

Battling Drought



*Securing Our
Water*



California has been suffering from a drought since 2012, and with 2013 on record as the state's driest year yet, many fear things will get much worse before there is any relief in sight. On January 17, 2014, California Governor Jerry Brown declared a drought emergency. With the declaration came the plea for Californians to cut their water use by 20 percent.

California's woes are echoed in headlines around the globe with drought-induced water scarcity affecting both the general population and farmers. Like California, many areas in China are in their third year of drought. In August 2012, six provinces in China encountered a prolonged heat wave that saw 2.2 million acres of crops fail and left 13 million people with little to no access to drinking water.

Brazil is now experiencing the same issues—dying crops and lack of water—in the face of a severe drought. As the world's largest coffee producer, Brazil's plight has sent coffee prices soaring, and current climate conditions could see the country lose 10 percent of its coffee crop by 2020. Likewise, Brazil could lose 20 to 22 percent of its soybean crop, according to agro-climatologist Hilton Silveira Pinto in a recent NPR interview.

California, Brazil, and China's problems bring to light the stark truth: droughts have far-reaching implications not only for those who work off the land but also for those who

depend upon it as a food and water source. For California, the looming scarcity of water has led Governor Brown to plead with Californians to cut their water use by 20 percent. In late January 2014, California officials announced that the State Water Project, a system of reservoirs and water delivery systems throughout Northern and Southern California, would halt. Twenty-five million residents and 750,000 farmland acres will now have to turn to other reservoirs, putting even more pressure on those systems. In its 54-year history, the State Water Project has never before completely stopped production.

The State Water Project is the system of aqueducts that supplies water to the San Francisco Bay area, where Carol Mahoney '93 serves as the Integrated Planning Manager for Zone 7 Water Agency. Zone 7 Water is the drinking water wholesaler for a population of about 220,000 residents, various tech industries, and grocery stores as well as a water supplier for a thriving agricultural community of vineyards and olive groves.



“Water is critical to the economic vitality of our region,” said Mahoney. “With an annual rainfall of only about 14.5 inches per year—very different than Shreveport’s average of 52 inches—we are dependent on water imported from the northern Sierra Nevada mountain range to augment our local groundwater basin that supplies only about 20 percent of our annual needs. Eighty percent of our drinking water and agricultural supplies travel from Northern California all the way through the Sacramento/San Joaquin Delta and into the San Francisco Bay Area.”

Another Creeping Phenomenon

In 2012, according to the National Climatic Data Center, the heat wave and drought in the United States cost \$30 billion while the death toll attributed to it, including deaths from heat stress, reached 7,500. Adjusted for inflation, the drought of 1998 is the second highest-costing natural disaster behind Hurricane Katrina in the past thirty years. Yet images of hurricane and tornado victims assail the public while droughts get much less coverage outside of the areas they directly affect. Why the disparity? Regularly referred to as a “creeping phenomenon” by both NASA and the National Drought Mitigation Center, droughts are difficult to define and predict.

The National Drought Mitigation Center (NDMC) defines droughts “as a protracted period of deficient precipitation resulting in extensive damages to crops, resulting in loss of yield.” Yet the NDMC is quick to point out that droughts cannot be seen

only as a physical phenomenon and that an operational definition that defines onset, severity, and the end of droughts is also needed. Operational definitions change according to which drought they define. What might be considered a drought in one area could be average rainfall for another, a conundrum that particularly strikes the interest of Associate Professor of Geology and Department Chair Dr. David Bieler.

“Drought itself isn’t a climatic problem completely,” said Dr. Bieler. “Yes, there is the water availability issue that is determined by climate, rainfall, snowmelt, and how much of that is evaporated. But, in many ways, drought is actually an agricultural issue, a human issue. Drought is a use problem and, in many cases, when looking at the historical record, we haven’t tried to look at separating those variables.”

Another Dust Bowl?

In 1985, researchers Wilhite and Glantz described four NDMC-accepted methods for measuring droughts. Meteorological, hydrological, and agricultural droughts cover the physical aspect of droughts while socioeconomic droughts determine the effect of drought on supply and demand. The well-documented Dust Bowl is a prime example of how all meteorological droughts stem from lack of precipitation but can be intensified by agricultural drought.

David Moss ’10, a graduate student at Syracuse University working on a Ph.D. in earth sciences, believes we have to be careful when comparing the Dust Bowl to current or future droughts.

“The Dust Bowl era was in part caused by poor farming practices,” said Moss. “This period was a significant time of drought that was exacerbated by the removal



Department of Environmental Quality employee sampling a public supply well for the Village of Evergeen.



“Drought itself isn’t a climatic problem completely..... In many ways, drought is actually an agricultural issue, a human issue.”

Dr. David Bieler

of natural prairie grasses and their replacement with wheat, which, when the drought came, died quickly and allowed for the removal of soil from the plains. Farming practices have since improved, and it seems unlikely that a similar ‘dust bowl’ situation will occur.”

The variability that goes into defining droughts is just as prevalent when it comes to predicting droughts. According to the NDMC, empirical studies have revealed that meteorological droughts never stem from a single cause. However, entities in the public and private sector are working continually to improve monitoring and forecasting products.

“With droughts, a ‘warning’ system is very difficult as the time scale can extend to months rather than the matter of days for tornadoes or hurricanes,” said Moss. “But I imagine we will probably start to see more drought forecasts coming out in the spring and hopefully start to see people change water usage in response to this.”

The United States Department of Agriculture, the National Weather Service, and the NDMC have produced the Drought Monitor since 1999, which maintains a weekly map of the

U.S. that monitors dryness. Mostly, meteorologists and forecasters rely on historical drought information. Dr. Bieler contends that though this method is sound, the historical record, unfortunately, does not reach far enough back to be a completely reliable indicator.

“Our data sets are not big enough to really get a potential scope of the problem,” he said. “We haven’t been collecting data that long. Because it’s a whole year’s worth of data that most are interested in and how that compares to a long-term average, many predictions are based off perhaps a 30-year average. But, who is to say that the 30 years we are basing that prediction on was what one might consider normal?”

A Water Shortage

Bieler, with the help of Trevor Stine '13, has worked to improve the historical record and future predictions by looking at the Arkansas River basin. This river basin supplies water to areas of Colorado, Kansas, Oklahoma, and Arkansas, much like the State Water Project supplies water to multiple large-scale cities in California. Their research was inspired by someone questioning Bieler on whether the U.S. was currently entering a new Dust Bowl era.

“My thought was ‘Well, I wonder what the climatic signature of the Dust Bowl was?’ How would we know? And that prompted this study where we took the upper Arkansas River valley from its headwaters in Colorado to Tulsa and made a series of maps from 1920 to 1950. We took the total precipitation

from each year and did a 30-year average, establishing a baseline. Then, we mapped out how the rainfall differed from that average.”

Their research found that from 1934 to 1938 – the height of the Dust Bowl – there was a huge rainfall deficit, as expected. But, interestingly, there was not a deficit in the headwaters.

“This is just the first step. Now, we need to go forward in mapping the temperatures,” said Bieler. “Either from the agricultural perspective the river was being used before it got farther east or it was evaporating. These are things we just haven’t evaluated yet.”

The exploration of historical drought records and emphasis on prediction models are meant to aid in diminishing the possibility of water shortages in the face of drought. A water shortage has implications not only on drinking

BY THE NUMBERS

100

percent of CA counties face severe drought conditions

1.7

billion spent on energy costs during 2007-09 CA drought

300

gallons per month saved by fixing a leaky faucet



Jesse Means '92

water but also food production. Areas such as California with growing populations dependent on reservoirs and rainfall are particularly vulnerable to droughts.

Drought Mitigation

Jesse Means '92, a geologist for the Drinking

Water Protection Program staff at the Louisiana Department of Environmental Quality, spends his days working to protect the quality of public water sources, a task that could become more challenging in the face of drought.

"Depending on how long or severe a drought is, contaminants may become more concentrated due to lack of rain water to

dilute them. As far as water availability goes, state or local governments may put water restrictions on communities and, in plain terms, if the water just isn't there, it isn't going to be available."

Means states that drought mitigation is a combined state and federal agency effort. The state of Louisiana has a Ground Water Emergency Response Contingency Plan in place should an unanticipated man-made or natural act render the state's ground water source unavailable. Researchers and urban developers continue to try to balance the need for both reactive and proactive measures. The Federal Emergency Management Agency (FEMA) indicates that mitigation would save \$4 for every \$1 expended in crisis mode.

At Zone 7 Water in the San Francisco Bay area, Carol Mahoney is knee deep in planning efforts that seek to integrate water supply, flood protection, groundwater management, and watershed protection as well as establish

THE Centenary FUND

**Your Support
Matters.**



Centenary College is developing leaders for a changing world. We are a Tier One National Liberal Arts College that offers a highly personal liberal arts and sciences education, preparing graduates to enter the world as wise, caring, and moral leaders.

Contribute online at CENTENARY.EDU/GIVE

annual operation plans for the water supply – a task that has become increasingly difficult given current California climate conditions.

“Our mantra has been, ‘Prepare for the worst and hope for the best!’” said Mahoney. “Our team found out in mid-January that the allocation of water from the State Water Project to be delivered to us would drop from five percent to zero. Translation: Maximize the use of our local supplies, like our groundwater basin and a local reservoir. This is easier said than done and where my training in geology from Centenary comes in handy.”

Agreeing with Means’s assessment, Mahoney confirms that the continued lack of precipitation is also cause for concern when it comes to the quality of the water that they do possess:

“Deliveries through the Sacramento/ San Joaquin Delta are subject to environmental laws and concerns over salt water intrusion. Should there not be enough fresh water flowing into the system from the Sierras this summer, then the water at the intake pumps that feed the aqueduct system will become more and more saline. At some point, the water could become too saline to be acceptable for treatment and distribution for drinking water. This also goes for supplying agriculture directly. At some point, the water will just be too salty for human consumption or plant application.”

The Livermore Valley, where Mahoney lives, only recorded 4.5 inches of rainfall for 2013 – 10 inches below the



The DEQ routinely collects water samples to monitor quality.

average. In response, she has begun to conserve water at home, keeping a bucket in the shower to catch excess water that is then used to flush toilets and turning off outdoor irrigation. She also advocates for recycled wastewater for irrigation:

“Recycled water is the only uninterrupted supply in this semi-arid environment, and parks and golf courses irrigated with it will enjoy a green summer, while the hills and many lawns will turn Golden State brown.”

Meeting Demands

Facing a rapidly expanding population, water scarcity even during non-drought years, and climate change that the National Resources Defense Council claims will only increase the possibility of droughts in the future, researchers are also looking to the past for answers.

“There is a very complicated history of drying and wetting cycles that we interpret back as far as 800 to 1100 years ago using tree ring data,” said Bieler.



“We can show how that corresponds with the archeological record as to whether people lived in higher elevations where it was cooler and therefore wetter or whether there was enough water that they could move down to lower levels in the valleys. People used to make adjustments for the climate change.”

Bieler argues that big fluctuations may not be that uncommon, but that the drought in California is particularly troubling due to the severity and duration. The reservoirs are also at record lows.

“Water has always been in short supply in California. How you meet the demands of a growing population and how you prioritize water use, i.e., drinking water, water for livestock, domestic use for watering lawns, fracking, is the issue at hand. And farmers need water for irrigation – failing to irrigate California crops is a national problem.”

Depending on precipitation levels in the summer and coming year, Mahoney’s team will turn to underground aquifers to meet indoor water needs and support local vegetation:

“The Integrated Planning team has been burning the midnight oil to determine how we can maximize the use of our supplies and be flexible enough to address new information as it comes in. We collaborate closely with our engineering and operations teams to understand where the system has weaknesses and work to fill gaps.”

She points out that understanding the whole system is key to planning for an emergency such as this drought or even a flood.

Sandra L. Postel, Director of the Global Water Policy Project and a National Geographic Fellow, accurately explains the challenges that lie ahead:

“For the past century and a half, humanity has enjoyed a relatively benevolent climate. During this time, we built big dams to tame the earth’s rivers, diverted flows from one river basin to another, drained wetlands for farming, and built oasis cities in the desert. We have so successfully masked aridity that we have become imbued with a false sense of security about our water future. In order for our modern culture to enjoy a millennium of prosperity in the West... we may need to embrace aridity and water’s tightening limits, and apply ingenuity and creativity to successfully live within those limits rather than continue to mask and deny them.” ■

ASK THE EXPERT

How do we become conservation-minded?



In a way, we’re already conservation-minded. We track relatively scarce resources (such as our bank balances) and carefully choose our usage. The problem is that when we do not believe a resource is scarce, we release ourselves from the mental barriers that previously existed (as many lottery winners know, sadly, once they’ve lost their winnings).

But there is hope. Our minds can help us preserve resources again with just a bit of foresight and planning. Many possibilities exist to accomplish this. For example, video games such as *World Without Oil* (worldwithoutoil.org) may help us build skills now in a virtual world and change our real-world behavior down the road. At home, one can make a real-world game out of saving water - incentivizing yourself and your family now to reinforce skills that we might need as second-nature later.

By bringing scarcity and conservation into our daily lives as concepts we can work with rather than fear, we equip ourselves with the skills and knowledge to cope with shortages that may happen.

Dr. Jonathan Westfall is a Visiting Assistant Professor of Psychology.

ENGAGE Sustainable Life

Is drought a possibility in your hometown? Check the U.S. Drought Monitor. <http://droughtmonitor.unl.edu/>

Severe drought is a natural disaster. Find out how to prepare. <http://www.redcross.org/prepare/disaster/drought>

Drought is not a new problem. Get a historical perspective. <http://cdn.wfp.org/hungermap/>