News from the CLIMAS El Niño-Drought Initiative

END InSight

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The University of Arizona.

Water management in dry times, dry places

Arizona, New Mexico, and much of the West are bracing for yet another long, dry summer. The winter of 2002–2003 brought little long-term drought relief to most of the Southwest, particularly in terms of replenishing water supplies. Although by some measures much of New Mexico reported near-normal winter precipitation, even these moisture totals were generally not enough to replenish reservoirs and otherwise improve water supplies, leaving the region quite vulnerable to continued drought and water supply disruptions. Conditions improved to a lesser degree in Arizona, with most areas still reporting drought conditions.

The intensity of the drought has varied considerably across the Southwest and so have its impacts, especially on water management. However, the correlation between the two is not always direct; in some cases, the areas that have received the least rainfall are those where drought seems to be a minor consideration, whereas other locations that have received more rainfall seem to be taking drought measures much more seriously.

This article will explore the experiences and responses of rural areas, towns, and cities in the Southwest to the effects of drought on their water systems. It will describe the historic process by which water was allocated in the Southwest, which forms the basis for current conditions. It will also look to the future of water use planning in Arizona and New Mexico and consider how urban and rural areas might cope with the possibility of extended dry periods in combination with continued population growth.

Drought effects vary widely

The differences in how rural areas, towns, and cities across the West are coping with drought are striking. Reactions range from minimal, voluntary water conservation measures, to much tougher restrictions governing aspects of daily life such as how often to wash the car or water the lawn. The responses of Phoenix and Santa Fe seem to lie at opposite ends of the spectrum, as Table 1 illustrates.

Phoenix experienced one of its driest winters ever in 2001–2002. Precipitation from November 2001 through April 2002 in climate division 6, where Phoenix is located, was 1.57 inches, or 29 percent of the long-term average (1). The city responded by imposing Stage 1 drought restrictions, which request that users decrease their water use by 5 percent, on a voluntary basis, and impose a similar reduction on all city departments (2). During the course of the year, the Salt River Project (SRP), which supplies substantial amounts of the city's drinking water, was forced to cut its deliveries by one-third, and many of the reservoirs on the Salt/Verde river system nearly dried up.

The winter of 2002–2003 was considerably wetter in the Phoenix area, with total precipitation on par with the long-term average. Near-normal rainfall also brought relief to the parched Salt/Verde watershed, the source of a substantial portion of Phoenix's water supply (1). The Salt River basin system is currently at 41 percent of capacity, slightly more than last year's storage. The Verde River basin system fared even better, filling to 60 percent of capacity, or more than two times as much water as last year (3). However, some reservoir levels remain low, and the one-third cut in SRP water deliveries is not expected to be lifted any time soon. The city has decided to remain under Stage 1 restrictions for the summer of 2003, at least until the monsoon rains begin.

The winter of 2001–2002 was also dry in Santa Fe, although not nearly as dry as it was in Phoenix. The climate division where Santa Fe is located received only about half of its normal precipitation from November 2001 through April 2002 (1) and reservoir

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Table 1. Drought Summary for Phoenix and Santa Fe.

	Phoenix	Santa Fe
Winter 2001-02 Precipitation (% average)	29%	55%
Winter 2001-02 Reservoir Storage (% Capacity)	31% (SR), 27% (VR)	29%
Summer 2002 Drought Restrictions	Stage 1	Stage 3
Winter 2002-03 Precipitation (% average)	101%	124%
Winter 2002-03 Reservoir Storage (% Capacity)	41% (SR), 60% (VR)	50%
Summer 2003 Drought Restrictions	Stage 1	Stage 3

SR=Salt River; VR=Verde River

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levels were at 29 percent of capacity. In response, Santa Fe imposed Stage 3 water restrictions during the summer of 2002. Stage 3 restrictions prohibit outdoor watering more than one day per week, and the planting of turf or sod is not allowed.

The winter of 2002–2003 was on the wet side: precipitation from November 2002 through April 2003 was 124 percent of the long-term average in Santa Fe's climate division (1). Even so, winter precipitation was insufficient to replenish the city's reservoirs, although levels did increase from 29 to 50 percent of total capacity between April 2002 and April 2003 (4).

Santa Fe plans to retain its Stage 3 drought status for the foreseeable future and has taken its drought restrictions further by announcing that it has no water for additional development this year (although building permits can be obtained if builders agree to retrofit water-saving toilets into already existing buildings) (5). New regulations permit residents to use gray water from showers, kitchen sinks, and washing machines for outdoor irrigation. The city government may soon consider a proposed bill that would require new homes and buildings to have water harvesting systems, which would capture and store rainfall and snowmelt for outdoor watering in drier times (6).

Other Southwestern cities have had diverse reactions to the drought's impacts on water supply and demand. Flagstaff, Arizona has implemented a permanent year-round ban on daytime lawn and garden watering and limited property owners to every-other-day landscape watering. Tucson, on the other hand, has not implemented any drought-related water restrictions, although a long-standing water conservation ethic has contributed to a 20 percent decrease in per capita water use since the 1970s (Phoenix's per capita water use has dropped only slightly) (7). Farther north, Denver is evaluating the long-term feasibility of recycling reclaimed water for use as drinking water (8).

Why do similarly parched municipalities take such different tactics in coping with a common constraint? A primary reason is differences in water supplies. Large municipal water providers in the Phoenix metropolitan area may have access to up to four sources of water: groundwater, Colorado River water via the Central Arizona Project (CAP) canal, SRP water from the Salt/Verde watershed, and treated effluent (used primarily for watering turf areas). Such water providers have the ability to switch between multiple water sources and thus have more options in coping with shortages. Santa Fe, on the other hand, receives its water supply largely from wells that draw on limited groundwater supplies and reservoirs that store surface water. This makes the city considerably more vulnerable to climatic variability.

Although cities have varied in their reactions to climatically induced threats to their water supplies, they are, for the most part, in better shape than rural areas. Urban areas may have access to multiple water sources, *and* they may also have the political clout and access to funding needed to better cope with drought. Cities may even make deals with farmers to gain access to their water resources. For example, the city of Prescott is considering spending $30 million to buy a 50,000-acre ranch with water rights that would greatly expand its water supply (9).

Small towns such as Española, New Mexico have their own serious water woes; the town is also in a Stage 3 water shortage, forcing it to drill new wells to ease the water shortage. Rural areas have also suffered severe drought impacts. The Navajo Nation, in particular, has access to few supplemental water sources and ranchers have been forced to sell their livestock, buy expensive feed and water supplies, or lose their herds (10).

The Colorado River

One of the advantages that some urban areas have is the ability to access water that originates outside their immediate area, such as Colorado River water. In many areas of the United States, groundwater is perceived to be in perpetually short supply, since much of it accumulated millennia ago when the climate was wetter; thus it is essentially a *non-renewable resource.* In some areas, its use is also restricted under state law. Phoenix-area water providers in most years seek to reduce their use of groundwater through substituting CAP or SRP water, which together supply about three-quarters of the city's drinking water, and also to increase their use of treated effluent to water parks and golf courses. However, given the one-third reduction in SRP deliveries, water providers are buying larger CAP supplies at substantially higher prices. Tucson is also expanding its use of CAP water by blending it with groundwater and delivering it to residents.

But increasing dependence on the Colorado River may not be a foolproof strategy for Southwestern cities. Even in non-drought years, the river is over-allocated between the seven Western states that share its water. The Colorado River Compact allocated 15 million acre-feet (maf) of the Colorado River's flow between seven Western states in 1922. Tree-ring records indicate that flows vary from 4.4 maf to over 22 maf, and average about 13.5 maf (11).

In 2002, the Colorado River flowed at only 3 maf, or less than one-fourth of its long-term average. Despite the lack of snowpack during the 2002 water year, the river still filled all of its deliveries, largely due to drawing down the system's large reservoirs. This has left Lake Powell at its lowest level since it was filled, at 51 percent capacity; Lake Mead is at 65 percent of capacity, the lowest in 30 years. To meet the demands of 7.5 maf of water for Arizona,

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Nevada, and California, water managers will have to draw further on water stored in Lakes Mead and Powell, since only 5.2 maf of flow is expected this spring (12). Water managers estimate that another dry year or two will lead to an emergency water shortage situation by 2005.

Drought on both the Colorado River and the Salt/Verde system at the same time is not something that Phoenix area water managers normally expect. Research conducted among 28 urban water providers in Phoenix, Tucson, and Nogales in 1999 revealed that Phoenix-area water mangers considered the likelihood of simultaneous drought on both water systems a very remote possibility (13). However, paleoclimatic records show that such simultaneous droughts have occurred in the past and may be expected to happen again in the future.

A historic look at water allocation

As the pressure on water supplies increases, tensions mount over how to best allocate resources. Understanding how, where, and to whom water rights in the Southwest are currently allocated requires knowing a bit about the history of water policy in Arizona and New Mexico.

In Arizona, New Mexico, and much of the West, the Doctrine of Prior Appropriation underpins water policy. During the settlement of the West by Anglo-Europeans, the earliest settlers in a particular area could establish water rights for whatever amount of water they could put to "beneficial use;" in other words, as long as they used the water they claimed, their rights trumped those of later water users. Since many of the early settlers in Arizona and New Mexico were farmers, and in many cases the land and water rights have been handed down through generations, a large portion of water in the Southwest is allocated to agricultural interests, despite the fact that a much smaller portion of the state's economy is now derived from this sector.

Water rights on tribal lands are another significant factor in water management in the West. In 1908, the Supreme Court held in *Winters v. United States* that in setting aside reservations, Congress had also intended to set aside sufficient water to satisfy present and future Native American needs (14). This ruling was later reinforced with *Arizona v. California* in 1964, in which the previous ruling was interpreted to mean that reservations where agriculture is a primary activity are entitled to an amount of water sufficient to irrigate all of the practicably irrigable acreage on the reservation, regardless of how much water a tribe is actually using (14). These rulings could have very significant impacts if and when they are adjudicated. For example, the Navajo Nation has not yet claimed its full Colorado River rights, but could theoretically eventually claim up to 5 maf. However, doing so would likely require a lengthy and expensive court case.

Obviously, times have changed since these rulings were handed down. Population growth, particularly in urban areas, has caused many to call for a new look at water policies in the Southwest. Prior appropriation may limit the flexibility of water policy to shift water from agricultural areas to areas of greatest need, namely urban centers. Approximately 80 percent of all water consumed in Arizona goes to agricultural uses, but this sector is responsible for only 1.5 percent of the Gross State Product (15). The beneficial use doctrine does not require economic considerations, only that water rights be satisfied according to the date that they were allotted.

Many policy makers have called for changes to water rights that could lead to the greatest benefits for the largest number of people. However, allocating water rights based on economic returns could yield some seemingly contradictory results in the struggle to conserve water. Casinos and golf courses in Las Vegas, Nevada, for example, argue that the revenue generated from tourism at their elaborate water features and lush fairways is far higher than that generated by agriculture, while farmers respond that protecting the country's ability to feed itself is more important.

Colorado River near Lake Powell in March 2002 (top) and March 2003 (bottom). Photos by John Dohrenwend.

Tensions over water during times of drought mount as the range of competing interests for this scarce resource expands. In addition to urban versus rural interests, water is also needed for environmental concerns, industry, and other uses. A recently released report by the Department of the Interior includes a map of potential water supply crises in the West by 2025. Santa Fe and Albuquerque are listed as sites where conflict over water resources is highly likely, while Phoenix and Tucson are said to have substantial conflict potential.

Expanded Drought Planning

Efforts are under way to better plan for and cope with water shortages that may currently be drought-induced, but are likely to become regular occurrences in the future. Both Arizona and

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New Mexico are in the process of putting together statewide drought plans. New Mexico will have a statewide water plan by the end of 2003 under a recently signed law. The plan will inventory the quality and quantity of water resources and include projections of water needs and proposals on how to meet them. It will also feature drought management and water-saving strategies. Cities, counties, and other water supplies will be required under another bill to adopt comprehensive water conservation and drought management plans, and to submit these plans to the state engineer by Dec. 31, 2005 (16).

Arizona is at an earlier stage of its drought planning process. Governor Janet Napolitano created a drought task force on March 20, 2003 that will work to increase the state's water conservation efforts and assess ways of helping drought stricken ranchers, farmers, wildlife and rural residents. CLIMAS is playing an active role in working with the task force in the creation of a drought plan.

The federal government is also seeking to play a more active role in managing water in the West. The Department of the Interior's recently announced Water 2025 plan would promote conservation and sharing of water resources among the West's expanding population and focus research efforts on issues such as desalinization to expand water supplies. More information is available at http://www.doi.gov/water2025/.

Such efforts toward more proactive drought planning and water management are likely to offer the West's best hope in dealing with future population growth, expanded water needs, and the possibility of greater climatic variability.

–Rebecca Carter, CLIMAS

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About END InSight

END InSight is a year-long project to provide stakeholders in the Southwest with information about current drought and El Niño conditions. As part of the Climate Assessment for the Southwest (CLIMAS) project at the University of Arizona, END InSight is gathering feedback from stakeholders to improve the creation and use of climate information.

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Please direct questions to Rebecca Carter:
(520) 622-9016, rhcarter@email.arizona.edu
CLIMAS, Institute for the Study of Planet Earth,
University of Arizona, PO Box 210156, Tucson, AZ 85721
http://www.ispe.arizona.edu/climas/