Water Policy in a Changing California

Jay R. Lund
Director, Center for Watershed Sciences
Professor of Civil and Environmental Engineering
University of California, Davis

watershed.ucdavis.edu/shed/lund/
CaliforniaWaterBlog.com
Where to begin?

How we get water in our homes

I don't have any information on this bit

CartoonChurch.com
1. California’s water system
2. Eternal change and tradeoffs
3. Future of California and water
4. Policy and the University
Late Pleistocene
Map of California

Reconstruction of landscape features about 16,000 years ago at the peak of the last Ice Age

Region covered by mountain glaciers
(white)

Intermontain basin lakes
(blue)

Coastline exposed by a 120 m drop in sealevel
(green)

BC 16,000 Source: USGS
Mediterranean Climate

1. Wet winters, dry summers
2. Special agriculture
3. Nice for tourists
4. Attracts people & industries globally
5. Migration fuels growth in all industries

California is a popular and dry place
Sacramento Valley Precipitation

Northern Sierra Precipitation: 8-Station Index, October 04, 2015

Percent of Average for this Date: 70%

- 1982-1983 (wettest) - 88.5
- 2005-2006 Daily Precip. - 80.1

Average (1922-1998): 50.0

- 2014-2015 Daily Precip. - 37.2
- 2013-2014 Daily Precip. - 34.3
- 1923-1924 (driest): 19.0

2014: 8th driest in 106 years, 4th driest in runoff
Sierra Snowpack

A warm drought

Lowest snowpack on record
Most annual rainfall variability in US


NOTES: Dots represent the coefficient of variation of total annual precipitation at weather stations for 1951-2008. Larger values have greater year-to-year variability.
Natural Runoff Variation

- **1977 (5.6 maf)**
- **Average (28.2 maf)**
- **1983 (71.9 maf)**

Unimpaired Delta Outflow

Source: California DWR
1. Location with excellent access to Asian and North American markets and immigrants

2. Global orientation for California economy
   a. Hides – early 1800s
   b. Gold – late 1800s
   c. Agriculture – 1890s to present
   d. Hollywood – since early 1900s
   e. Education and services – since 1900s
   f. Electronics, aircraft, and software – post WWII

3. California is a global economy and society
Complexity of Water in California
California depends on an engineered statewide network
# 2015 Estimated Agricultural Drought Impacts

<table>
<thead>
<tr>
<th>Description</th>
<th>Impact</th>
<th>Base year</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought water shortage (million acre-ft)</td>
<td>8.7</td>
<td>26.4</td>
<td>33%</td>
</tr>
<tr>
<td>Groundwater replacement (million acre-ft)</td>
<td>6.0</td>
<td>8.4</td>
<td>72%</td>
</tr>
<tr>
<td>Net water shortage (million acre-ft)</td>
<td>2.7</td>
<td>26.4</td>
<td>10%</td>
</tr>
<tr>
<td>Drought-related idle land (acres)</td>
<td>540,000</td>
<td>9 million*</td>
<td>6%</td>
</tr>
<tr>
<td>Crop revenue losses ($)</td>
<td>$900 million</td>
<td>$35 billion</td>
<td>2.6%</td>
</tr>
<tr>
<td>Dairy and livestock revenue losses ($)</td>
<td>$350 million</td>
<td>$12.4 billion</td>
<td>2.8%</td>
</tr>
<tr>
<td>Costs of additional pumping ($)</td>
<td>$590 million</td>
<td>$780 million</td>
<td>75.5%</td>
</tr>
<tr>
<td>Net revenue losses ($)</td>
<td>$1.8 billion</td>
<td>45 billion rev.</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Total economic impact ($)</strong></td>
<td><strong>$2.7 billion</strong></td>
<td><strong>NA</strong></td>
<td><strong>NA</strong></td>
</tr>
<tr>
<td>Direct job losses (farm seasonal)</td>
<td>10,100</td>
<td>200,000#</td>
<td>5.1%</td>
</tr>
<tr>
<td><strong>Total job losses</strong></td>
<td><strong>21,000</strong></td>
<td><strong>NA</strong></td>
<td><strong>NA</strong></td>
</tr>
</tbody>
</table>

* NASA-ARC estimate of normal Central Valley idle land is 1.2 million acres.

# Total agriculture employment is about 412,000, of which 200,000 is farm production.
Floods, Droughts & Lawsuits:
Many Objectives

Water supplies
Floods
Environmental habitat
Hydropower
Recreation
Native Habitat and Fishes

California’s freshwater fishes are losing:

- **OK:** 22 species
- **Special Concern:** 69 species
- **Listed:** 31 species
- **Extinct:** 7 species

Salmonid Habitat

Wetlands remaining (% of 1900):
- 2002 (45%)
- 1960 (27.6%)
- 1900 (100%)
- Current rice field
Changing Water Challenges

Source: Hanak et al. 2011
Many Local, State, Federal Agencies

Separate Federal and State agencies & laws – wholesalers & regulators

1,000s of locally-elected water agencies

Most infrastructure funded & governed by local and regional water districts

Many coordinating water contracts
Drivers of Change

• Climate
  • Sea level rise
  • Warming
  • Precipitation change
  • Extreme whiplash

• Deterioration
  • Aging infrastructure
  • Contaminants – salts, nitrates, etc.
  • Mining legacy
  • Groundwater overdraft
  • Earthquakes
  • Sacramento-San Joaquin Delta

• Economy and Demography
  • State and federal finances
  • Globalization
  • Population growth and urbanization

• Ecosystems
  • New invasive species
  • Continued degradation

• Science and technology
  • New chemicals
  • New Technologies
Dry with Regional Water Problems

1) Klamath River system
2) Sacramento Valley
3) Mountain communities
4) The Delta
5) Bay Area
6) San Joaquin River
7) Tulare Basin
8) Southern California
9) Salton Sea
10) Colorado River
11) Salinas Valley
12) Groundwater
• Sacramento Valley - 5+ bcm taken upstream
• Delta farmers – 1+ bcm
• Bay Area – 30% directly, another 40% upstream
• S. Central Valley – 5 bcm directly; 5 bcm upstream
• S. California – 30% of supplies
Problems of California’s Sacramento-San Joaquin Delta

• Physical instability
  • Land subsidence
  • Sea level rise
  • Floods
  • Earthquakes

• Ecosystem instability
  • Habitat alteration
  • Invasive species

• Economic instability
  • High costs to repair islands
  • Worsening water quality for agric. & urban users
Today's Challenges

1) Limits of traditional management

2) Major problems
   • Native species and their habitats (esp. wetlands)
   • Reconciling for permanent scarcity
   • Groundwater – depletion, degradation, rights
   • Poor rural water systems
   • Rebuilding or abandoning the Delta
   • Weak state and federal governments

3) Modernizing statewide system
   • Serving many goals (conflict and mutual need)
   • Locally-driven portfolios in a statewide system
   • Challenges for state government and regulation