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Savannah P. Rodriguez

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Concepts in Climate Change and Public Health Preparedness

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New Mexico has historically and continues to face the threat of water scarcity due to extreme droughts. It is the sixth-fastest-warming state in the nation and according to the Union of Concerned Scientists, it is only expected to get worse (“Confronting Climate Change,” 2016). Climate change has caused changes in precipitation patterns, which are expected to result in “more intense droughts and a greater proportion of precipitation falling as rain rather than snow” (“Confronting Climate Change,” 2016). Many areas of the state are receiving less than 15 inches of precipitation per year (NOAA, 2019). The National Integrated Drought Information System (NIDIS), found that New Mexico had the longest duration of moderate to exceptional drought, lasting 329 weeks, from May 1, 2001 to August 14, 2007. More recently, New Mexico faced its most intense period of exceptional drought that affected 54.27% of land on January 19, 2021 (“New Mexico”).

The NIDIS uses a five-category system to classify droughts from abnormally dry (D0) to exceptional drought (D4) (“New Mexico”). During an abnormally dry season, the state’s soil moisture is low and fire danger increases. During a moderate drought (D1), livestock require supplemental food and water; burn bans and firework restrictions are put in place. During a severe drought (D2), pasture yield is limited, and farmers are forced to sell their livestock. Crop growth is stunted and dryland crops become brown. There is a huge risk of wildfires so fuel mitigation practices (i.e. thinning trees, removing underbrush, and tree limbing) are initiated (“Wildland Fire”). During an extreme drought (D3), livestock that has not been sold begin to suffer and even die, and feed costs increase. Crop yields are low and the Conservation Reserve Program authorizes emergency grazing provisions for farmers for up to 90 days (“USDA Announces”). Fire danger is extreme at this point and farmer irrigation allotments are decreased. During an exceptional drought, no surface water is left for agricultural use and farmers are forced

to use water from private wells. Also, burn bans increase, federal lands are closed to the public as a fire precaution, and rivers that flow through the state, including the largest river, the Rio Grande, are completely dry (“New Mexico”).

Currently, 92.3% of New Mexico is abnormally dry; 81.8% is facing moderate drought, 66.6% is facing severe drought, 62.4% is facing extreme drought, and 9.0% is facing exceptional drought (“New Mexico”). “New Mexico’s map of drought looks like an ugly, painful bruise,” writes Sean P. Thomas of the Santa Fe New Mexican. He notes that a key factor in the state’s prolonged drought conditions is due to a dry monsoon season in 2020, with a drop in precipitation of about 52-72%. Richard Strait, the State Soil Scientist, explains that because of last summer’s weak monsoon season, “we went into winter with particularly dry soil across the state...then, when the snow finally fell, that dry soil acted like a sponge, soaking up the moisture and leaving less water available to become snowmelt runoff. And on top of that, snowfall was relatively light across the state this winter” (Segarra, 2021). Strait states that drought periods in New Mexico are cyclic and tend to appear every 10 to 15 years, however New Mexico has been under the exceptional drought category for the past 20 years.

Strait states that New Mexico has had “some decent snow this winter” but one snowstorm does not help New Mexico’s drought situation in the long-term (Segarra, 2021). With spring snowstorms, some of that moisture is lost to the atmosphere because after the snowfall, warmer, windier days follow. The problem lies in that “the wind and heat can quickly sublimate the snow, turning it into water vapor before it can help moisturize the ground” (Segarra, 2021). According to Strait, these kinds of weather patterns are currently in the forecast. He states that New Mexico is getting some snow up in the mountains, “where it matters,” which is good for residents in the valleys because it contributes to the water supply, but this is not a long-term solution.

Droughts affect every part of the environment, leaving farmers, farmworkers, and ranchers in New Mexico to be the first in line to feel the economic impact. The livelihoods of these workers depend on sufficient water supply for survival, whether it be to literally feed themselves and their families, to run their businesses selling crops and livestock, or to make a living. According to the National Farm Worker Ministry, sporadic and unpredictable rainfall create job insecurity for these workers; if there is no water, there is no crops, if there are no crops, there is no work.

“Farming and ranching to pay the bills could become an unsustainable way of life in New Mexico, as the water supply dwindles and farms resort to pumping more groundwater to irrigate,” writes Cody Nelson in High Country News. The agricultural industry commands massive amounts of water and is the largest consumer of water in the state. For example, in 2015, irrigation accounted for 76% of water withdrawals (Nelson, 2021). To put this water demand in perspective, a pecan tree for example, needs up to 200 gallons of water daily during warm months and a single cow can command up to 30 gallons per day, not including the amount of water required for irrigation of the fields they graze (Nelson, 2021).

In the midst of these water challenges, the New Mexico Interstate Stream Commission (ISC) has reached out to farmers along the Rio Grande and Rio Chama and asked them to “either cut back on farming this year or brace for a short irrigation season” (Nelson, 2021). Page Pegram, a hydrogeologist with the ISC suggests that ranchers should “run [their] cattle for enjoyment and tradition rather than as their primary source of income...” and for farmers, “if they have the option not to farm, they should consider that option,” (Nelson, 2021).

Nelson writes that the impact of droughts prevents farmers from getting their full water appropriations, and results in them growing significantly less than usual, having to make decisions about what to grow and what not to grow, and even forcing them out of the farming industry entirely. Travis Harris, a farmer and rancher in New Mexico, grows alfalfa, winter wheat, and has 30 cows. He is one of many in the state that has felt the impact of droughts on his livelihood. He states that last fall, his water got shut off a month earlier than expected, “There’s no snowpack. There’s no water in storage up north...it’s very scary going into this season,” (Nelson, 2021). Edmund Ogaz, another farmer in New Mexico, grows chile, pecans, and onions. When he first started farming 45 years ago, he got water from the local irrigation district and at that time, it was enough to sustain his farm, however now he has had to rely on groundwater pumping. The problem with using groundwater to irrigate is that it is lower quality than river water, and has an increased salt content, which means that different kinds of fertilizers need to be used to protect the crops (Staten, 2021). In order to conserve water, Ogaz has also had to change the way he plants and no longer plants multiple crops on the same land. He states that water is coming in much later than it used to. He would start irrigating in February or early March but now has to wait until June.

These water challenges come as a direct consequence of droughts and significantly affect New Mexico’s agricultural economy. The effect of drought on agricultural productivity causes reduced crop yields, damage to pasture and range, and reduced plant growth (Drugova et al., 2020). The state’s agricultural sector brings in about \$2.5 billion per year, with livestock contributing to 81% of agricultural production and crops contributing to 19% (Johnson et al., 2020). According to Drugova et al., of all agricultural sales in the state, cattle and calves represent 24% and hay/forage (all irrigated) represents 6%. 15% of cattle

and 37% of hay/forage are produced on reservations. To put these economical losses into perspective, it is estimated that for the Mescalero Apache tribe, the direct losses of drought affecting cattle is about \$86,000 and for the Navajo Nation, \$1.235 million (Drugova et al., 2020). Drought serves as a serious threat both tribal and non-tribal agricultural economies in the state.

Though droughts in state are only expected to worsen, there lies some hope in the efforts of the New Mexico Office of the State Engineer and the New Mexico Water Resources Research Institute. Together, along with the help of several other federal and state agencies, updates have been made to the New Mexico Drought Plan (NMDP) in 2018. The NMDP is an approach to address the state's drought problem in order to protect its people and its resources. Within the plan is a drought response system that is adaptive to the changing needs and conditions and is continually updated (every five years) with the influx of new information ("Drought in New Mexico"). The objectives of the NMDP are to a) synthesize previous drought plan efforts and streamline the content; b) make strategic adjustments to previous drought plans; and c) lay a foundation for future collaborative improvements. To achieve these objectives, the NMDP does the following:

- defines an updated drought operational framework to be followed in addressing drought and drought-related activities,
 - explains monitoring activities to identify drought status and triggers for the different stages of drought,
 - describes impact and vulnerability assessment,
 - outlines the responses to drought based on triggers and impact conditions,
 - identifies long- and short-term mitigation activities that can be implemented to prepare for drought and to minimize the impacts of future droughts,
 - compiles impact assessments as presented by relevant state agencies,
 - acts as a catalyst for the creation and implementation of local drought planning and response efforts, including the drought plan update process, and
 - includes a future work section describing potential work that is outside of the scope of this plan ("Drought in New Mexico")

State and federal agency emergency response actions are based on impact conditions that affect agriculture, drinking water, water quantity, wildfire, wildlife, and recreation, economic development, and tourism. For example, during increased drought levels, the New Mexico Department of Agriculture (NMDA) provides hay sourcing and during production/yield losses, the Conservation Reserve Program (CRP) provides emergency grazing through their acreage program (“Drought in New Mexico”).

Some farmers like Jay Hill in the Mesilla Valley have turned to technology to adapt to water challenges brought on by climate change. Hill uses driplines to irrigate over 900 acres of field crops and livestock. A dripline is a hose that is planted alongside the roots of the crop that has an emitter about every 12 feet that provides just the right amount of water for crops, thus minimizing waste (Murphy and Mooney, 2019). In addition to drip irrigation practices, some farmers also use lasers to finely slope the ground in their orchards which allows the water to be distributed evenly. The Elephant Butte Irrigation District is also adapting by trying to capture as much stormwater as possible and channel it into the river system (Murphy and Mooney, 2019).

According to the NMDP, some mitigation strategies for drought include enhancing water supply through aquifer recharge and demand management through reducing losses, reducing use, and employing economic incentives. The 2018 New Mexico State Water Plan estimates that \$10,350,000 is needed for other drought mitigation projects such as “shortage sharing agreements, emergency drought restrictions for public water supplies, drilling back-up wells, conjunctive use strategies to rest the aquifer and rely on renewables when available...” and “water banking rather than a permanent transfer of water rights to address the temporary shortage,” (“Drought in New Mexico”).

New Mexico has always been in a constant state of drought, which strongly and negatively impacts the livelihoods of farmers, farmworkers, and ranchers. Though the state's drought status is only expected to worsen, there are many viable solutions to solve, or rather improve the problem. These mainly include incorporating technology into agricultural practices and using sustainable agricultural practices. These methods however are easier said than done and require funding. The drought problem requires the help of policymakers to provide farmers with the resources to conserve water in order to continue on in the agricultural industry. More importantly, this problem requires humans to make lifestyle changes to decrease their carbon footprints in order for the world to cool off and continue on.

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