

## **Coping With Drought to Ensure Societal Stability and Food Security: California Encapsulates Many Global Issues**

Jerry R. Schubel, Ph.D

President and CEO, Aquarium of the Pacific, Long Beach, California, U.S.

Bill Patzert, Ph.D

Climatologist, NASA's Jet Propulsion Laboratory, Pasadena, California, U.S.

### **Summary**

Much of the world, like California, faces serious shortages of fresh water. Water is often scarce; water issues are complicated. Agriculture is by far the largest user of water globally, and in California it accounts for 80% of all water used. Globally and in California, people have generally settled far from water supplies. Consequently, there has been extensive and increasing intervention by humans to capture and move water for agricultural, urban, and industrial uses. Globally, most of the world's waters — surface and ground — are shared resources and no agreements or frameworks exist for managing shared water sources. It can be anticipated the availability of water in general will decrease because of climate change, as demand grows from a ballooning population, and as the need for more food grows, tensions over these shared waters are increasing. The United Nations (UN) predicts that the world will need 70% more food by 2050 to feed an additional 2.5 billion people. Agriculture already uses nearly 50% of the Earth's ice-free surface and 70% of its fresh water. We need a new "green revolution," one that grows more nutritional food on less land, using less water, less fertilizer, and less pesticides. California is a perfect laboratory to illustrate these issues. It is the seventh largest economy in the world, has the largest agricultural economy of any state in the United States and currently is faced with a serious drought. California could become a model for other states and nations facing serious drought.

### **Current realities**

Water is essential for a stable society. It is the most extracted natural resource on Earth, and the one natural resource for which there is no substitute. Climate change will dramatically redefine the global water picture. Nearly half of all the world's population already lives in water stressed areas and these tensions are expected to increase to 60% by 2025.

The Global Situation Eighty four percent of the population lives on the driest half of Earth. This has led to extensive intervention by humans to capture and transport water. Most of the world's waters are shared resources and 50% of the world's population depends upon shared water resources. At least 274 groundwater basins straddle international borders. As water shortages increase, the potential for trans-boundary water conflicts increase. According to the UN, more than 60% of all international river and lake basins — and nearly all the international aquifers outside of Europe and North America — lack cooperative frameworks for cross-boundary water sharing. Water access is poised to be the world's next major security threat.

According to UNESCO, by 2025 1.9 billion people will live in countries with absolute water scarcity, and two-thirds of the world population will approach water stress conditions. Climate change is beginning to take a toll. Water shortages will not only be a less-affluent country issue — Spain, South Korea, Australia, and even the U.S. already face challenges. Rapidly growing cities constitute major centers of water demand and major water losses with some leakage rates reaching 30%-50%. Improved water management is needed to ensure global security.

The California Situation In California, as in much of the world, the people are not where the water is. Most California water is in the north, while most of the people are in the south. California has developed an elaborate system to capture, store and distribute the water from where it is located to where it is needed. California has the largest agricultural economy of any U.S. state and accounts for 60% of all the state's water use. Once the linchpin of the California economy, the

state's agriculture sector accounts for only 2% of its economy, driving a call for a reevaluation of the state's water distribution. California could be an excellent laboratory for developing solutions for the present and coming global water crisis.

California currently is in a long-term drought — the worst since record-keeping began more than 135 years ago. California has had droughts throughout history, but a ballooning population, a rapidly growing agricultural economy, and diversification of the California's economy has dramatically increased the demand for water. One hundred years ago, California's population was fewer than 2 million. Today it is near 38.5 million and is projected to reach 47.7 million by 2040. On January 20, 2015 more than 77% of the state was in the two worst categories of drought — “exceptional” and “extreme,” according to the National Oceanic and Atmospheric Administration (NOAA) Drought Monitor. The drought is exacerbated by some of the warmest years on record, with the 2013-2014 winter being the warmest on record. California's average temperature was 61.5°F, 4.1°F above the 20th century average, beating the previous record set in 1934 by 1.8°F (NOAA).

The high temperatures and the lack of precipitation took a toll on California's major water storage mechanism: snow pack in the Sierra Nevada. The 2013-2014 snowpack was less than 15% of normal volume. On April 1, 2015, it was at 5% of the historical average. In January 2015, the state's major surface reservoirs averaged 37% of capacity. Groundwater levels are also falling, some as much as 1-1.5ft/month. With higher temperatures, humans and nature use more water.

### **Scientific opportunities and challenges**

Attention should be focused on developing drought-resistant crops and on new approaches to ocean desalination that are less energy intensive. While many scientific and technical solutions exist, the challenge is to get them adopted. Often this means changing attitudes and behaviors, and developing sustainable economic models. These issues must be addressed by a coalition of scientists and engineers, economists, politicians, and even spiritual leaders. Organizing these seemingly disparate forces is where we should put our emphasis.

### **Policy issues**

#### **International**

- The single most important issue is development of international frameworks for sharing surface and sub-surface water bodies, particularly in areas of political unrest. (UN must lead)

#### **California**

California and the world need—the next “green revolution” — one that increases crop yields using less water, less fertilizer, and less pesticides, while also producing crops that have greater nutritional value. In the meantime, California needs to (i) improve irrigation to increase efficiency and reduce losses; (ii) choose crops that match the climate, available water, and soil type; (iii) price water appropriately; and finally (iv) revise outdated water laws. The last will be a major challenge, but is necessary.

Southern California imports about 70% of its water: 50% from the Delta, 20% from the Colorado River. Both sources will continue to decline with climate change. The balance comes primarily from groundwater and much of that is overdrawn.

#### Some steps to reduce water demand in Southern California:

- Reduce urban indoor water use by 15% to 20% permanently. (Each city must take the lead.)
- Reduce outdoor water use significantly through mandatory restrictions with fines. (Reductions mandated by the state and enforced by cities.)
- Price water appropriately to reflect its value. Use tier pricing to reflect high use while

- protecting those least able to pay. (May require legislation)
- Provide funds to cities to eliminate significant leaks. (State Legislature)
- Inventory groundwater resources so both surface water and groundwater can be managed together more effectively. (state in collaboration with water districts).
- Create a comprehensive public education program — a campaign — to help people understand where our water comes from, where it goes, and the changes in behavior we need to make on a permanent basis. (state in partnership with cities)

These emergency measures need to be institutionalized.

#### Some state-wide strategies:

- The state should explore all ideas for reducing demand and increasing supply.
- State water allocations should reflect uses most important to the health and safety of Californians, to the state's economy, and to nature.
- The State Water Board, the Governor's Office, and the Legislature should continue dialogue to ensure that allocations reflect these priorities. Discussions should be expanded to include a representative cross-section of stakeholders. Agriculture deserves particular scrutiny.

In addition to reducing demand, we should increase the amount and reliability of the water supply.

#### Some steps to increase the reliability of supply

- Place a greater emphasis on local water supplies through
  - Expanded use of water recycling. (cities)
  - Capture and storage of stormwater. (cities)
  - Expanded use of greywater systems. (cities)
  - Use smart meters to monitor water use and detect leaks. (cities and state)
  - Expanded use of permeable pavement to capture stormwater. (cities and state)
  - Desalination of saline and brackish waters (cities and state)
  - Ensuring adequate investment in infrastructure to eliminate water loss. (cities and state)
- Clean-up and manage groundwater for sustainable use. (state and water districts)
- Improve reliability of the State Water Project. (state)
- Conduct targeted research critical to improving management of the state's water. (state and water districts)

The challenges of dealing with a warming climate and the high probability of more frequent, more intense, and longer droughts are daunting. All challenges carry with them opportunities. Californians have the natural, intellectual, and fiscal resources to adapt to "the new normal" while conserving a high quality of life for which California is known. In doing so, the state can become an example for other parts of the nation and the world facing similar situations. Seizing this leadership opportunity would result not only in a more resilient state, but also a sustainable economy.

#### **References**

Coping With the California Drought Crisis; Report of an Aquatic Forum of the Aquarium of the Pacific, December 2014

[www.aquariumofpacific.org/mcri/info/coping\\_with\\_the\\_california\\_drought\\_crisis](http://www.aquariumofpacific.org/mcri/info/coping_with_the_california_drought_crisis)

*\*\* A policy position paper prepared for presentation at the conference on Sustainability Challenges: Coping with Less Water and Energy, convened by the Institute on Science for Global Policy (ISGP), on June 5, 2015, in Whittier, California, U.S.*