# Water Resilience in the Face of Climate Change: From Droughts to Flooding

**Climate change is already affecting water quality and availability. Rising temperatures and sea levels, and an increase in extreme weather events, lead to more droughts and floods, which threaten everything from public health to food and energy production.[1] Some regions like California, where drought has ravaged the state for the last few years, are now facing life-threatening floods.[2] Yet California is also an example of how reliance on fossil fuels and factory farms contribute to these climate change events.[3] Achieving water resilience requires implementing water management strategies that include moving away from fossil fuels and factory farms.**

## What Is Water Resilience?

The U.S. Environmental Protection Agency looks at water resilience through the lens of the ability of utility systems to minimize the impacts of disasters, withstand risks, and quickly restore access to safe drinking water and properly treated wastewater.[4] The State of California embraces a broader definition that also refers to a community's ability to endure climate change-driven drought and flood, and to secure water supplies for both human and natural systems.[5] Some scholars take this even further to define water resilience as returning the environment to its original strength through a combination of natural environmental restoration and human action.[6] These human actions to bolster water resilience must include moving away from the fossil fuels and factory farming practices that contribute to climate change and reduced water availability.

Water resilience is threatened by climate change. Climate change is causing an increase in both the frequency and duration of flooding and drought events across the globe.[7] This combination is no coincidence. As global temperatures rise, the warmer atmosphere holds more water vapor, leading to fewer but wetter storms.[8] When storms follow periods of drought, they are more likely to cause flash flooding, since parched soil is unable to absorb rain. More frequent droughts followed by extreme rain events create a vicious cycle of drought and flooding already emerging in many parts of the U.S.[9] For example, the Midwest and Southwest are expected to experience increasingly "flashier" floods in the coming years.[10]

The overall flood risk in the U.S. is estimated to increase by more than 26 percent over the next three decades as a direct effect of climate change. In addition to changes in precipitation patterns, due to rises in sea levels, the probability of a 100-year flood event will increase sevenfold by the end of the century.[11] By 2050 to 2079, the U.S. population exposed to large flooding events could more than double.[12]

## Water Resilience, Public Health, and Environmental Justice

Weather disturbances, be it from flooding or drought, cause disruptions to water systems that can lead to a pause in operations, loss of water supply or restricted water use, and degraded water quality.[13] These water outages can lead to harmful public health outcomes.[14]

Floodwaters often contain disease-causing bacteria, parasites, viruses, and other unhealthy pollutants.[15] Exposure to contaminated floodwaters, such as when sewage backups enter buildings, can lead to infected wounds, skin rashes, gastrointestinal illness, tetanus, and respiratory illness from mold growth.[16] Warmer water (which climate change causes) is more hospitable to these pathogens.[17] Further, recent research shows that the ubiquity of toxic chemicals in day-to-day life is increasing the toxicity of U.S. floodwaters, which is sometimes given the name “toxic stew.”[18] Floodwaters also pose significant threat when downed powerlines are nearby, which is not uncommon.[19]

In addition to affecting public health, floods are also harmful to people’s homes and livelihoods. Currently, 14.6 million homes have a substantial level of flood risk, with that number expected to rise in the coming years.[20] In 2022 alone, more than 3.4 million Americans were forced from their homes due to severe weather — 70 percent of whom were fleeing hurricanes, floods, or fires.[21]

Poor and marginalized communities across the globe often bear the brunt of the effects of climate change, and low-income Americans are more likely live in floodplains and therefore evacuate their homes in the face of extreme weather events.[22] In the U.S., flood risks are concentrated in poor white communities, with evidence that climate change will increase the risks for Black communities.[23] For example, low-income, non-white neighborhoods in Texas and New York experienced markedly worse flooding from Hurricanes Harvey and Sandy, respectively.[24]

One economic consequence of increasing flood risk in the U.S. is the overvaluation of residential real estate, estimated to be up to $237 billion as of February 2023.[25] This is beginning to cause problems as insurance companies stop offering insurance or significantly increase premiums in areas at high risk of experiencing the effects of climate change.[26] It is estimated that low-income homeowners are at greater risk of losing home equity due to increased flood risk.[27]

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Further, there is strong evidence of racial, ethnic, and economic disparities in adverse mental health effects following flooding events, such as depression, anxiety, and post-traumatic stress disorder (PTSD).[28] These trends are in line with other evidence that climate change events disproportionately impact people of color, who suffer higher levels of health impacts such as mortality, respiratory and cardiovascular disease, mental health effects, and heat-related illness.[29] Globally, these inequalities will extend to developing countries and cities in the Global South, which are expected to bear the brunt of climate change through heat waves, flooding, and increased levels of pollution exacerbated by extreme weather events.[30]

## Water Resilience Is Threatened by Fossil Fuels and Factory Farms

The fossil fuel industry is accelerating our warming climate and more-extreme weather events.[31] Factory farms are another significant contributor, as factory farm animal production accounted for 13% of total U.S. methane emissions in recent years.[32] Both the fossil fuel and factory farm industries are also major water polluters and users.[33] Finally, both are vulnerable to flooding and drought, which can cause significant public harm through food and energy shortages and excessive environmental damage.[34] This double-edged sword highlights the need to move away from a dependence on fossil fuels and the current factory farming system.

Burning fossil fuels for electrical energy is a water-intensive process, especially compared to energy produced from renewable resources such as wind and solar.[35] Therefore, drought can directly affect our ability to produce electricity from fossil fuels. Already, a significant portion of power generation facilities face difficulty in securing freshwater resources needed for their cooling process.[36]

Flooding poses risks to energy security as well since power outages from flood events disrupt businesses and day-to-day life. For example, flooding from Superstorm Sandy affected 23,000 New York City businesses, causing loss of power and leading to direct losses of $8.6 billion.[37] Fossil fuels are especially susceptible compared to renewable energy sources, since flooding can disrupt the transport of oil, coal, and liquefied natural gas (LNG) by train and barge.[38] The U.S. Department of Energy cites increasing flood intensity and frequency as risks to electrical power generated by coal, natural gas, and biofuels, but not by solar and wind.[39]

Flooding can also increase the environmental harms from factory farms. Floods can drown animals and pollute nearby water sources with manure from overflowing lagoons.[40] For example, flooding from Hurricane Florence in 2018 killed more than 5,000 animals in North Carolina and breached dozens of manure lagoons, with one spilling over 2.2 million gallons of hog waste alone.[41]

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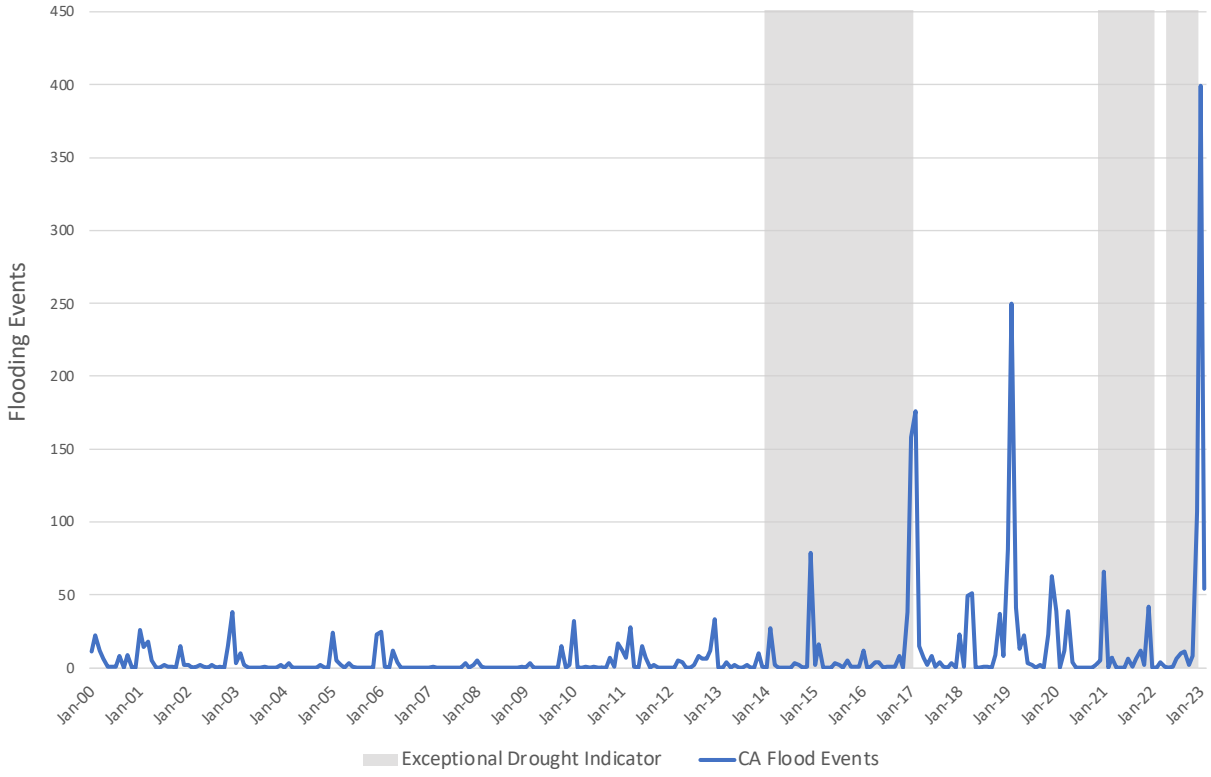
Waste spilled from these lagoons can pollute nearby waterways and groundwater with pathogens such as *E. coli*, salmonella, and hepatitis A. as well as agricultural pesticides and pharmaceuticals.[42] Following Hurricane Florence, 30 percent of surface water samples in North Carolina were found to be unsafe for swimming due to contamination with human and pig waste.[43] Agricultural chemicals in floodwaters can also cause algal blooms that harm aquatic ecosystems and human health.[44]

## California Case Study

Few areas in the U.S. have experienced the whiplash effects of increasing drought and flooding more than California. Following the driest 22-year period in 1,200 years, Californians are now experiencing catastrophic floods from snow melt.[45] And looking ahead, there is no relief in sight as climate scientists are forecasting mega-storms and floods in California in the coming decades due to climate change.[46] Figure 1 shows the increase in flooding events since 2000, often following periods of exceptional drought.

**Figure 1. Flood Events and Periods With Exceptional Drought in California, 2000-2023**




*Source: Food & Water Watch analysis of National Oceanic and Atmospheric Administration*

As seen in Figure 1, both periods of exceptional drought and flooding events have become more common in the past few years.[47] These trends amplify each other as soils that are dried out from periods of drought are less absorbent and more prone to flooding. In California's Central Valley, peak flood flows are expected to increase by up to five times over the next five decades, thanks to climate change.[48]

In April 2023, heavy rains flooded thousands of acres of Central Valley farmlands, and the slowly melting snowpack — which was up to 400 percent of its historic average size — threatened to increase the flood's size three times over.[49] The flood resurrected the long-dry Lake Tulare, which had been converted to cropland and residential land, and future flooding will likely bring billions in losses to farmers and surrounding communities.[50] As of May 2023, in addition to residents evacuating their homes, dairy farmers in California's Central Valley had to relocate more than 100,000 head of cattle due to flooding.[51] And due to the intensity of the flooding, industry executives admitted an inability to focus on containing manure from contaminating nearby waters, instead focusing on saving the animals.[52]

Furthermore, a nearby industrial compost facility that holds thousands of tons of sewage sludge from Los Angeles County is at risk of contaminating the floodwaters and nearby groundwater, streams, and rivers with toxic metals and other contaminants.[53] Like flooding elsewhere, many of the residents most impacted by the floods are Latinx and low-income Californians — many of whom lost access to running water during the severe drought just the year before.[54] Research shows that a "mega-storm," accelerated by climate change, could be coming in the near future.[55] These trends and predictions highlight the need to address the climate crisis and its threat to water resilience.

## Conclusion and Recommendations

Given the serious threats that climate change poses to water resilience, we must act now to ensure safe water supplies and a habitable environment in the decades to come. Two significant actions we can take to address this are ending reliance on fossil fuels and moving our food system away from the current factory farm model. Federal and state governments can help avert the worst effects of climate change and stop egregious water abuses by banning new factory farms and fossil fuel extraction.

Moreover, we must support the resilience of water utilities across the country by investing in public drinking water and wastewater systems through legislation such as the Water Affordability, Transparency, Equity, and Reliability (WATER) Act.[56] These efforts must prioritize environmental justice communities, as people of color and low-income communities face the biggest threats to water resilience and other harms caused by climate change.[57]

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