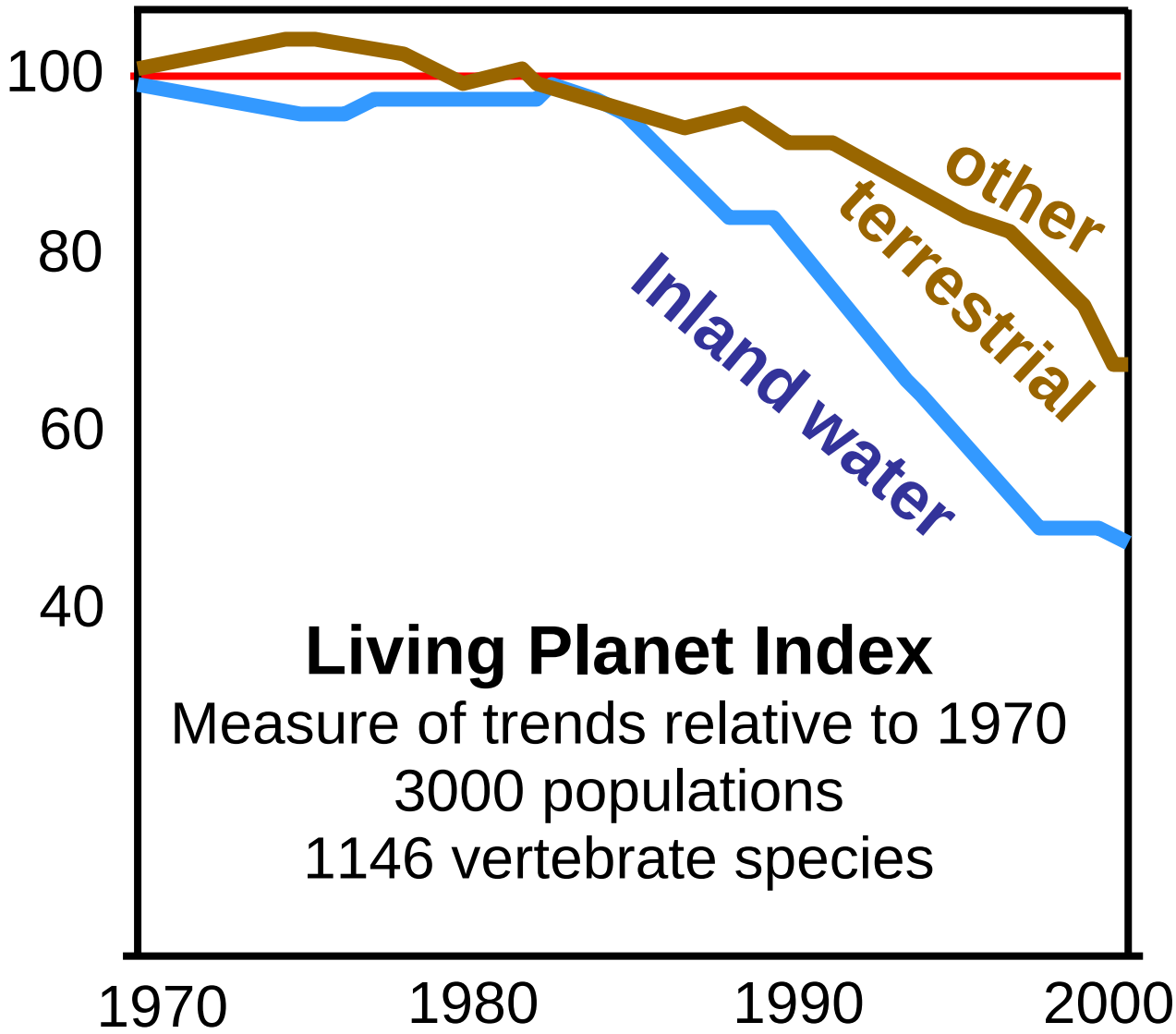

**Impact strength**

Very high | High | Moderate | Low

**Impact trend (last 50-100 yrs)**

Fast increase | Increase | Continuing | Decreasing

# Biodiversity response to impact




## Israel

**45%** of extinct plant species are aquatic

**40** invertebrate species locally extinct

**1** (out of 7) amphibians extinct

**1** fish species locally extinct

**10** breeding birds locally extinct as breeders


More water resource development
↓
Especially in arid/dry regions
↓
Greater damage to freshwater
and non-aquatic ecosystems
& their biodiversity
↓
Degradation of services
↓
Reduced human well-being

# Meeting Basic Ecological Needs for Water: Science and Policy

- Past water policies and decisions have led to major ecological degradation.
- More than 20 percent of all freshwater fish species in the U.S. are now threatened or endangered because of human use of water.
- Who speaks for the environment? Policy issues.

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# Water, Ecosystems, and Policy: Some History

- U.S. Endangered Species Act of 1973 (to protected threatened species).
- California Supreme Court “public trust” decision for Mono Lake in 1983.
- Central Valley Project Improvement Act of 1992 (provides 1 BCM of water for ecosystems).
- Growing allocations of instream flows in rivers.
- New legal rulings for delta smelt (e.g., December 2007 ruling on operations of pumps)

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# Connections Between Ecosystem Water Needs and Water-Use Efficiency

- Major water policy issue is the conflict over allocations between urban, agricultural, and ecosystem water demands.
- Fixed supply: fewer opportunities to increase total water supply. So now what?
- Can we look to improved efficiency as a way to provide water for ecosystems?
- Yes – growing number of examples.

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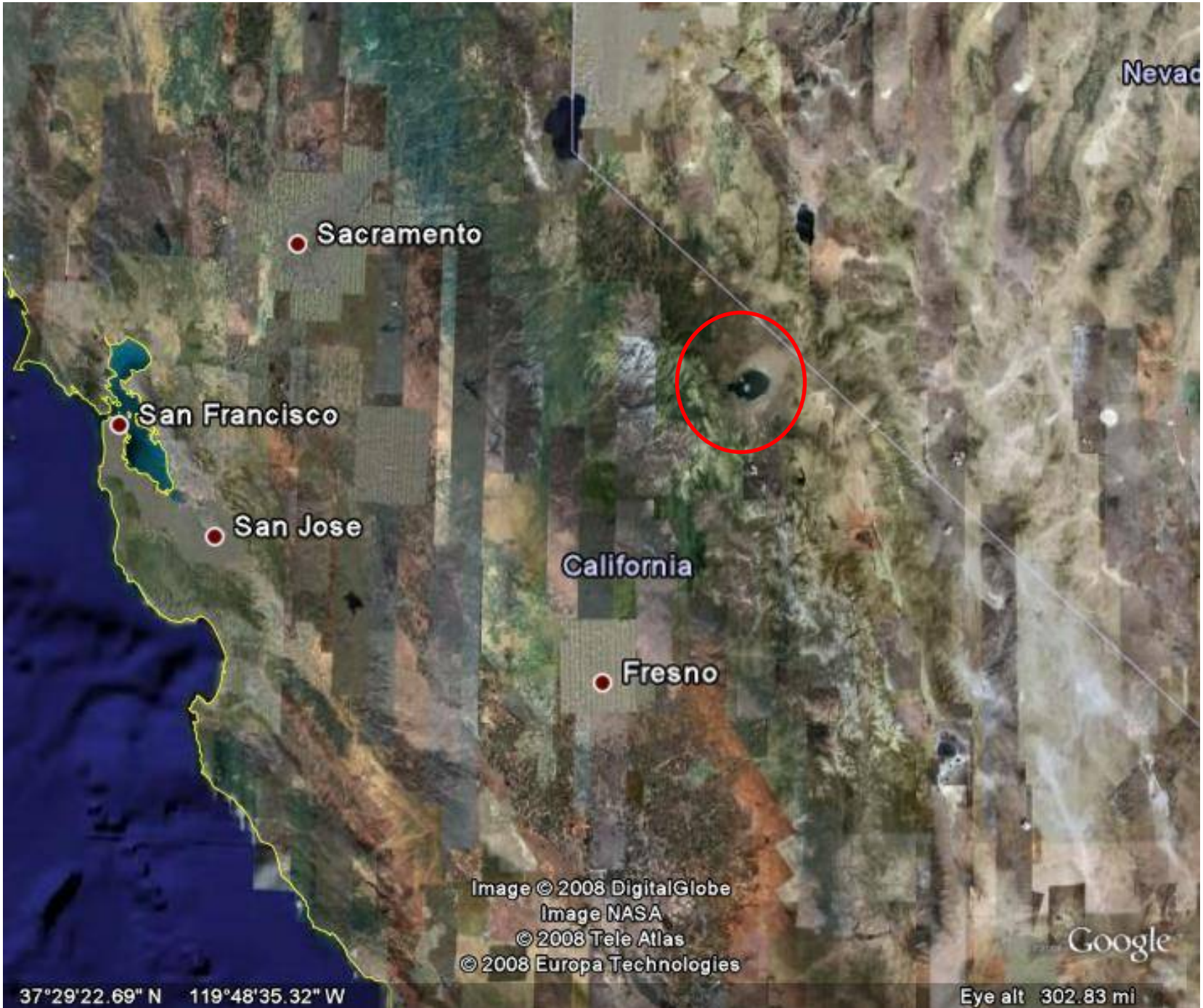
Los Angeles Aqueduct
and Mono Lake
The “Delta”
Redding
Sacramento
San
Francisco
Fresno
Los
Angeles
San
Diego


Nevad
Sacramento
San Francisco
San Jose
California
Fresno
Image © 2008 DigitalGlobe
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Google
37°29'22.69" N 119°48'35.32" W
Eye alt 302.83 mi


Mono
© 2008 Tele Atlas
Google
37°59'19.57" N 119°02'39.32" W elev 6376 ft 2005 Eye alt 20.68 mi

# Mono Lake and the Public Trust

*"The public trust…is an affirmation of the duty of the state to protect the people's common heritage of streams, lakes, marshlands and tidelands…."*

– Supreme Court of California, 1983

- Mono Lake has "public trust values" that the state has an obligation to maintain.
- The Court ruled that the State Water Board failed to take these values into account when allowing Los Angeles to divert water from the Mono Basin.
- Over time, water was returned to Mono Lake.

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# The Mothers of East Los Angeles, Mono Lake, and Efficient Toilets

- Non-profit group of women advocates.
- Developed a partnership with city and water agency in mid-1990s.
- For every inefficient toilet they replaced, they received $25. New, efficient toilets were provided free by the city water department.
- By 1998, 50,000 toilets replaced by MELA; jobs created.
- The water saved permitted the city to cut water withdrawals from Mono Lake.

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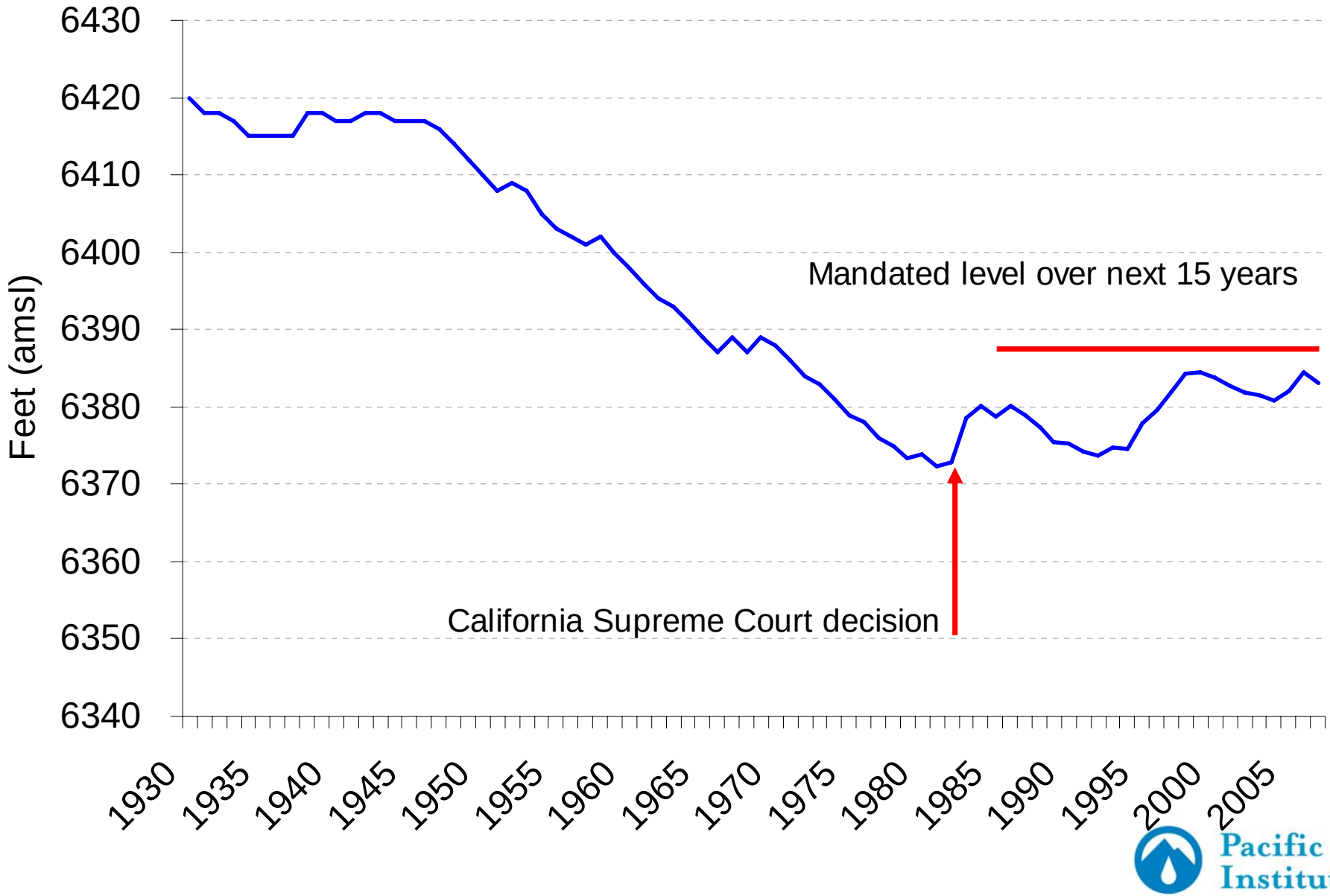
# Mono Lake Level

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# Sacramento-San Joaquin Delta Problem

- The Delta is the “heart” of California’s water system.
- Historically – a very rich inland aquatic ecosystem.
- It is the center of California’s water distribution system: from North/Sierra to South/Coastal.
- Ecosystems are collapsing there and new laws and court rulings say water must be returned to the environment.

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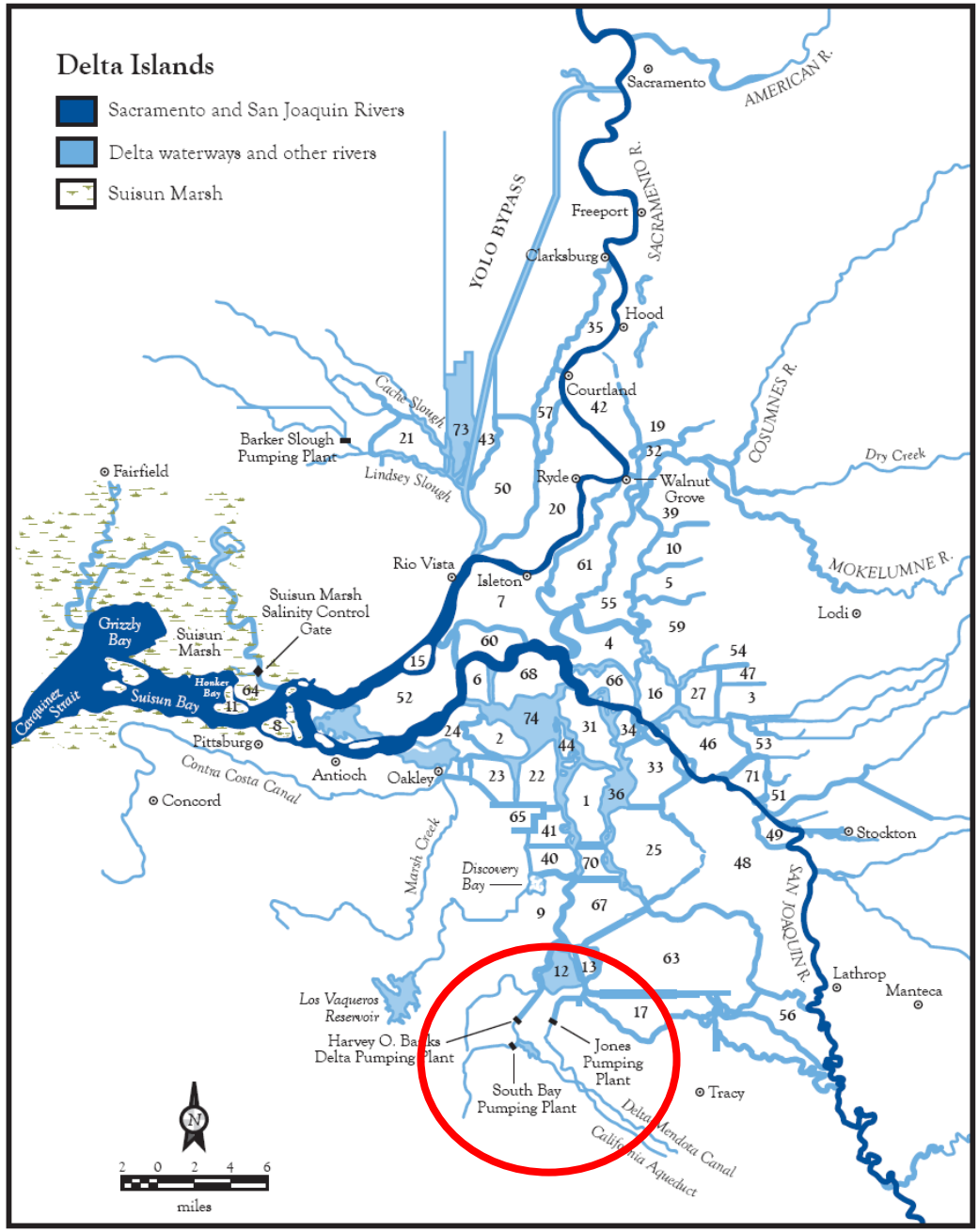
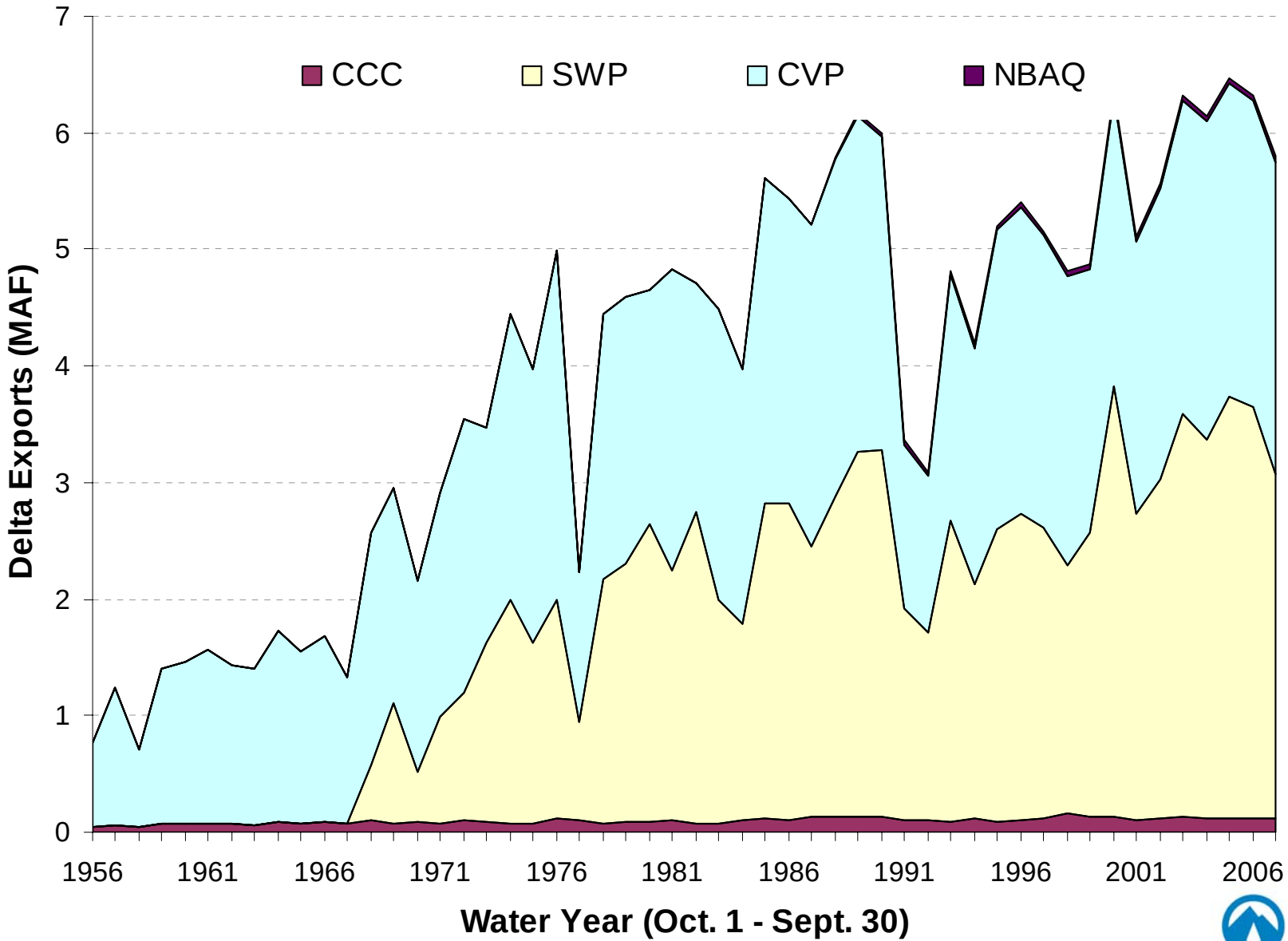

Delta Islands
Sacramento and San Joaquin Rivers
Delta waterways and other rivers
Suisun Marsh
Sacramento
AMERICAN R.
YOLO BYPASS
SACRAMENTO R.
Freeport
Clarksburg
Hood
Courtland
Cache Slough
Barker Slough Pumping Plant
Lindsey Slough
Fairfield
Ryde
Walnut Grove
COSUMNES R.
Dry Creek
Rio Vista
Isleton
MOKELUMNE R.
Lodi
Suisun Marsh Salinity Control Gate
Grizzly Bay
Suisun Marsh
Honker Bay
Suisun Bay
Carquinez Strait
Pittsburg
Antioch
Oakley
Contra Costa Canal
Concord
Marsh Creek
Discovery Bay
Stockton
SAN JOAQUIN R.
Lathrop
Manteca
Los Vaqueros Reservoir
Harvey O. Banks Delta Pumping Plant
Jones Pumping Plant
South Bay Pumping Plant
Tracy
Delta Mendota Canal
California Aqueduct
N
2 0 2 4 6
miles

# Exports of Water from the Delta are Up

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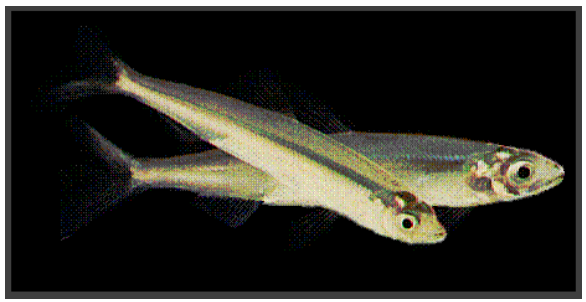
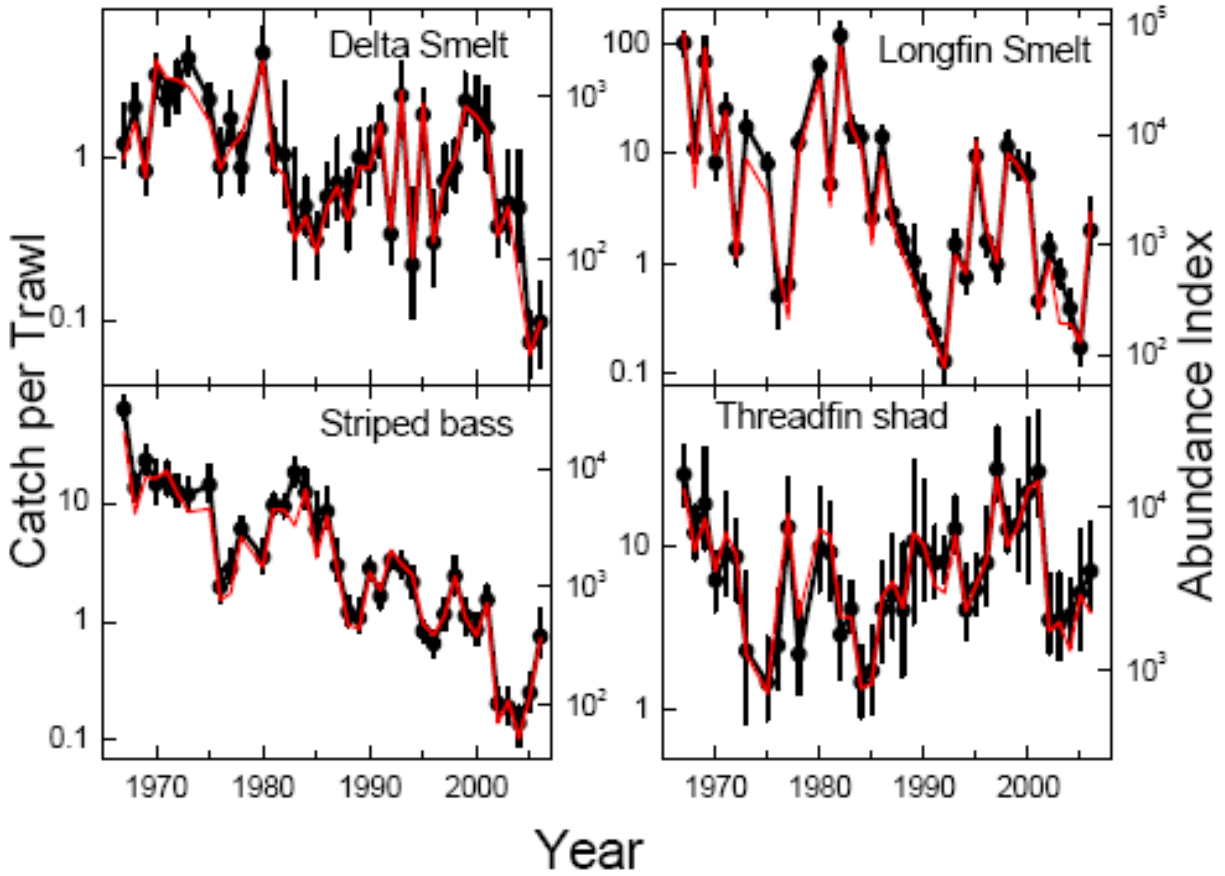
# Delta Fisheries Declines



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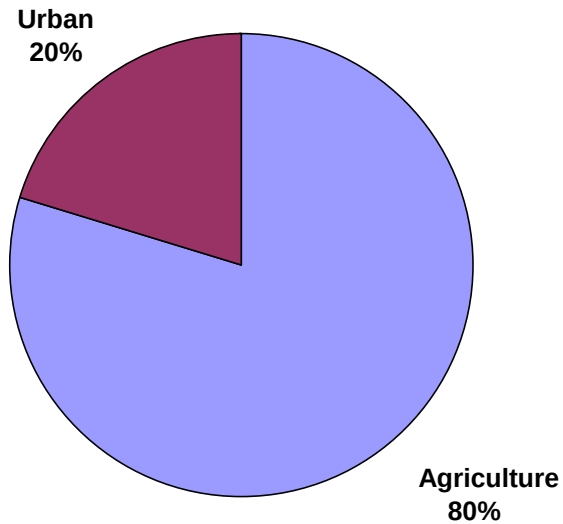
# The Role of Agriculture and Efficiency in Meeting Ecosystem Water Needs

- Most (80%) of water from Delta goes to agriculture.
- Can improving efficiency of water use help meet ecosystem water needs?
- What is the science?
- What is the policy?

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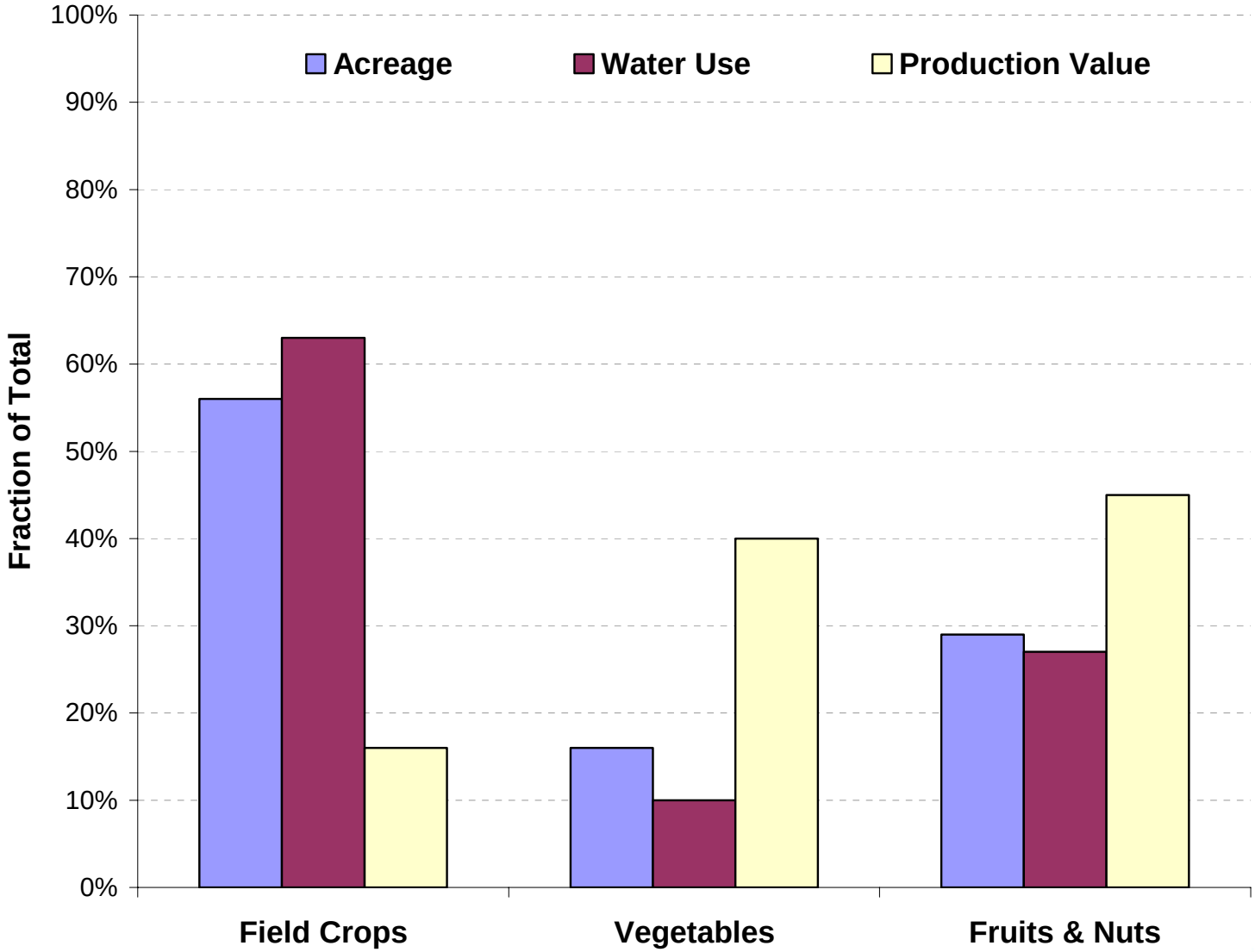
# Agricultural Efficiency Scenarios

- **Incremental Crop Shifting**: from field crops to vegetable, fruit, tree crops.
- **Efficient irrigation technology**: from flood to sprinkler and drip systems.
- **Advanced irrigation management**: improved soil monitoring and management.
- **Advanced irrigation scheduling**: regulated deficit irrigation (RDI).

# Crop Switching Can Increase Income and Reduce Water Use

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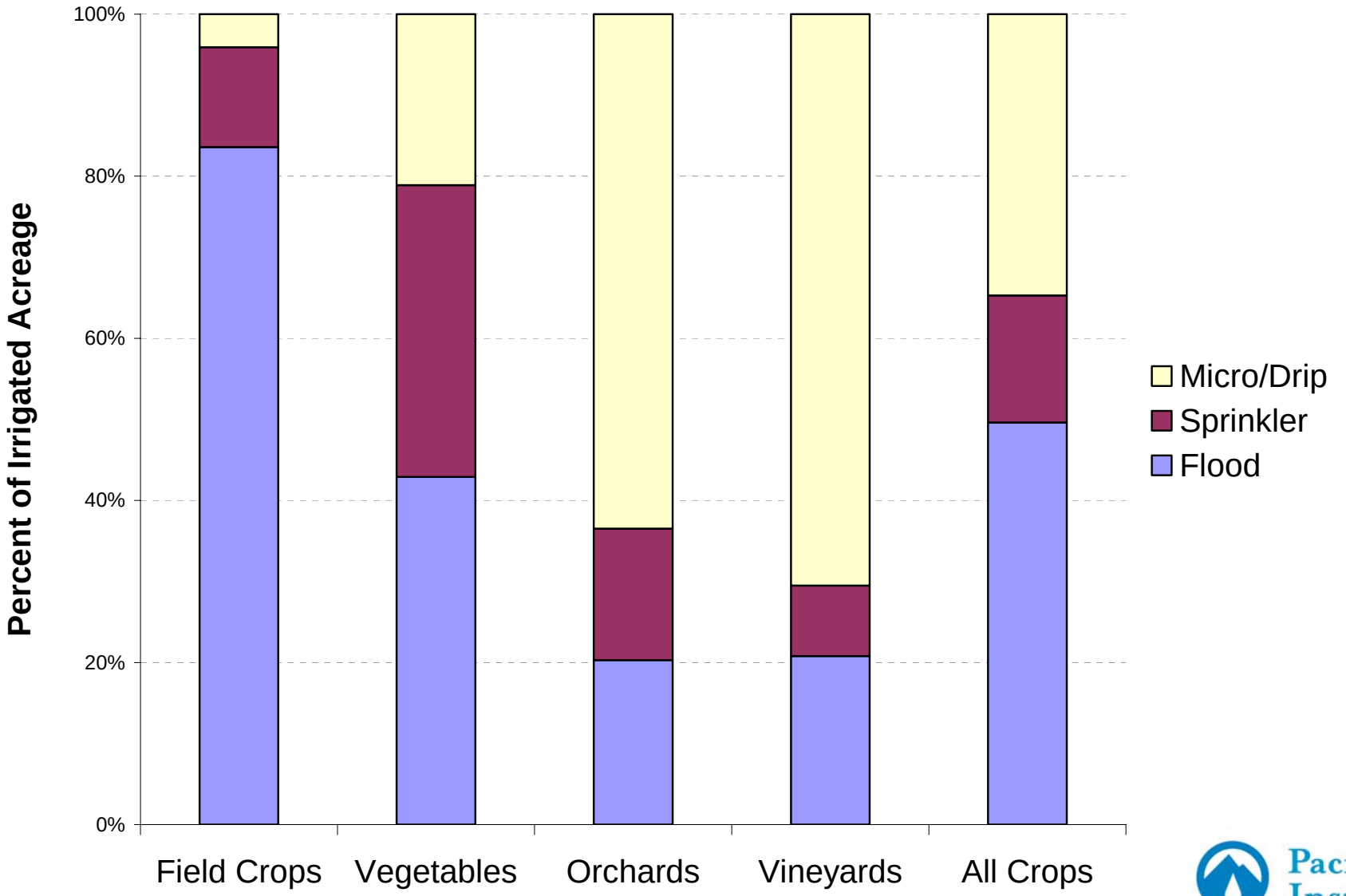
# Irrigation Technology is Improving, But Potential Remains for Further Improvement

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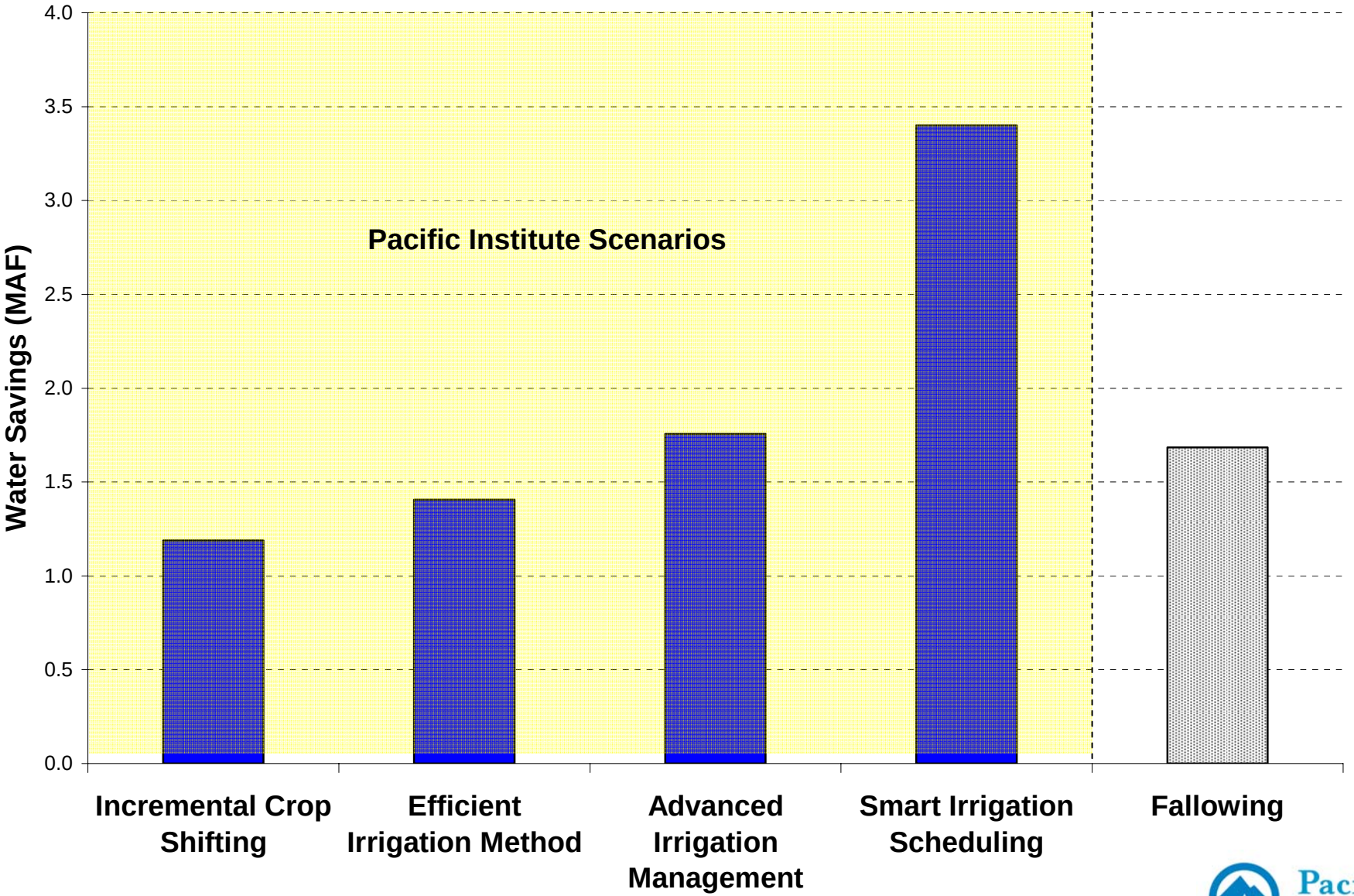
# Water Savings from Efficiency Scenarios

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# Conclusions

- Water use, ecosystem health, and management are closely related.
- We now understand that ecosystems must have water to maintain their, ***and our***, health.
- Water management must now guarantee water for ecosystems.
- Legal, technical, and policy approaches are possible for finding, and guaranteeing water.

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# Thank you.

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