Droughts, Floods, and Wildfires: Paleo Perspectives on Disaster Law in the Anthropocene

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Abstract

Humanity's impact on the earth has become so pronounced that momentum is building toward adopting a new term for the modern geological age—the "Anthropocene." The term signifies that human activity has reached a scale that it is now a planetary force capable of shaping ecosystems and natural processes. And yet, anthropocentric natural resources management and environmental lawmaking in the United States reveal a lack of control in managing natural systems and fostering resilience to extreme events. These systems do not easily conform to the whims of reactionary environmental policies. Droughts, floods, and wildfires, in particular, are often conceptualized as unforeseeable disasters when in fact their occurrence is a typical feature of the American landscape. The manner in which environmental laws have evolved to respond to these natural systems reveals a strong belief that nature can be adapted to modern human activities, instead of adapting human activities to nature. Legal frameworks are consequently reactive in disposition when control proves impossible, relying on subsidized insurance programs and disaster relief funds that do little to build resilience. This article examines contemporary legal doctrines and policies governing management of droughts, floods, and wildfires from a paleoenvironmental and paleoanthropological perspective. Modern approaches and reforms can be assessed through a conceptual model provided by hundreds of thousands of years of hunter-gatherer resilience strategies. The resilience model suggests that drought, flood, and wildfire laws can more adequately enhance societal resilience by prioritizing mobility, diversification, and awareness of changes in the surrounding environment.

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INTRODUCTION

Within the first seven months of 2014, the U.S. Federal Emergency Management Agency ("FEMA") had issued thirteen separate major disaster declarations due to flooding, including states in the American West, Mississippi River Delta, and Eastern Seaboard regions.[1] The U.S. Forest Service was so preoccupied with fighting wildfires that firefighting funds were exhausted, forcing officials to tap into wildfire prevention funds instead.[2] Meanwhile, by February 2015, 822 counties in the United States had been declared "drought disaster counties" by the U.S. Department of Agriculture,[3] including all counties in California, Nevada, New Mexico, Arizona, and Utah, and most counties in Texas, Oklahoma, Kansas, Colorado, Idaho, Washington, and Oregon.[4]

Various state governors issued their own disaster or state of emergency declarations due to flooding, drought, or wildfire, allowing them to invoke special powers or tap into extraordinary funds. California governor Jerry Brown declared a drought state of emergency in January 2014, asking residents to cut their water

1. *Disaster Declarations for 2014*, FED. EMERGENCY MGMT. AGENCY, http://www.fema.gov/disasters/grid/year/2014 (last visited Apr. 28, 2015).

2. Kevin Freking, *Money Allocated for Fighting Fires to Run Out*, ASSOCIATED PRESS (Aug. 5, 2014, 4:13 PM), http://bigstory.ap.org/article/money-allocated-suppressing-fires-run-out.

3. U.S. DEP'T OF AGRIC., SECRETARIAL DISASTER DESIGNATIONS—2014 CROP YEAR ALL (last updated Feb. 25, 2015), http://www.usda.gov/documents/2014-all-crop-list-counties.pdf.

4. U.S. DEP'T OF AGRIC., 2014 SECRETARIAL DROUGHT DESIGNATIONS—ALL DROUGHT (July 16, 2014), http://www.usda.gov/documents/usda-drought-fast-track-designations-071614.pdf.

consumption by twenty percent.[5] Governors in Oregon and Washington declared wildfire states of emergency in July following widespread burning across the region.[6] In Florida, over $66 million of disaster relief was disbursed within sixty days of a May 6 flooding disaster declaration requested by Governor Rick Scott.[7] New York Governor Andrew Cuomo secured $28 million to repair flood-damaged infrastructure after declaring a State Disaster Emergency in May.[8]

Public discourse has mirrored the political declarations with headlines that conceptualize the droughts, floods, and wildfires of 2014 as unprecedented natural disasters.[9] Despite the rhetoric, however, FEMA issues hundreds of disaster declarations every year.[10] In 2011, for instance, 242 such declarations were made, 114 of which were wildfire-related.[11] The reality is that droughts, floods, and wildfires are cyclical ecological processes. In fact, many ecosystems depend on the cycle of droughts, floods, and wildfires to maintain balance between species.[12] If these events are disasters, they are decidedly human ones.

Unpredictable natural disasters are a convenient scapegoat for the damage caused to people and the U.S. economy, but a more rigorous examination reveals a policy infrastructure that fails to appreciate the inevitability of large-scale natural events. Instead, laws designed to address droughts, floods, and wildfires

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5. Ian Lovett, *California Approves Forceful Steps Amid Drought,* N.Y. TIMES (July 15, 2014), http://www.nytimes.com/2014/07/16/us/forceful-steps-amid-a-severe-drought.html.

6. Joanna M. Foster, *Oregon, Washington Declare States of Emergency as Wildfires Spread,* CLIMATE PROGRESS (July 17, 2014, 9:57 AM), http://thinkprogress.org/climate/2014/07/17/3461159/state-of-emergency-wildfires-grow/.

7. *Disaster Assistance for Florida Reaches More than $65 Million in 60 Days*, FED. EMERGENCY MGMT. AGENCY (July 3, 2014), https://www.fema.gov/news-release/2014/07/03/disaster-assistance-florida-reaches-more-65-million-60-days.

8. *Governor Cuomo Announces Federal Approval of Major Disaster Declaration Request Following Recent Storms and Flooding in Central and Western New York*, OFFICE OF THE GOVERNOR OF NEW YORK (July 8, 2014), http://www.governor.ny.gov/news/governor-cuomo-announces-federal-approval-major-disaster-declaration-request-following-recent.

9. *See, e.g.*, Sam Stanton, *California Braces as Drought Sparks Early Fire Season,* EMERGENCY MGMT. (July 14, 2014), http://www.emergencymgmt.com/disaster/California-Drought-Sparks-Early-Fire-Season.html; Jennifer Welsh, *California's Drought Is 'The Greatest Water Loss Ever Seen,' and the Effects Will Be Severe,* BUS. INSIDER (July 15, 2014, 1:50 PM), http://www.businessinsider.com/californias-drought-cost-state-22-billion-2014-7; Maria L. LaGanga & Michael Muskal, *Washington Wildfire, Biggest in State History, Claims First Fatality*, L.A. TIMES (July 21, 2014, 12:52 PM), http://www.latimes.com/nation/nationnow/la-na-nn-washington-wildfires-death-20140721-story.html; *Floods Sweep Across Midwest States as Rains Swamp Missouri and Illinois*, GUARDIAN (July 1, 2014, 2:42 PM), http://www.theguardian.com/world/2014/jul/01/floods-rain-storms-midwest-illinois-missouri-chicago.

10. *Disaster Declarations by Year*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/disasters/grid/year (last visited Apr. 28, 2015).

11. *Id.*

12. *See, e.g.*, BETH MIDDLETON, FLOOD PULSING IN WETLANDS: RESTORING THE NATURAL HYDROLOGICAL BALANCE 1 (Beth A. Middleton, ed. 2002) (surveying floodplain ecosystem restoration); HENRY A. WRIGHT & ARTHUR W. BAILEY, FIRE ECOLOGY: UNITED STATES AND SOUTHERN CANADA 1 (1982) (describing the role of fire in balanced forest ecosystems); Nate McDowell et al., *Mechanisms of Plant Survival and Mortality During Drought: Why Do Some Plants Survive While Others Succumb to Drought?*, 178 NEW PHYTOLOGIST 719, 720 (2008) (exploring drought-induced tree mortality and survival).

conceptualize them as unpredictable or unlikely natural disasters, prioritizing insurance schemes and emergency assistance funds instead of integrated disaster planning mechanisms that prepare communities for the inevitable. What proactive planning measures do exist typically exhibit ambitious, anthropocentric characteristics. Interstate water transfers and irrigation channels, dikes, dams, and levees, and large-scale fire suppression networks are temporary fixes, but fail to address the larger, structural dynamics that make human populations and the economy vulnerable to droughts, floods, and wildfires in the first place. When those command-and-control approaches deteriorate or fail, reactive measures like subsidized insurance programs and disaster relief funds are provided to soften the blow, but likewise do little to mitigate risk and build resilience.

Fortunately there are alternative approaches that can foster resilience. Because droughts, floods, and wildfires have been occurring for millennia, the coping mechanisms of our human ancestors provide a wealth of unexplored success strategies that can be adapted to a contemporary context. This article takes the broadest view possible, starting with primate ancestry and continuing through millions of years of human evolution and hunter-gatherer societies. Because homo sapiens survived for hundreds of thousands of years as nomadic hunter-gatherers, identifying the strategies that fostered resilience to droughts, floods, and wildfires provides a model for conceptualizing and correcting vulnerabilities in our modern legal landscape. The resilience model suggests that legal frameworks addressing droughts, floods, and wildfires can more effectively build resilience by prioritizing mobility, diversification, and awareness of the surrounding environment. The model may be applied to other extreme natural events (e.g., tornados, volcanic eruptions, and earthquakes), but droughts, floods, and wildfires are a natural empirical starting point because of their cyclical regularity across time. While some societies may or may not be exposed to volcanic activity, for example, nearly all human communities have at one point or another been faced with water shortages, inundations, or forest fires. Similarly, droughts, floods, and wildfires expose vulnerabilities that silently develop over a period of years or decades, making resilience particularly challenging.

This article examines U.S. drought, flood, and wildfire laws from a paleoenvironmental and paleoanthropological perspective. In Section I, a review of scientific literature reveals that while climate change may be exacerbating the frequency and severity of twenty-first century droughts, floods, and wildfires, their occurrence has been a fixture of the natural environment for millennia. Section II builds on a finding of extreme events' regularity to explore human approaches across time. A review of hunter-gatherer coping mechanisms reveals a resilience model that prioritizes mobility, diversification, and awareness of the surrounding environment. Conversely, agricultural societies exhibit vulnerability to droughts, floods, and wildfires because they were static, heavily reliant on one resilience approach, and could not integrate changes in the environment into societal decision-making. In Section III, drought, flood, and wildfire laws and policies are examined in detail. The resilience pillars of these legal regimes conform to three general approaches: First, reliance on anthropocentric infrastructure or management paradigms that attempt to control nature; second, subsidized or government-backed insurance programs that spread risk across society; and third, generous disaster relief funds that partially rehabilitate communities when disaster strikes. Unfortunately, these approaches do little to mitigate risk and promote resilience. Alternative frameworks are proposed in Section IV by viewing contemporary vulnerabilities through the lens of the paleoanthropological resilience model. By promoting mobility, diversifying policies, and integrating environmental change into decision-making, modern drought, flood, and wildfire laws can significantly enhance societal resilience. Until these laws align themselves with the realities of underlying environmental dynamics, however, people and property will continue to suffer.

I. DROUGHTS, FLOODS, AND WILDFIRES: FROM PLEISTOCENE TO ANTHROPOCENE

The first indication that the U.S. disaster policy infrastructure is out of touch with environmental processes is the fact that droughts, floods, and wildfires are perceived as disasters in the first place.[13] Their impact may be disastrous,[14] but these natural events have long been a fixture of the American landscape. Heavy rains that cause floods, drops in precipitation associated with drought, and wildland forest fires have been occurring on a cyclical basis for hundreds of thousands of years.[15] By surviving to the present day, plant and animal species have successfully adapted to droughts, floods, and wildfires, and in many cases depend on them to maintain a balanced ecosystem.[16] While human societies have been confronted with these natural events for hundreds of thousands of years, contemporary American lifestyles—characterized by immobile urban and agricultural development and a proclivity for living close to water bodies—is not particularly well-suited to withstand extreme environmental events.

13. *See, e.g.*, *Disaster Declarations for 2014*, *supra* note 1; Freking, *supra* note 2; U.S. DEP'T OF AGRIC., *supra* note 3.

14. Even disaster designations themselves, however, are subjective and sometimes political. *See* Jeff Guo, *How Droughts Are Like Recessions*, WASH. POST (July 21, 2014), http://www.washingtonpost.com/news/storyline/wp/2014/07/17/how-droughts-are-like-recessions/.

15. *See generally* Daniel G. Gavin et al., *Forest Fire and Climate Change in Western North America: Insights from Sediment Charcoal Records*, 5 FRONTIERS ECOLOGY & ENV'T 499, 500-01, 503-04 (2007); O. Pechony & D.T. Shindell, *Driving Forces of Global Wildfires Over the Past Millennium and the Forthcoming Century*, PROC. NAT'L ACAD. SCIS., 19167, 19167 (2010); Edward R. Cook et al., *Drought Reconstructions for the Continental United States*, 12 J. CLIMATE 1145, 1145 (1999); Anders J. Noren et al., *Millennial-Scale Storminess Variability in the Northeastern United States During the Holocene Epoch*, 419 NATURE 821 (2002); Yehouda Enzel & Stephen G. Wells, *Exacting Holocene Paleohydrology and Paleoclimatology Information from Modern Extreme Flood Events: An Example from Southern California*, 19 GEOMORPHOLOGY 203 (1997); Noam Greenbaum et al., *A 2000 Year Natural Record of Magnitudes and Frequencies for the Largest Upper Colorado River Floods Near Moab, Utah*, 50 WATER RES. RESEARCH 5249 (2014); Victor R. Baker, *Paleoflood Hydrology: Origin, Progress, Prospects*, 101 GEOMORPHOLOGY 1 (2008); Thomas C. Peterson et al., *Monitoring and Understanding Changes in Heat Waves, Cold Waves, Floods, and Droughts in the United States*, 94 BULL. AM. METEROLOGICAL SOC'Y 821, 830 (2013).

16. *Id.*; *see* MIDDLETON, *supra* note 12; WRIGHT & BAILEY, *supra* note 12; McDowell et al., *supra* note 12.

Accordingly, when infrastructure designed to control droughts, floods, and wildfires is overwhelmed, it is easy to deduce that the event was unpredictable or unlikely.[17] Recently, discourse surrounding natural disasters has focused on climate change, and the degree to which extreme events are being exacerbated by anthropogenic activity. While there is certainly ample evidence that a build-up of greenhouse gases in the atmosphere may be increasing the frequency or severity of droughts, floods, and wildfires to some degree, the highly politicized nature of the climate change debate overshadows a more critical matter. Droughts, floods, and wildfires are cyclical fixtures of the natural environment. They have occurred for millions of years and are likely to continue occurring for the foreseeable future. The notion that a drought, flood, or wildfire cannot be predicted—thereby justifying reactionary laws and policies—is not supported by available evidence.[18] In this section, a review of scientific literature reveals that droughts, floods, and wildfires occur regularly in the natural environment, and justify a more proactive and integrated approach to disaster planning.

A. DROUGHTS[19]

Many observers are understandably alarmed by the severity of current drought conditions in the United States. As of May 6, 2014, half of the United States was in a state of drought.[20] A year earlier, eighty-one percent of the country was also in a state of drought.[21] Looking further back, half of the country has been in drought for half of the weeks from 2000 to 2014.[22] Droughts throughout the 1990s caused billions of dollars in agricultural damages.[23] Drought-related

17. A common refrain is the fallacy of the "100-year" or "500-year" flood, an often misunderstood term of legal significance. *See Experts: Term '100-Year' Flood Misleads Public*, NBC NEWS, http://www.nbcnews.com/id/25463476#.U-FYWPldWmg (last updated June 30, 2008, 7:42 PM).

18. *Id. See generally supra* note 15; Philip Bump, *What's Exceptional About the Current Drought—And What Isn't*, WASH. POST BLOG (May 17, 2014), http://www.washingtonpost.com/blogs/the-fix/wp/2014/05/17/whats-exceptional-about-the-current-drought-and-what-isnt/; Justin Sheffield et al., *Little Change in Global Drought Over the Past 60 Years*, 491 NATURE 435, 437 (2012); P.C.D. Milly et al., *Stationarity Is Dead: Whither Water Management?*, SCI., 573, 573 (2008).

19. The various definitions and conceptualizations of "drought" are explored in detail in Section I. For purposes of this sub-section, drought is defined in meteorological terms, i.e., as a reduction in precipitation over time relative to a baseline. *See, e.g.*, Robert W. Adler, *Balancing Compassion and Risk in Climate Adaptation: U.S. Water Drought, and Agricultural Law*, 64 FLA. L. REV. 201, 209-13 (2012). *See generally* Donald A. Wilhite & Michael H. Glantz, *Understanding the Drought Phenomenon: The Role of Definitions,* 10 WATER INT'L 111-20 (1985).

20. *Drought Recorded Across Half of the U.S.*, NAT'L AERONAUTICS & SPACE ADMIN. (May 13, 2014), http://earthobservatory.nasa.gov/IOTD/view.php?id=83650.

21. Brad Plumer, *Five Maps of America's Massive Drought*, VOX, http://www.vox.com/2014/5/15/5720870/drought-california-us-maps (last updated May 15, 2014, 4:40 PM).

22. Bump, *supra* note 18.

23. *Billion Dollar Disasters: A Chronology of U.S. Events*, LIVESCIENCE (Jan. 31, 2004, 2:00 AM), http://www.livescience.com/114-billion-dollar-disasters-chronology-events.html.

damages in 1980 and 1988 may have been the costliest in history.[24] Various regions of the United States experienced severe droughts throughout the 1950s, 1960s, and 1970s, including the American West, Northeast, and Southwest.[25] The infamous Great Plains Dust Bowl of the 1930s was catastrophic for the U.S. economy and was exacerbated by poor agricultural practices.[26] A century of data shows that droughts can occur virtually anywhere, and often quite regularly.[27]

The last one hundred years, however, have not been uniquely dry;[28] droughts in the twentieth century may actually have been less severe and shorter in duration than in previous centuries.[29] A survey of research examining historical documents, tree rings, archaeological remains, lake sediment, and geomorphic data presents evidence that major multiyear droughts have occurred naturally once or twice a year in the United States since the seventeenth century,[30] including several that surpassed twentieth century droughts in duration and intensity.[31] In the second half of the sixteenth century and the last quarter of the thirteenth century, much of the United States experienced multidecadal "megadroughts" that likely exceeded twentieth century droughts in severity, duration, and spatial scale.[32] These megadroughts are exceeded only by four even more severe droughts in the period 1 A.D. to 1200 A.D.[33] The data suggests that the contemporary experience with drought in the United States is not representative of the full range of potential drought conditions in North America. While contemporary droughts wreak havoc on the U.S. economy,[34] they are relatively moderate in severity and duration by first millennium standards; a megadrought from the first millennium would likely precipitate a level of devastation the U.S. legal and societal infrastructure is not equipped to withstand.

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24. *See* MICHAEL J. HAYES ET AL., ESTIMATING THE ECONOMIC IMPACTS OF DROUGHT 1 (2004), *available at* https://ams.confex.com/ams/pdfpapers/73004.pdf.

25. *See* Cook et al., *supra* note 15, at 1145.

26. *See* Zeynep K. Hansen & Gary D. Libecap, *Small Farms, Externalities, and the Dust Bowl of the 1930s*, 112 J. POL. ECON. 665, 687 (2004).

27. *See generally* Cook et al., *supra* note 15.

28. The percent area of the contiguous United States experiencing moderate-to-extreme drought from January 1900 to October 2012 shows that widespread persistent drought occurred in the 1930s (central and northern Great Plains, Northwest, and Midwest), 1950s (southern Great Plains and Southwest), 1980s (West and Southeast), and the first decade of the twenty-first century (West and Southeast). Peterson et al., *supra* note 15, at 827 fig. 4.

29. Connie A. Woodhouse & Jonathan T. Overpeck, *2000 Years of Drought Variability in the Central United States*, 79 BULL. AM. METEOROLOGICAL SOC'Y 2693, 2706 (1998).

30. *Id.* at 2698.

31. *Id.* at 2697.

32. *Id.* at 2698-2704.

33. *Id.* at 2704.

34. *See, e.g.*, Ya Ding et al., *Measuring Economic Impacts of Drought: A Review and Discussion*, 20 DISASTER PREVENTION & MGMT.: INT'L J. 434 (2011).

With climate change discourse becoming increasingly politicized and vitriolic,[35] it is important to remember that severe droughts are not solely a function of human-caused warming and a more unpredictable climate; droughts have occurred for thousands of years[36] and will likely continue to do so. It is imperative to approach drought management as a serious and continuous endeavor in that regard, regardless of climate change discourse. It is also relevant to note that droughts are notoriously difficult to define and measure.[37] Many climate-related variables affect drought, such as precipitation, temperature, stream discharge, and soil moisture.[38] However, evidence is accumulating that droughts in the United States are likely to become longer and more severe as temperatures rise.[39]

By downscaling global temperature and precipitation models and integrating regional data, models can estimate future drought scenarios.[40] In the western United States, for example, a midrange greenhouse gas emissions scenario[41] would create twenty-first century droughts that are significantly longer, larger, and more severe than twentieth-century droughts.[42] In addition, future droughts are likely to be increasingly temperature-driven—as opposed to precipitation-driven—than historical droughts were, making recovery from droughts more difficult as warmer climates cause increased evaporation.[43] Extrapolating drought projections from climate models cannot provide exact predictions for complex phenomena,[44] and it is not clear that causal assumptions about temperature increases leading to drought are accurate; it is plausible that drought drives temperature increases due to a decrease in evaporative cooling instead.[45]

In any case, debating the degree to which climate change will increase the duration, extent, and severity of future droughts in the United States misses the point. What is most important is to recognize that drought is neither a recent phenomenon nor a temporary experience. Extreme drought conditions have occurred in the United States for millennia, and will continue to occur for the foreseeable future. This reality has had, and will continue to have, severe implications for water resources and agricultural policy.

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35. *See generally* Maxwell T. Boykoff & Jules M. Boykoff, *Climate Change and Journalistic Norms: A Case-Study of U.S. Mass-Media Coverage*, 38 GEOFORUM 1190 (2007) (examining the disconnect between climate change science and its portrayal in the media).

36. *See* Peterson et al., *supra* note 15, at 827 fig. 4.

37. *See supra* text accompanying note 19.

38. Peterson et al., *supra* note 15, at 827.

39. *See* David S. Gutzler & Tessia O. Robbins, *Climate Variability and Projected Change in the Western United States: Regional Downscaling and Drought Statistics*, 37 CLIMATE DYNAMICS 835, 835 (2011).

40. *See id.*

41. *See id.* at 837.

42. *See id.* at 847.

43. *Id.*

44. Gutzler & Robbins, for example, describe their methods as "an extremely simple approach." *Id.*

45. Sheffield et al., *supra* note 18, at 437.

B. FLOODS

Like droughts, floods have been a fixture of the North American landscape for centuries. Unlike droughts, which can be defined in purely meteorological terms, flooding can result from land use and water management practices in addition to meteorological changes in precipitation and temperature.[46] Extensive development of agricultural lands, urbanization, and hydrological installations like dams and levees in the twentieth century have dramatically altered floodplains and surrounding ecosystems, making it challenging to assess historical flood trends.[47] Furthermore, one of the most basic principles of flood frequency analysis—that hydrologic regimes remain "stationary" and conform to independent and identically distributed random processes—has been called into question in recent years,[48] and with it, the value of historical flood records.[49] Consequently, trends regarding the magnitude or frequency of floods are more difficult to ascertain than droughts or wildfires.

Nonetheless, streamgauge measurements and paleoflood records can be used to observe changes in precipitation and flood patterns independent of human activity. For the past century or so, as the principle of stationarity would predict, flood magnitudes have been relatively stable.[50] Total annual precipitation in the United States has increased by five percent on average over the past fifty years,[51] but increased precipitation did not lead to increased flooding in all areas.[52] However, regional analyses indicate that the severity of flooding depends on local conditions. The Southwest, for example, may have experienced a decrease in flood magnitudes due to lower precipitation levels over the past 120 years, while precipitation and flooding in the northern Midwest has been increasing.[53]

Paleohydrology is a nascent discipline,[54] but provides compelling evidence that extreme and frequent flooding has been common in North America for thousands of years. Large floods have been an increasingly frequent characteris-

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46. Peterson et al., *supra* note 15, at 825.

47. *See id.*

48. *See* Jery R. Stedinger & Veronica W. Griffis, *Getting From Here to Where?*, *Flood Frequency Analysis and Climate,* 47 J. AM. WATER RES. ASS'N 506, 510 (2011) (affirming the value of historical records but noting that factors like climate change, urbanization, and development may result in nonstationarity).

49. *See, e.g.*, P.C.D. Milly et al., *supra* note 18, at 573 (rejecting the stationarity assumption). *But see* Gabriele Villarini et al., *On the Stationarity of Annual Flood Peaks in the Continental United States During the 20th Century,* 45 WATER RES. RESEARCH, no. 8, 2009, at 1 (rejecting the assumption may be overblown or premature).

50. Villarini et al., *supra* note 49, at 12.

51. Peterson et al., *supra* note 15, at 826.

52. New England, for example, has experienced a significant increase in days with heavy precipitation, but that trend does not correlate with increased flooding, possibly because local flooding events depend on sustained rainfall over time, or because precipitation increases are taking place during seasons when flooding is rare. *See id.* at 825-26.

53. Peterson et al., *supra* note 15, at 826 fig. 3.

54. *See generally* Baker, *supra* note 15, at 1.

tic of the Colorado River Basin over the past two thousand years.[55] Similarly, New England lake deposits suggest that extreme flooding events have been occurring regularly for thousands of years,[56] while increases in flood magnitude over the past six hundred years may be taking place independently of anthropogenic activity.[57] Flooding in the Mojave River Basin that likely eclipsed the magnitude and frequency of modern floods shaped Southern California's geography.[58] There is little evidence that extreme floods are only the result of developments in the twentieth or twenty-first centuries; rather, flooding has occurred for centuries with and without the presence of human activities, and it is highly likely to continue.

Placing extreme flooding in historical perspective is important because extreme events experienced today may play a large role in shaping disaster planning. It is equally important, however, to assess future flooding scenarios and trends in flood patterns given global environmental changes such as rising temperatures. Because of the complexity of hydrological dynamics as well as the high degree of human interference in surface water systems, there is a paucity of information regarding flood trends generally; data relating to the impact of climate change is even scarcer.[59] The 5th Assessment Report of the Intergovernmental Panel on Climate Change ("IPCC") in 2013 characterized the state of understanding regarding flood trends as having "low agreement" and therefore "low confidence" regarding changes in the magnitude or frequency of flood events on a global scale.[60] The best substitute may be precipitation data, keeping in mind that extreme precipitation events do not always lead to floods.[61]

That said, fundamental principles of climatology correlate rising atmospheric temperatures with increases in precipitation: warmer air can hold more moisture, increasing the amount of potential rainfall. There has been a marked increase in extreme precipitation events in the United States over the past fifty years.[62] The central United States is the only region in the world that the IPCC Report deems "very likely" to have experienced increases in the frequency or intensity of heavy precipitation.[63] That conclusion is verified by increases in one-day extreme

55. *See* Greenbaum et al., *supra* note 15, at 5249.

56. Noren et al., *supra* note 15, at 823.

57. *Id.*

58. Enzel & Wells, *supra* note 15, at 217.

59. *See generally* Dennis L. Hartmann et al., *Observations: Atmosphere and Surface*, *in* CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS (T.F. Stoker et al. eds., 2013), *available at* http://www.climatechange2013.org/images/report/WG1AR5_Chapter02_FINAL.pdf; Stedinger & Griffis, *supra* note 48.

60. *See* Hartmann et al., *supra* note 59, at 213-14.

61. *See supra*, text accompanying note 52.

62. *U.S. Climate Extremes Index*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., http://www.ncdc.noaa.gov/extremes/cei/graph/us/4/01-12 (last visited Apr. 28, 2015); *accord Climate Change Indicators in the United States*, ENVTL. PROT. AGENCY, http://www.epa.gov/climatechange/science/indicators/weather-climate/heavy-precip.html (last updated May 2014).

63. Hartmann et al., *supra* note 59, at 213.

precipitation events recorded by the National Oceanic and Atmospheric Administration.[64]

Indications that extreme precipitation events are increasing in the United States, and that this trend may lead to increases in flooding, make a coherent legal framework capable of adapting to this reality more necessary than ever. The paleo record, which shows consistent flooding across temporal and spatial dimensions, confirms this necessity. Ultimately, however, whether floods are becoming marginally more severe or more frequent than they were fifty years ago is less notable than the fact that their occurrence is and always has been a characteristic of the North American landscape. Floods have shaped the United States year after year. That they continue to do so should not be surprising.

C. WILDFIRES

Compared to droughts and floods, the occurrence of wildfires is more heavily influenced by human activity. While water management and land use may influence vulnerability to droughts and floods, the absence or presence of water in both extremes is largely a product of meteorological processes. As the above discussion reveals, the occurrence of droughts and floods involves a complex interaction between air, surface, and soil dynamics as well, complicating our understanding of causal connections and historical trends. The scientific literature shows that droughts and floods have been common in the United States for centuries, but that fact alone does not point to a law or policy failure regarding disaster management. In other words, if drought and flood law and policy is problematic, it has not had a noticeable effect on the occurrence of droughts and floods, meteorologically defined.

Wildfires, on the other hand, exhibit a more formulaic cause-and-effect relationship. There are three ingredients necessary for a fire to occur: fuel, heat, and oxygen.[65] Atmospheric oxygen levels are difficult to manipulate, but fuel and heat conditions are highly susceptible to changes in the environment and forest management techniques. The various types of fuel (e.g., grass, brush, tree trunks, and rotten logs) have little variance in chemical composition; what is important is the moisture content and size of those fuels. The moisture content determines how much heat is necessary to ignite the fuel, while the size of the fuel dictates the ease with which that fuel reaches the ignition point.[66] Dryer, finer fuels such as grass, brush, and small trees are much easier to ignite than wetter, larger fuels. Small fuels also combust more quickly, sending fires farther afield and faster upwards than larger fuels, creating potentially devastating wind storms.[67]

64. *See U.S. Climate Extremes Index*, *supra* note 62.
65. H.T. Gisborne, *Fundamentals of Fire Behavior*, 64 FIRE MGMT. TODAY 15, 15 (2004).
66. *Id*. at 16.
67. *Id.* at 16-17.

These dynamics implicate the risk of wildfires. Changes in the climate affect moisture content, which in turn affects temperature, precipitation, and humidity. These changes increase or decrease the amount of heat necessary to ignite fuel. At the same time, human modifications to the size, quantity, or arrangement of fuels can make it significantly easier or harder for fuel to ignite, combust, and spread. In essence, climate change and forest management are two significant drivers of wildfire risk; in the United States, this risk appears to be increasing in recent decades. While the number of fires has been drastically reduced since the 1980s, the extent of wildfires has steadily increased.[68] In other words, there are now fewer fires than there were in the twentieth century, but the fires that do occur are much larger.[69]

These developments are likely the result of influences from climate change and human intervention. On the one hand, observed temperature increases in the United States simultaneously reduce moisture content in trees and soil while expanding temporal fire windows.[70] This also makes forests more vulnerable to insects and invasive species that kill and dry out indigenous species.[71] On the other hand, widespread fire suppression as a forest management policy preference has interfered with natural growth cycles that allow low-intensity fires to reduce the quantity and density of fuels in forested areas and keep invasive species at bay.[72] As a result, forests accumulate fuel loads capable of generating large, uncontrollable fires.

Historically, forests experience more frequent, low-intensity fires. In fact, the natural recurrence of fire in a given forested area—the "historic fire return interval"—provides many benefits to the ecosystem. Fires clear dead vegetation, provide nutrients to the soil, reduce vegetation density, and allow sunlight to reach the forest floor, allowing tree seedlings to grow.[73] At low intensities, these types of fires provide little threat to mature trees and wildlife, and, from a human perspective, reduce future wildlife suppression costs and damages.[74] Prior to large-scale human influence, fire regimes developed organically according to regional ecological attributes (e.g., vegetation, topography, climate, etc.).[75]

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68. *See Total Wildland Fires and Acres (1960-2009)*, NAT'L INTERAGENCY FIRE CTR., http://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html (last visited Apr. 28, 2015).

69. *See id.*

70. Phillip J. van Mantgem et al., *Climatic Stress Increases Forest Fire Severity Across the Western United States*, 16 ECOLOGY LETTERS 1151, 1151 (2013); *see also* David H. Freedman, *America Is Burning: The Fight Against Wildfires Gets Real,* MEN'S J. (Aug. 2014), http://www.mensjournal.com/magazine/america-is-burning-the-fight-against-wildfires-gets-real-20140723?page=2.

71. Freedman, *supra* note 70.

72. Scott L. Stephens et al., *The Effects of Forest Fuel-Reduction Treatments in the United States*, BIOSCIENCE 549, 549 (2012).

73. *See* Geoffrey H. Donovan & Thomas C. Brown, *Be Careful What You Wish For: The Legacy of Smokey Bear*, 5 FRONTIERS ECOLOGY & ENV'T 73, 77 (2007).

74. *See id.*

75. *See generally* Gavin et al., *supra* note 15 (exploring environmental attributes driving fire intervals).

Changes in these attributes led to decadal variation in fire frequency, but fire activity remained relatively stable prior to 1800.[76]

The shift from frequent low-intensity fires to infrequent high-intensity fires is a major turning point in the paleorecord of wildfires in the United States. However, it is highly likely that anthropogenic activity has contributed to the shift and that an increase in large fires was not an intended consequence of wildfire laws that promoted those activities. Consequently, there is potential to reexamine wildfire law in hopes of realigning current policies with symbiotic natural cycles. The historical record also makes clear that defeating wildfire is not a realistic objective. Unless forests are cleared in their entirety—a development that would have devastating consequences for humans and the environment[77]—they will either experience fires near their historic fire return interval or accumulate fuel loads that increase the risk of large, high-intensity wildfires. Wildfire records documenting the role of human intervention make clear that anthropogenic forces heavily influence fire dynamics. The overall success of these interventions in relation to human communities notwithstanding, the paleorecord tells a story of the legacy of wildfire law.

D. COMMONALITIES

The historic occurrence of droughts and floods, in contrast, does not paint a clear picture of the consequences of human intervention. Droughts and floods are complex components of the water cycle and its extremes; many forces shape their occurrence and severity. Consequently, the role of anthropogenic activities in drought or flood frequency is less easily measured, and the productivity of drought law and flood law must therefore be judged by the effects that these policies have had on humans and the environment. The paleorecord of droughts and floods should not be dismissed. On the contrary, the recurrence of droughts and floods over thousands of years has critical implications. First, droughts and floods should not be seen as irregular or unlikely events that are unworthy of serious legal or policy consideration. Droughts and floods are fixtures of the American landscape and are unlikely to dissipate anytime soon; it would be prudent to develop laws that are responsive to their frequency rather than reactive to their occurrence. Second, droughts and floods have occurred throughout the Holocene and its various climatic permutations. While anthropogenic climate change in the twenty-first century may influence the frequency or severity of future events, droughts and floods should not be dismissed as products of climate change. Because droughts and floods would occur regardless of dramatic changes in climate, framing adaptation efforts solely in the context of climate

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76. *See* Pechony & Shindell, *supra* note 15, at 19167.

77. *See* James Hamblin, *The Health Benefits of Trees,* ATLANTIC (July 29, 2014, 12:02 AM), http://theatlantic.com/health/archive/2014/07/trees-good/375129/.

change is misleading and likely unproductive. Climate change or no climate change, droughts and floods must be addressed.

II. THE TRANSITION FROM HOMINIDS TO AGRICULTURALISTS: EVOLVING APPROACHES TOWARD DROUGHTS, FLOODS, AND WILDFIRES

"For most of the history of our species we were helpless to understand how nature works. We took every storm, drought, illness and comet personally. We created myths and spirits in an attempt to explain the patterns of nature."[78] ~ Ann Druyan

There is a common narrative about the relationship between humans and natural disasters like droughts, floods, and wildfires. The narrative invariably starts with the assumption that human populations have been victims of these disasters since the dawn of our species' existence, living for thousands of years in high-risk conditions. Somewhere around the turn of the twentieth century, so the narrative continues, scientists and technocrats began discovering and implementing grand new technologies capable of defeating nature's hazards. Thousands of miles of irrigation canals were built to ensure water supplies in times of drought, dams and levees were installed to protect homes and farmland from floods, and extensive firefighting techniques were employed to suppress fires and eliminate collateral damage. Today, the next chapter of the narrative opens with a heated debate about climate change and its contribution to the failure of these systems to protect us from disaster: from helpless ancient societies, to the triumph of human ingenuity and ambition, to the return of a vindictive mother nature.[79]

The narrative is compelling, but misleading.[80] Climate change might be frustrating modern coping mechanisms, but it would be improvident to assume that those mechanisms were flawlessly designed in the first place. Section III below examines contemporary drought, flood, and wildfire law in the United

78. *Understanding Pattern Formation During Morphogenesis,* SCI. IN THE NEWS, HARVARD GRADUATE SCHOOL OF THE ARTS & SCIS. (July 3, 2012), http://sitn.hms.harvard.edu/flash/2012/morphogenesis/.

79. For a literary deconstruction of this narrative, see generally DANIEL QUINN, ISHMAEL: AN ADVENTURE OF THE MIND AND SPIRIT (2d ed. 1995); DANIEL QUINN, STORY OF B (1997); DANIEL QUINN, MY ISHMAEL (2d ed. 1998).

80. Professor Jedediah Purdy provides an alternative framework for analyzing American understandings of nature in *American Natures: The Shape of Conflict in Environmental Law*, 36 HARV. ENVTL L. REV. 169 (2012). Purdy argues that four values have emerged from the American experience that motivate environmental lawmaking. The first, providential republicanism, treats nature as existing for individual human use. *Id*. at 178. Second, progressive management values technocratic public governance of natural resources in order to maximize utility. *Id*. at 189. The era of romantic epiphany gave rise to the thought of nature as a source of, or locale for, spirituality and contemplation. *Id*. at 199-200. Finally, advances in environmental science created a sense of ecological interdependence. *See id*. at 207-08. This article does not dispute that framework, and in many ways our modern drought, flood, and wildfire laws exhibit all four values. There is also, however, a rich history of human relationships with nature whose experiences precede the pioneers of providential republicanism. Those experiences—and their values—are presented in this section in the context of drought, flood, and wildfire adaptation.

States and finds that, in many respects, those laws are not responsive to, or even cognizant of, key aspects of the natural processes they purport to manage. These shortcomings are in stark contrast to technological advances in fields like hydrology, engineering, and forestry that could, in theory, complement less anthropo-dominant legal frameworks. One force possibly frustrating reform is a perception that anthropocentrism is the only feasible approach to environmental management—that before humans had the ability to dominate environmental processes, they suffered. The following section will deconstruct that belief by showing that hunter-gatherer societies avoided suffering by remaining mobile, diversifying their response strategies, and maintaining awareness of the surrounding environment. There are, remarkably, many examples of human communities and civilizations adapting to droughts, floods, and wildfires in these unique, productive ways. While these approaches may not be capable of large-scale replication in every instance, the lessons of the past can inform the future.

A. HUNTER-GATHERER ADAPTATION STRATEGIES

Droughts and floods are so central to the human experience that we may owe our existence to them in the first place. For millions of years, droughts have forced animals to congregate around shrinking water sources, just as floods bring them together on shrinking areas of dry ground. Our primate ancestors, living in rainforests on the edge of these wetlands between four and seven million years ago, would have found tremendous quantities of new foods by coming down from trees to take advantage of droughts and floods.[81] Between 2.9 and 2.4 million years ago, however, climate changes evaporated wetlands, resulting in more seasonal precipitation; these changes favored a more bipedal hominid capable of efficiently moving between sources of water.[82] Humans evolved from this cycle of dry and wet seasons, becoming highly mobile in order to expand their territorial range and increase the variety of available food.[83] As a result, a large brain may have been needed to make an inventory of seasonal water sources, while tools had to be developed to capitalize on food types (such as bone marrow) that could not be accessed by the human body alone.[84] The ability to take advantage of droughts and floods during periods of climate variability resulted in human occupancy of much of the eastern hemisphere by one million years ago;[85] as the world became drier between four-hundred-and-fifty thousand and seventy thousand years ago, homo sapiens emerged, survived, and thrived as rain-chasers.[86]

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81. CLIVE FINLAYSON, THE IMPROBABLE PRIMATE: HOW WATER SHAPED HUMAN EVOLUTION 12, 21 (2014).
82. *Id.* at 36-37.
83. *See id.* at 47.
84. *Id.* at 58.
85. *Id.* at 68.
86. *Id.* at 94.

Many examples of this lifestyle reveal unique adaptation mechanisms to droughts and floods—mechanisms that were often ignored and eradicated by modern colonizers. In Australia, the Mardu people survived in largely desert environments by maintaining a small, highly mobile population capable of reacting to and exploiting changing conditions.[87] During rainy periods, for example, the population would splinter into even smaller groups to utilize temporary water sources.[88] This intimacy with the local environment had two additional advantages: hunting and gathering was a common skill and not overly burdensome; and decision-making was based on prevailing environmental conditions and, therefore, collective.[89] The Mardu demonstrate a hunter-gatherer attribute that not only recognizes changes in the surrounding environment, but also integrates those changes into community decision-making.

Similarly, the Chumash people of Southern California were able to withstand periods of extreme drought and flooding by diversifying their food sources, trading with their neighbors, and prioritizing population mobility.[90] Adjusting settlement locations during periods of heavy rains, droughts, or wildfires significantly increased productivity by capitalizing on favorable conditions while minimizing the damage caused by unfavorable conditions. Fostering diplomatic relations with neighbors, meanwhile, diversified the policy base by providing an external coping mechanism when extreme events marginalized self-reliance. When hunter-gatherers deviated from these common principles of diversification and mobility, they suffered. The Great Plains Indians' heavy reliance on bison, for example, made them vulnerable to climatic shifts and disease.[91] On the other hand, some Native Americans were adept at recognizing flood-prone areas and responding accordingly by elevating infrastructure to reduce flood risk.[92]

The relationship between wildfire and hunter-gatherers, while not as central to the development of humanity as droughts or floods, also fits into a model of mobility, diversification, and ecological awareness. On the one hand, hunter-gatherers developed resilience to unintentional wildfires by remaining mobile instead of rooted to one particular location. They migrated away from drier regions and toward wetter ones, where wildfires were less likely to occur. If wildfires did befall them, nomads suffered few losses because their mobility allowed them to quickly resettle in a fire-free location. On the other hand, hunter-gatherers also proactively harnessed the benefits of low-intensity fires in

87. *Id.* at 136-37.

88. *Id.* at 140-41.

89. *See id.* at 137-38.

90. Lynn H. Gamble, *Culture and Climate: Reconsidering the Effect of Palaeoclimatic Variability Among Southern Californian Hunter-Gatherer Societies*, 37 WORLD ARCHAEOLOGY 92, 98 (2005).

91. Elizabeth Colson, *In Good Years and in Bad: Food Strategies of Self-Reliant Societies*, 35 J. ANTHROPOLOGICAL RESEARCH 18, 22 (1979).

92. TRISTRAM R. KIDDER, *Making the City Inevitable: Native Americans and the Geography of New Orleans, in* TRANSFORMING NEW ORLEANS AND ITS ENVIRONS: CENTURIES OF CHANGE 9, 13 (Craig E. Colten ed., 2000).

order to prevent high-intensity fires, clear dense forested areas, or draw out game.[93] In floodplains, for example, burning was utilized frequently to collect small animals for food, while rapid growth of vegetation feeding on the now nutrient rich soil would attract a diversity of species.[94] In more arid regions like California and Oregon, prescribed burns limited fuel buildup and, consequently, high-intensity fires.[95]

B. THE RISE OF AGRICULTURE AND FIXED VULNERABILITIES

This mobile and adaptable hunter-gatherer approach to water variability and wildfire remained successful for millions of years and, in limited cases, is still practiced to this day.[96] There are countless examples of hunter-gatherer adaptation strategies to droughts, floods, and wildfire, though not all of them have been successful. The most common mechanisms that persisted are variations on the characteristics of early hominids that made human ancestors so successful in the first place: diversification, mobility, and a fine-tuned awareness of the surrounding environment and local conditions. However, around 10,000 years ago, the emergence of agriculture during the Neolithic Revolution transformed the human species and the world. The ability to produce food in vast quantities allowed humans to reproduce rapidly and allocate labor and resources to technological development, resource accumulation, and community expansion. On the eve of agriculture, humans numbered ten million;[97] today there are over seven billion.[98] While the transition was also fueled by droughts, floods, and wildfire, it was specifically made possible by the relatively stable climates and water systems of the Holocene.[99] Most of the regions in which agriculture originated in or rapidly

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93. *See* Larry Mason, *Listening and Learning from Traditional Knowledge and Western Science: A Dialogue on Contemporary Challenges of Forest Health and Wildfire*, 110 J. OF FORESTRY 187, 189 (2012) (documenting knowledge exchange between North American tribal communities and non-tribal scientists and forest managers with respect to fire management).

94. Henry T. Lewis, *Hunter-Gatherers and Problems for Fire History*, *in* PROCEEDINGS OF THE FIRE HISTORY WORKSHOP 115, 115 (U.S. Dep't of Agric., Forest Serv. ed., 1980), *available at* http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/9400/Pro_Of_The_Fir_His_Wor_Sho.pdf#page=121.

95. *Id.* at 118.

96. Unfortunately, however, many communities of hunter-gatherers were quickly and forcefully integrated into agriculture-based civilizations, destroying our window into a lifestyle that spans millions of years of human evolution. *See, e.g.*, FINLAYSON, *supra* note 81, at 132-45 (discussing the Mardu people of Australia).

97. Bruce Winterhalder & Douglas J. Kennett, *Behavioral Ecology and the Transition from Hunting and Gathering to Agriculture*, *in* BEHAVIORAL ECOLOGY AND THE TRANSITION TO AGRICULTURE 1 (Bruce Winterhalder & Douglas J. Kennett eds., 2006).

98. *U.S. World and Population Clock,* U.S. CENSUS BUREAU, http://www.census.gov/popclock/ (last visited Apr. 28, 2015). Population density can explain much of the population growth: there are typically 0.1 hunter-gatherers per square kilometer, while rice agriculturalists can sustain 1000 per kilometer. Winterhalder & Kennett, *supra* note 97, at 1. The effects of population density on the environment are numerous and well chronicled. *See, e.g.*, D. PIMENTAL ET AL., *Ecology of Increasing Diseases: Population Growth and Environmental Degradation*, 35 HUM. ECOLOGY 653, 653 (2007).

99. FINLAYSON, *supra* note 81, at 150-51.

spread to featured warm, arid river systems[100] or tropical highlands that offered predictable precipitation sufficient to support large-scale crop production and irrigation.[101] There are a myriad of theoretical frameworks attempting to further explain the transition to agriculture,[102] but the manner of transition is less important here than the experiences of agricultural societies in times of drought, flooding, and wildfire. Agricultural systems offer certain advantages, but resilience to extreme natural events has not always been one of them. In fact, selected adaptation failures from the past provide a glimpse of the vulnerabilities today.

By 1000 A.D., farming was practiced throughout the American Southwest, including in what is now Nevada, New Mexico, Utah, Colorado, and Mexico.[103] Within this region, agricultural societies settled in forested uplands where rainfall sustained annual crop production, particularly corn, the staple crop.[104] Eventually agricultural success led to population densities that likely met or exceeded regional capacity.[105] Density on this scale had several consequences. Most importantly, it precluded mobility, which led farmers to double-down on their investments by building dams and terraces,[106] making relocation less appealing and further limiting mobility. Density also put pressure on forested areas and forced farmers to reduce the risk of wildfire. Before modern firefighting techniques were developed the most reliable wildfire risk reduction strategy was forest clearing, which had the added benefit of producing timber resources and creating the potential for further agricultural expansion. Intense logging also led to soil erosion and would have eliminated the option of complementing crop production with foraging during low-yield periods.[107] These vulnerabilities were tested between 1250 and 1450, when rainfall in upland areas deviated from otherwise stable precipitation patterns observed throughout the second millennium A.D.[108] The inability to relocate upstream, downstream, or to a different upland elevation or river basin caused unprecedented regional collapse and abandonment.[109]

In earlier cases, failures to adapt to drought prompted collapse not only of agricultural regions, but also of the agricultural system itself. For example, about four thousand years ago in Anatolia, Egypt, Greece, Palestine, and Mesopotamia, farmers responded to climate change-induced drought by abandoning sedentary

100. For example, the Tigris, Euphrates, Jordan, Yangtze, Yellow, Indus, Nile, Mississippi, Ohio, and Niger Rivers. *See id.*

101. *Id.*; *see also* Winterhalder & Kennett, *supra* note 97, at 6.

102. *See, e.g.*, Winterhalder & Kennett, *supra* note 97, at 4-10.

103. Linda Cordell, *Aftermath of Chaos in the Pueblo Southwest, in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE 179, 181-82 (Garth Bawden & Richard Martin Reycraft eds., 2000).

104. *Id.* at 181.

105. *Id.* at 182-83.

106. *Id.*

107. *Id.* at 183.

108. *Id.* at 185-86.

109. Other factors such as warfare and disease likely contributed. *See id.* at 189.

agriculture altogether and transitioning to pastoral or nomadic lifestyles.[110] Modern economies of scale, however, both preclude nimble and dramatic transitions to nomadic lifestyles and induce public reliance on a state-administered, market-based agricultural system that places significant pressure on the state to deliver during times of drought. For example, fifteenth century droughts in India coincided with periods of unrest and revolt among agricultural tenants and lower classes suffering from famine and increased food prices.[111] This dynamic repeated itself during nineteenth century droughts in India, when grain prices skyrocketed in the face of speculation, and many landless laborers abandoned their homes, became reliant on charity, or died.[112] Unusually, fields that relied on complex reservoir irrigation schemes during this period were worse off than rain-fed fields because drought conditions were not considered when the irrigation systems were developed.[113]

In arid regions, floodplains are often the only water source available for irrigating cropland, and are often desirable locations for residential development due to their proximity to drinking water. Unfortunately, floodplain development makes societies highly susceptible to extreme floods. This was the case in Southern Peru around 1350 A.D., when an unexpected El Niño event devastated the Chirabaya people, washing away their homes and farmland.[114] The Chirabaya had moved into and developed the Ilo Valley, irrigating farmland with a river-fed canal and settling large villages at the base of the valley walls.[115] However, their flood-control measures were inadequate, and floods easily breached the irrigation canal.[116] Furthermore, political leaders were unable to muster post-disaster support from neighboring areas, forcing the collapse and eventual abandonment of the valley.[117] In South Arabia, Iron Age societies were faced not with a single flooding catastrophe but with repeated flooding events that wreaked havoc on city-states that predominantly relied on exploiting forest resources to produce incense.[118] Pastoralists that retained more tribal, mobile communities, on the other hand, were more resilient and still exist to this day.[119]

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110. Harvey Weiss, *Beyond the Younger Dryas: Collapse as Adaptation to Abrupt Climate Change in Ancient West Asia and the Eastern Mediterranean*, *in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE, *supra* note 103, at 75, 91.

111. Kathleen D. Morrison, *Naturalizing Disaster: From Drought to Famine in Southern India*, *in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE, *supra* note 103, at 21, 29-30.

112. *Id.* at 24-25.

113. *Id.* at 23.

114. Richard Martin Reycraft, *Long-Term Human Response to El Niño in South Coastal Peru, Circa A.D. 1400*, *in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE, *supra* note 103, at 99.

115. *Id.*

116. *Id.* at 104, 118.

117. *Id.* at 116.

118. Juris Zarins, *Environmental Disruption and Human Response: An Archaeological-Historical Example from South Arabia*, *in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE, *supra* note 103, at 35, 46.

119. *Id.*

In other cases, droughts, floods, and wildfires were not the primary culprits behind societal collapse, but unwise approaches to these natural events accelerated the downfall. The collapse of the Maya, for example, was likely a product of warfare and intense internal competition, but a heavy reliance on corn carried a high degree of risk that could not buttress against the political instability.[120] Sophisticated water management infrastructure and techniques that preserved flows in times of drought, while protecting communities from floods, were able to support the corn reliance and sustain the community in years of relative peace.[121] A risky water management strategy, however, could not withstand the pressures of political discord.[122] Similarly, while the Moche people of Peru experienced climatic fluctuations that imposed extreme droughts and floods on urban populations, political fragmentation was a complementary element of civilizational decline.[123] In Greece, poor forest management practices correlated with sharp agricultural and population declines. Instead of conserving forests or practicing limited prescribed burns to reduce wildfire risks, Bronze Age populations cleared entire forests, destabilizing topsoil, and increasing sedimentation in rivers.[124] Rivers became choked, and populations were forced to relocate or abandon the region altogether.[125]

C. HISTORIC MODELS OF RESILIENCE

The transition to agriculture took place between eight thousand and thirteen thousand years ago.[126] Prior to this, hunter-gatherers survived for hundreds of thousands of years. Not all hunter-gatherer societies were resilient to droughts, floods, and wildfires, and not all agricultural societies were highly vulnerable. However, it is likely that the decline of the hunter-gatherer was more a product of relative, rather than internal, weaknesses. In other words, hunter-gatherers were marginalized because agriculture-supported societies subsumed them, not because the hunter-gatherer lifestyle was no longer feasible.[127] That, combined with the sheer longevity of the hunter-gatherer approach, suggests that the ways in

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120. Claude Chapdelaine, *Struggling for Survival: The Urban Class of the Moche Site, North Coast of Peru*, *in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE, *supra* note 103, at 121, 125.

121. Vernon L. Scarborough, *Resilience, Resource Use, and Socioeconomic Organization: A Mesoamerican Pathway*, *in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE, *supra* note 103, at 195, 200-02.

122. *See* Weiss, *supra* note 110, at 91 (exploring similarly untenable strains on both political cooperation and water resources management in West Asia and the Mediterranean).

123. Chapdelaine, *supra* note 120, at 139.

124. Curtis Runnels, *Anthropogenic Soil Erosion in Prehistoric Greece: The Contribution of Regional Surveys to the Archaeology of Environmental Disruptions*, *in* ENVIRONMENTAL DISASTER AND THE ARCHAEOLOGY OF HUMAN RESPONSE, *supra* note 103, at 11, 18.

125. *Id.* at 14.

126. Winterhalder & Kennett, *supra* note 97, at 1.

127. *See id.* at 3.

which hunter-gatherers survived droughts, floods, and wildfires may provide relevant insights today. Similarly, the largely unsustainable nature of modern agriculture and human consumption make the agricultural failures of the past worth learning from. By contrasting paleo approaches to droughts, floods, and wildfires, we can construct a model for resiliency that can be up-scaled to the present.

Hunter-gatherers exhibit three fundamental characteristics that enable communities to withstand droughts, floods, and wildfires: mobility, diversified policy portfolios, and awareness of the surrounding environment. Mobility allows populations to react to environmental conditions by relocating away from unfavorable locations, or towards favorable locations, at low cost. Diversification of policy options, in turn, ensures that when changes in the environment apply pressure to one source of societal stability, other sources can be relied upon to maintain continuity. Awareness of the surrounding environment, finally, enables mobility and diversification by providing the information needed to recognize challenges and opportunities. In hunter-gatherer societies, awareness was often coupled with effective integration of information into decision-making processes.

Ancient agricultural societies, conversely, failed because they were immobile, overly reliant on a limited number of coping mechanisms, and insensitive to changes in the surrounding environment. Where population density precluded relocation of farmlands, societies were highly vulnerable to droughts, floods, and wildfires. Immobility had the added effect of promoting investments in sedentary infrastructure, increasing the cost of relocation. Reliance on one resilience strategy, such as a single crop, made agriculturalists even more vulnerable because it eliminated sources of, and the skills needed to exploit, alternative food sources. Finally, awareness of the surrounding environment was minimized because agriculture created a system wherein resources are obtained wholly outside of a wilderness context. Forest clearing and development in floodplains or desert regions may be necessary in limited circumstances, but excessive use demonstrates a lack of foresight. Unfortunately, all three characteristics can be seen in U.S. drought, flood, and wildfire laws and policies.

III. DROUGHT, FLOOD, AND WILDFIRE LAWS IN THE UNITED STATES: PRODUCTS OF THE NEOLITHIC REVOLUTION

Because droughts, floods, and wildfires impact agricultural, rural, and urban land use schemes in the United States, the laws that address these natural events are necessarily broader in scope than their names would suggest, encompassing a variety of substantive legal frameworks[128] and implicating federal, state, and administrative jurisdictions. Across this complex web of laws, however, the

128. For example, agriculture law, water law, energy law, real estate and land-use law, and public lands management.

characteristics of vulnerable and unsustainable agriculture-based societies described above—immobility, lack of diversification, and insensitivity to the surrounding environment—are manifested in disquieting ways. Each legal system is examined for these indicia of vulnerability.

A. DROUGHT LAW

Drought is, admittedly, an immensely complex challenge for a legal framework to address. First, a consensus definition of what constitutes a drought is elusive. In Section I, the historical record of drought was primarily conceptualized in meteorological terms; that is, drought is a sustained reduction in baseline precipitation conditions across time.[129] Many temporal studies and government agency programs rely on the Palmer Drought Severity Index, which calculates mostly meteorological data.[130] A common alternative definition perceives drought in terms of supply and demand; more specifically, a drought occurs when demand for water, whether human or environmental, exceeds supply.[131] These more operational definitions include *hydrological drought*, marked by a deficiency of ground and surface water resources measured against the needs of a water management system; *agricultural drought*, characterized by a lack of soil moisture and consequent crop failure; and *socioeconomic drought*, which occurs when demand for water outstrips the current supply.[132]

Second, even if a common definition can be agreed upon to guide policy, threshold determinations must account for regional variations because one region of the United States may expect—and consequently demand—more or less water availability than another.[133] As seen in Section II, a historical analysis may also provide definitional perspective. According to the historical record, twenty-first century droughts are not unusual and reflect a normalized distribution of water availability.[134] Reconciling these various definitional nuances produces complex and, at times, arbitrary drought determinations. The U.S. Drought Monitor, for example, provides drought maps relied upon by the U.S. Department of Agriculture, Internal Revenue Service, and various other agencies.[135] It self-identifies as

129. *See* Adler, *supra* note 19; Wilhite & Glantz, *supra* note 19, at 113.

130. *Comparison of Major Drought Indices: Palmer Drought Severity Index,* NAT'L DROUGHT MITIGATION CTR., http://drought.unl.edu/Planning/Monitoring/ComparisonofIndicesIntro/PDSI.aspx (last visited Apr. 28, 2015). *But see* William M. Alley, *The Palmer Drought Severity Index: Limitations and Assumptions,* 23 J. APPLIED METEOROLOGY & CLIMATOLOGY 1100 (1984) (reviewing aspects of drought dynamics not considered by the Palmer Drought Severity Index).

131. *See, e.g.*, Kelly T. Redmond, *The Depiction of Drought, A Commentary*, 83 BULL. AM. METEOROLOGICAL SOC'Y 1143, 1144 (2002).

132. Ashok K. Mishra & Vijay P. Singh, *A Review of Drought Concepts*, 391 J. HYDROLOGY 202, 206 (2010).

133. Adler, *supra* note 19, at 210-11.

134. *See, e.g.*, Woodhouse & Overpeck, *supra* note 29, at 2693-98.

135. *U.S. Drought Monitor Background*, NAT'L DROUGHT MITIGATION CTR., http://droughtmonitor.unl.edu/AboutUSDM/Background.aspx (last visited Apr. 28, 2015).

a "blend of science and subjectivity," incorporating climatic, hydrologic, and soil data, impact assessments, and expert opinion.[136] As of August 12, 2014, the Drought Monitor depicted much of the American West and Southwest in a state of drought.[137]

The apparent public apathy that tends to occur before, during, and following a drought poses an additional challenge toward the development and implementation of serious drought management measures. Because the onset and effects of drought are gradual, the need for action is not recognized until impacts are acute,[138] at which point responses are necessarily reactive and not proactive.[139] The eventual transition back to wetter, less water-stressed conditions is accompanied by a psychological transition back to business as usual and a collective forgetting of the drought problem.[140] A 1989 Minnesota Department of Natural Resources report analyzing the previous summer's drought observed similar impacts in the 1930s Dust Bowl, prompting the authors to ask: "Have we not learned how to control wind and water erosion in the last fifty years? Or are attitudes regarding land and water stewardship really unchanged during this period?"[141]

Finally, drought law is a challenging undertaking because it encompasses an uncoordinated set of federal and state agricultural laws, water resources laws, and disaster management policies. These laws are distributed across state and federal jurisdictions and time periods, making it difficult to articulate—much less coordinate and implement—a coherent drought law framework. The sheer number of institutional actors involved across time and space make enacting laws and policies with common goals or approaches in mind unlikely. In fact, the various legal doctrines involving drought management are often working against drought mitigation and adaptation. Doctrines of water allocation largely promote economically productive uses of water, with little concern for conservation or future scarcity.[142] Agricultural policies, by and large, are designed to maximize yields and stabilize food production.[143]

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136. *Id.*

137. Anthony Artusa, *U.S. Drought Monitor CONUS*, NAT'L DROUGHT MITIGATION CTR. (Aug. 19, 2014, 8:00 AM), http://droughtmonitor.unl.edu/MapsAndData/MapArchive.aspx.

138. Redmond, *supra* note 131, at 1144.

139. Adler, *supra* note 19, at 208.

140. JOHN STEINBECK, NOVELS 1942-1952 312 (2001) (noting this phenomenon in *East of Eden*: "And it never failed that during the dry years people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way."); *see also* Adler, *supra* note 19, at 208-09.

141. MINN. DEP'T NAT. RES. DROUGHT OF 1988 1, 41 (Jan. 1989), *available at* http://climate.umn.edu/pdf/drought88.pdf.

142. *See* Adler, *supra* note 19, at 209.

143. *See* Agricultural Adjustment Act of 1933, 7 U.S.C.A. §§ 601-627 (West 1933) (*invalidated by* United States v. Butler, 297 U.S. 1 (1936)); *see* Agricultural Adjustment Act of 1938, 7 U.S.C. §§ 1281-1407 (1938).

Even drought management plans, couched in terms of disaster relief, do little to reduce vulnerability to future droughts.[144]

State common law doctrines primarily determine water allocation in the United States. States east of the Mississippi River follow riparian law, which grants "reasonable use" rights to riparian landowners.[145] Under this system, any riparian landowner may make a reasonable use of water at any time, so long as the water remains on the parcel abutting the water source.[146] Perhaps inadvertently, the territorial dimension of riparianism is an elegant water conservation strategy because it precludes costly and inefficient large-scale water transfers to distant lands.[147] The downside, however, of riparianism is that riparian lands may not be the most logical water destination.[148] For example, many riparian lands are located in floodplains where increased development comes with an increased risk of flood damage. The reasonable use standard may also be problematic in times of drought; a particular use may be reasonable for the individual riparian landowner but not economically productive in the aggregate.[149] In these cases, courts have traditionally adjudicated water rights, but fact-specific litigation is tedious, has little precedential value, and is devoid of a larger, comprehensive drought strategy.[150]

For the reasons stated above, most eastern states now practice a model of regulated riparianism, in which an administrative agency issues permits based loosely on riparian concepts and on case-by-case considerations. In Florida, for example, well-funded water management districts issue permits to users as long as minimum flow requirements are met to maintain ecological integrity.[151] In theory, administrative agencies could develop region-specific drought mitigation and adaptation strategies; too often, though, they struggle to incentivize conservation.[152] Considering the difficulty inherent in determining which water uses take priority during drought in the absence of a coherent drought policy, it is not a

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144. *See generally Drought Planning Resources, By State*, NAT'L DROUGHT MITIGATION CTR., http://drought.unl.edu/Planning/PlanningInfobyState.aspx (last visited Apr. 28, 2015); DROUGHT PREPAREDNESS COUNCIL, STATE OF TEXAS DROUGHT PREPAREDNESS PLAN 4 (2005), *available at* http://seca.unl.edu/web_archive/StateDroughtPlans/DroughtPlans/TX_2005.pdf; NAT. RES. AGENCY, CAL. DEP'T WATER RES., CALIFORNIA DROUGHT CONTINGENCY PLAN 7 (2010), *available at* http://seca.unl.edu/web_archive/StateDroughtPlans/DroughtPlans/CA_2010.pdf.

145. BARTON H. THOMPSON, JR. ET AL., LEGAL CONTROL OF WATER RESOURCES: CASES AND MATERIALS 28 (5th ed. 2013).

146. *Id.* at 29.

147. *Id.* at 30.

148. *See, e.g.*, *id.* at 31.

149. Robert W. Adler, *Climate Change and the Hegemony of State Water Law*, 29 STAN. ENVTL. L.J. 1, 19 (2010).

150. *Id.*

151. FLA. STAT. § 373.0421 (2010).

152. *See, e.g.*, Ryan B. Stoa, *Florida Water Management Districts and the Florida Water Resources Act: The Challenges of Basin-Level Management*, 7 KY. J. EQUINE AGRIC. & NAT. RES. L. 1, 73 (2014); Adler, *supra* note 19, at 224.

remarkable improvement that decisions are now in the hands of bureaucrats instead of judges.[153]

States west of the Mississippi River—historically a more arid region—follow the doctrine of prior appropriation, in which water rights are disconnected from land ownership and are obtained based on the order in which water users make beneficial use of the resource.[154] This system provides freedom to transport water to wherever it might be needed, but precludes drought-induced reductions across the board. In times of drought or water scarcity, senior appropriators retain priority regardless of how they use their water and have little incentive to reduce their consumption. Furthermore, because water rights are transferrable, they are subject to market forces that may not be conducive to optimum—or even rational—conservation strategies in times of drought.[155] For example, many bottled-water companies source their water from drought-ridden states.[156] California, which is in a state of exceptional drought, produces ninety-five percent of U.S. broccoli and ninety-nine percent U.S. walnuts, water-intensive crops that require around five gallons of water to produce one head of broccoli or walnut.[157] Similarly, more than half of hydraulic fracturing wells—which employ a water-intensive process of shale oil development—are located in areas experiencing drought.[158]

Curiously, a third doctrine of water law governs groundwater, despite the fact that groundwater systems are usually connected to surface waters and are therefore part of the same hydrological system. Groundwater laws have traditionally developed more slowly than surface water laws.[159] This is unfortunate considering the increasing use of groundwater,[160] the immense potential of groundwater reserves in times of drought,[161] and the sobering fact that groundwater reserves take much longer to replenish, if they do so at all.[162] In general, there are five doctrines governing groundwater, with variations on one of three

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153. Adler, *supra* note 149, at 20.

154. THOMPSON, JR. ET AL., *supra* note 145, at 169-71.

155. Adler, *supra* note 19, at 226.

156. Julia Lurie, *Bottled Water Comes from the Most Drought-Ridden Places in the Country*, MOTHER JONES (Aug. 11, 2014, 6:00 AM), http://www.motherjones.com/environment/2014/08/bottled-water-california-drought.

157. Alex Park & Julia Lurie, *It Takes How Much Water to Grow an Almond?!*, MOTHER JONES (Feb. 24, 2014, 6:55 AM), http://www.motherjones.com/environment/2014/02/wheres-californias-water-going.

158. MONIKA FREYMAN, HYDRAULIC FRACTURING & WATER STRESS: WATER DEMAND BY THE NUMBERS 6 (2014).

159. THOMPSON, JR. ET AL., *supra* note 145, at 444-46.

160. *Groundwater Use in the United States,* U.S. GEOLOGICAL SURVEY, http://water.usgs.gov/edu/wugw.html (last updated Mar. 17, 2014, 11:04 AM).

161. Approximately ninety percent of U.S. freshwater supplies are located underground. *Groundwater Facts*, NAT'L GROUNDWATER ASS'N, http://www.ngwa.org/fundamentals/use/pages/groundwater-facts.aspx (last updated Oct. 18, 2010).

162. *See generally* Yoshihide Wada et al., *Global Depletion of Groundwater Resources*, *in* GEOPHYSICAL RESEARCH LETTERS 1 (2010); P.B. McMahon et al., *A Comparison of Recharge Rates in Aquifers of the United States Based on Groundwater-age Data*, 19 HYDROGEOLOGY J. 779 (2011), *available at* http://co.water.usgs.gov/publications/non-usgs/McMahon2011_Hydrogeo.pdf.

paradigms: first, the rule of capture, in which anyone may extract as much groundwater as needed without limit; second, reasonable use, in which overlying landowners may use groundwater as long as that use is reasonable and/or equitable; and third, prior appropriation, in which groundwater rights attach on a first-in-time, first-in-right basis and endure by making continuous beneficial use of the water.[163] Doctrines based on reasonable use and prior appropriation mirror the drought deficiencies explained above. The rule of capture, however, adds a wrinkle with devastating consequences for drought resilience because it incentivizes using as much groundwater as possible. Farmers in these capture-governed areas find themselves in a race to drill deeper and deeper in search of diminishing supplies.[164] Rapid declines in the groundwater table can cause land subsidence, damaging crops, irrigation canals, and urban infrastructure. For example, in the Central Valley of California a 1,200 square mile area has been sinking by almost a foot per year.[165] Groundwater extraction rates are so high that global sea level rise can partially be explained by groundwater runoff from the United States.[166]

In spite of the drought-insensitive nature of their water allocation systems, states have adopted targeted drought laws. Forty-seven states have developed, or are developing, drought management plans; however, thirty-two of these are reactive in nature and do little to reduce future vulnerability.[167] Even plans focused on mitigation pay inordinate attention to process, such as coordination and governing authority that, while important, do little to address larger structural problems such as land use and water rights.[168] Many plans, regardless of approach, channel funding towards drought relief. While providing financial aid to drought victims shows compassion, it does little to modify the behavior patterns that created the vulnerability to drought damage in the first place.[169] On the contrary, financial compensation to redress drought damage incentivizes a business-as-usual approach.

While states have traditionally dictated the development of water law, the federal government plays a large role by funding large water infrastructure projects such as dams, dikes, and canals that harness water systems for human

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163. THOMPSON, JR. ET AL., *supra* note 145, at 447.

164. *See, e.g.*, Lisa M. Krieger, *California Drought: San Joaquin Valley Sinking as Farmers Race to Tap Aquifer*, SAN JOSE MERCURY NEWS (June 10, 2014, 1:28 PM), http://www.mercurynews.com/drought/ci_25447586/california-drought-san-joaquin-valley-sinking-farmers-race.

165. Tom Philpott, *California Farmers: Drill, Baby, Drill (for Water, That Is)*, MOTHER JONES (Apr. 2, 2014, 6:00 AM), http://www.motherjones.com/tom-philpott/2014/04/california-drought-groundwater-drilling.

166. U.S. DEP'T INTERIOR, U.S. GEOLOGICAL SURVEY, GROUNDWATER DEPLETION IN THE UNITED STATES (1900-2008) 50-51 (2013), *available at* http://pubs.usgs.gov/sir/2013/5079/SIR2013-5079.pdf.

167. *See generally Drought Planning Resources, by State*, *supra* note 144.

168. *See e.g.*, *Drought Planning Resources*, *supra* note 144; DROUGHT PREPAREDNESS COUNCIL, *supra* note 144; NAT. RES. AGENCY, *supra* note 144.

169. Adler, *supra* note 19, at 231.

benefit.[170] Reservoirs promote drought resilience by storing surface water flows, and irrigation systems can dramatically increase agricultural productivity.[171] But large-scale infrastructure projects may also promote population growth or agricultural development in areas where water is scarce.[172] Even where water is relatively abundant, federal water projects can shape growth trajectories for a region, with major drought implications. The Apalachicola-Chattahoochee-Flint ("ACF") River Basin, for example, is shared by Georgia, Alabama, and Florida—states with relative water abundance. In 1989, however, the Army Corps of Engineers agreed to expand the storage of Lake Lanier and other reservoirs in order to satisfy the water demands of Atlanta's burgeoning population.[173] While the decision enabled the city to continue on its growth trajectory, downstream users in Alabama and Florida suffered, embroiling the states and federal government in litigation for decades.[174] The conflict was especially tense for all parties when drought conditions made scarce water resources even scarcer.[175]

Because agriculture accounts for nearly ninety percent of water consumption in the United States,[176] it stands to reason that federal agricultural policy and drought disaster assistance play a major role in U.S. approaches toward drought. Until the Dust Bowl of the 1930s ravaged farming communities, the federal government's role in agriculture was minimal; if drought caused farmland to become unusable, farmers were forced to relocate without any type of federal assistance.[177] The Dust Bowl marked a turning point as the public recognized the vital role that agriculture played in providing food for the nation. New Deal policies created agricultural programs to minimize risk for farmers, for example through subsidized feed, subsidized crop insurance, and financial aid grants.[178]

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170. *See* Melanie Gall et al., *The Unsustainable Trend of Natural Hazard Losses in the United States*, 31 SUSTAINABILITY 2157, 2163 (2011); A. Dan Tarlock, *United States Flood Control Policy: The Incomplete Transition from the Illusion of Total Protection to Risk Management,* 23 DUKE ENVTL. L. & POL'Y F. 151, 159 (2012).

171. *Irrigation,* ENVTL. PROT. AGENCY, http://www.epa.gov/agriculture/ag101/cropirrigation.html (last updated June 27, 2012) (noting that "Irrigation makes agriculture possible in areas previously unsuitable for intensive crop production").

172. Adler, *supra* note 19, at 235 (citing RICHARD W. WAHL, MARKETS FOR FEDERAL WATER: SUBSIDIES, PROPERTY RIGHTS, AND THE BUREAU OF RECLAMATION (1989). *But see* Mark Kanazawa, *Pricing Subsidies and Economic Efficiency: The U.S. Bureau of Reclamation*, 36 J.L. & ECON. 205, 229 (1993) (finding that agricultural water use may not be as responsive to water cost subsidies as previously suggested).

173. NICOLE T. CARTER ET AL., APALACHICOLA-CATTAHOOCHEE-FLINT (ACF) DROUGHT: FEDERAL WATER MANAGEMENT ISSUES 5 (2008), *available at* http://www.dep.state.fl.us/mainpage/acf/files/crs_report_congress030508.pdf.

174. *Id.* at 23.

175. *Id.* at 6-8; *see also* Lewis Jones et al., *Updating Twentieth Century Water Projects to Meet Twenty-First Century Needs: Lessons from the Tri-State Water Wars*, 29 GA. ST. U. L. REV. 959, 970 (2013).

176. *How Important Is Irrigation to U.S. Agriculture,* U.S. DEP'T OF AGRIC., ECON. RESEARCH SERV., http://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/background.aspx#.U_KimfldWmg (last updated June 7, 2013).

177. Adler, *supra* note 19, at 245.

178. *Id.* at 247.

The federal government also intervened in commodity markets to stabilize supply and demand. Successive Agricultural Adjustment Acts[179] provided grants that incentivized agricultural development in arid regions with the knowledge that government-backed insurance programs would spread the risk across society.[180] These policies were not just meant to protect farmers—they were designed to prop up entire farming communities.[181] Post-World War II policies created general disaster relief funding frameworks through which governors can request, and the President can grant, disaster assistance.[182] In the 1970s, the federal government encouraged large-scale consolidation of small farms into large agribusinesses, while maintaining subsidies, in order to dramatically increase yields and promote agricultural exports.[183] Needless to say, maximizing short-term yields is at odds with sustainable water or soil consumption.

For the most part, the pillars of agricultural law and policy that were set in motion in the twentieth century—crop subsidies, government-backed insurance, and direct relief payments—are still in place today. The Agricultural Act of 2014,[184] which established agricultural spending for the following ten years, allocates $44.4 billion for commodity programs and $90 billion for crop insurance.[185] Disaster relief funds were distributed a week after the Act was signed into law, including $100 million for livestock losses in California.[186] These three pillars of federal agricultural policy seem likely to remain in place for the foreseeable future; public attitudes regarding approaches to drought are receptive to most adaptation proposals, but they are least supportive of agricultural reforms.[187]

B. FLOOD LAW

An interesting aspect of flood policy in the United States is that while the federal government foots the bill for large flood control projects, insurance

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179. *See* Agricultural Adjustment Act of 1933, 7 U.S.C.A. §§ 601-627 (West 1933) (*invalidated by* U.S. v. Butler, 297 U.S. 1 (1936)); *see* Agricultural Adjustment Act of 1938, 7 U.S.C. §§ 1281-1407 (1938).

180. Adler, *supra* note 19, at 250.

181. *Id.* at 253.

182. *See, e.g.*, Federal Disaster Relief Act of 1950, Pub. L. No. 81-875, 64 Stat. 1109 (1950) (current version at 42 U.S.C. §§ 5121 *et seq.* (1995)).

183. Adler, *supra* note 19, at 259-60.

184. Agricultural Act of 2014, Pub. L. No. 113-79 128 Stat. 649 (2014).

185. Brad Plumer, *The $956 Billion Farm Bill, in One Graph,* WASH. POST BLOG (Jan. 28, 2014), http://www.washingtonpost.com/blogs/wonkblog/wp/2014/01/28/the-950-billion-farm-bill-in-one-chart/.

186. *Obama Administration Announces Additional Assistance to Californians Impacted by Drought*, U.S. DEP'T OF AGRIC. (Feb. 14, 2014), http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=2014/02/0022.xml.

187. James W. Stoutenborough & Arnold Vedlitz, *Public Attitudes Toward Water Management and Drought in the United States,* 28 WATER RES. MGMT. 697, 707 (2014) (noting that "agriculture is the last place the public wants to look for water supply savings.").

schemes, and disaster relief,[188] decisions pertaining to city planning and management—and therefore significant flood mitigation potential—are left to local mayors, zoning boards, county commissions, and planning departments.[189] For that reason, flood management approaches and vulnerabilities vary from one locality to another, creating a piecemeal web of local regulations and federal infrastructure projects. Because most counties contain lakes, rivers, streams, or a coastline presenting flood hazards, this dynamic puts at least forty percent of the U.S. population at risk,[190] as nearly eighteen million people live in the highest risk flood hazard areas.[191] Consequently, floods are a greater threat and create more economic damage than any other natural event.[192] It is very difficult to quantify the direct and indirect costs of flooding,[193] which often reach tens of billions of dollars annually,[194] and which are increasing.[195]

This increase in flood damage is a troubling trend, especially when accounting for changes in wealth and population.[196] One possible explanation is that floods are becoming more frequent, or more severe in magnitude or extent. Some databases show an increase in the number of floods reported in the last several decades,[197] though this could be due to an improvement in flood monitoring and would not necessarily account for factors such as the influence of human engineering and land use on flood incidence. Studies of flood trends throughout American history, explored in Section I, do not conclusively show a trend.[198] The other possibility, then, is that increases in the cost of flood damages are a product of societal vulnerability; that is, adaptation to floods is deteriorating. Whether that hypothesis is true or not, it is clear that U.S. flood law and policy have not been a model for disaster resilience.

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188. ASS'N OF STATE FLOODPLAIN MANAGERS, FLOOD MAPPING FOR THE NATION: A COST ANALYSIS FOR THE NATION'S FLOOD MAP INVENTORY 4 (Mar. 1, 2013), *available at* http://www.floods.org/ace-files/documentlibrary/2012_NFIP_Reform/Flood_Mapping_for_the_Nation_ASFPM_Report_3-1-2013.pdf (noting the increase in federal aid as a percentage of all economic costs of hurricanes).

189. SAMUEL D. BRODY ET AL., RISING WATERS: THE CAUSES AND CONSEQUENCES OF FLOODING IN THE UNITED STATES 3 (Cambridge Univ. Press, 2011).

190. *Implementation of the Biggert-Waters Flood Insurance Reform Act of 2012: One Year after Enactment: Hearing Before the Subcomm. on Econ. Pol'y of the S. Comm. on Banking, Hous., & Urban Affairs*, 113th Cong. 48 (2013) (statement of Craig Fugate, Adm'r, FED. EMERGENCY MGMT. AGENCY).

191. *Id.* (noting that 5.6% of the U.S. population lives in the highest-risk flood-hazard areas).

192. BRODY ET AL., *supra* note 189, at 11.

193. The National Weather Service's flood damage data, for example, exclude tidal, or coastal, flood damage from their estimates. *See Hydrologic Information Center—Flood Loss Data*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., http://www.nws.noaa.gov/hic/ (last visited Apr. 28, 2014) (noting that damages often go underreported).

194. *Id.*

195. Gall et al., *supra* note 170, at 2175. *See generally Hydrologic Information Center—Flood Loss Data*, *supra* note 193.

196. *See* Gall et al., *supra* note 170, at 2177 (showing an increase in flood damages even after wealth and population are normalized).

197. *See, e.g.*, BRODY ET AL., *supra* note 189, at 11 (noting that floods increased from an annual average of 394 in the 1960s to 2,444 in the 1990s).

198. *See, e.g.*, Hartmann et al., *supra* note 59; *see also* Peterson et al., *supra* note 15, at 826 fig. 3.

Prior to the federal government's engagement in flood issues, adaptation measures were predominantly left to local governments, which addressed them on a case-by-case basis. That meant allowing rivers to run their courses and accepting the risk of floodplain development in cases where floods could be attributed to natural causes. Flood relief, importantly, was not—and is not—foreclosed by the absence of federal policies. Common law tort remedies, for example, sometimes allow victims to recover damages due to flooding. Landowners who use their properties in such a way as to cause flood damage to another are subject to nuisance claims,[199] and trespass actions have been successful in cases where induced floods constituted an invasion of property.[200] Negligence can be assigned for flood control measures that fail to meet an appropriate standard of care.[201] Finally, doctrines of water law have been instrumental in dictating small-scale flood control policies. Installations that protect one riparian property from water incursion but increase the risk for downstream riparian lands is a classic inquiry into what constitutes "reasonable use."[202] And even if flood control measures like dams, fill, or gabions are successful in a prior appropriation state, they would not be permissible if streamflows are altered such that a downstream senior appropriator's water rights are impaired.[203] Takings claims, alleging that flood protection regulations unconstitutionally diminish property values without just compensation, are discussed in Section IV.

Reliance on local efforts and common law principles, however, did not provide the type of flood protection framework that satisfied progressive managers.[204] Widespread levee installation became the civil engineering project *du jour*, but coordination and maintenance was difficult considering the magnitude of the challenge.[205] The legacy of this period is evidenced by over 100,000 miles of levees still in place today.[206] Perhaps because eighty-five percent of levees are locally owned and operated, many are in a state of disrepair;[207] full rehabilitation might cost more than $100 billion.[208]

199. Edward A. Thomas & Sam Riley Medlock, *Mitigating Misery: Land Use and Protection of Property Rights Before the next Big Flood*, 9 VT. J. ENVTL. L. 155, 164, n. 58 (2008) (citing Sandifer Motors, Inc. v. City of Roeland Park, 628 P.2d 239, 242–44 (Kan. Ct. App. 1981)).

200. *Id.* at 164, n. 61 (citing Musumeci v. State, 43 A.D.2d 288, 291 (N.Y. App. Div. 1974)).

201. *Id.* at 165, n. 63 (citing Kunz v. Utah Power & Light Co., 526 F.2d 500, 504 (9th Cir. 1975)).

202. *See* THOMPSON JR. ET AL., *supra* note 145, at 34 (explaining factors relevant to a reasonableness determination).

203. *See id.* at 169-71.

204. *See* Purdy, *supra* note 80 (detailing the rise in ambitious environmental engineering approaches).

205. *See* Tarlock, *supra* note 170, at 158.

206. AM. SOC'Y OF CIV. ENG'RS, 2013 REPORT CARD FOR AMERICA'S INFRASTRUCTURE: LEVEES 1 (2013), http://www.infrastructurereportcard.org/a/documents/Levees.pdf.

207. *Id.* at 2. In 2013, the American Society of Civil Engineers gave the United States a grade of D- for its poor levee infrastructure. *Id.* at 1.

208. *Id.* at 3.

Just as the Dust Bowl of the 1930s prompted federal intervention in agricultural policy, the Mississippi Flood of 1927 necessitated a federal role in flood policy. The Flood Control Act of 1928[209] assigned flood control to the Army Corps of Engineers, which remains the agency responsible for building infrastructure to protect floodplain communities and investments.[210] The mechanism to accomplish this task was a system of structural defense measures such as dams, levees, and upstream reservoirs, taking into account a river basin's entire hydrogeographical area.[211] Large reservoirs, of course, have tremendous ecological impacts[212] as they create lakes or widen rivers over lands that were previously dry, thus displacing or drowning plant and animal species. The temptation to hold back floodwaters was nevertheless too great for social or environmental concerns to overcome, and therefore reservoir dam building continued through the 1960s.[213] Importantly, however, Congressional preference for a project-based water planning approach caused the principle of basin-wide management to fall by the wayside.[214] Instead, large water projects are conducted on an ad hoc basis, and the Corps of Engineers has not developed an integrated basin management mindset.[215] When water projects are undertaken on this scale without a measured evaluation of the effects that hydrological installations have on the basin and its water users, the likelihood of conflict increases. The ongoing ACF River Basin conflict, for example, was sparked by the Army Corps of Engineers' decision to expand the storage capacity of Lake Lanier, denying downstream communities in Alabama and Florida their expected flows.[216]

Flood control projects have been generally effective at retaining water flows, but several drawbacks emerge when infrastructure forms the basis of flood policy. First, there are ongoing maintenance and operational costs. The average age of dams in the United States is fifty-two years; the cost to repair them is estimated at $57 billion.[217] Most are under the inspection authority of state regulatory programs that are woefully underfunded[218] or, as in Alabama's case,

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209. Flood Control Act of 1928, 33 U.S.C. §§ 702a-702m, 704 (2013).

210. Tarlock, *supra* note 170, at 159.

211. *See id.* at 160.

212. *See generally* R.M. Baxter, *Environmental Effects of Dams and Impoundments*, 8 ANN. REV. ECOLOGY & SYSTEMATICS 255 (1977).

213. *See* Tarlock, *supra* note 170, at 163-64.

214. *See id.* at 164.

215. *See id.* (citing the National Water Commission's critical assessment of the Corps of Engineers' water management capacities).

216. *See* Adler, *supra* note 19, at 231.

217. AM. SOC'Y OF CIV. ENG'RS, 2013 REPORT CARD FOR AMERICA'S INFRASTRUCTURE: DAMS 1, 3 (2013), http://www.infrastructurereportcard.org/a/documents/Dams.pdf [hereinafter 2013 REPORT CARD]; *Levees: Investment & Funding*, AM. SOC'Y CIV. ENG'RS, http://www.infrastructurereportcard.org/a/#p/levees/investment-and-funding (last visited Apr. 28, 2015).

218. *See State Dam Safety Budgets*, AM. SOC'Y OF CIV. ENG'RS, http://www.infrastructurereportcard.org/a/#e/dam-safety-budgets (last visited Apr. 28, 2015).

non-existent.[219] Second, infrastructure fails, and does so with potentially devastating results. Of 14,000 dams in the United States that would cause a loss of life upon failure, 2,000 are in a deficient condition.[220] From 2005 to 2013, dams failed 173 times.[221] A 2008 dam failure in Nevada that flooded 600 homes and stranded 3,500 people, for example, was the result of poor construction and maintenance.[222] Levee failures likewise contributed to the devastation caused by Hurricane Katrina,[223] which resulted in 1,200 deaths and $200 billion in damage.[224] Third, infrastructure provides a false sense of security, promoting development in floodplains that would not occur without protective infrastructure, consequently increasing flood damage when infrastructure fails. This moral hazard was identified during the heyday of dam construction,[225] but was largely ignored in favor of floodplain development.

The limitations of infrastructure as a flood protection policy were recognized when Hurricane Betsy killed seventy-six people and flooded 165,000 homes in 1965.[226] The scale of devastation caused by large floods—combined with the risk factors involved—makes flood insurance a financially unpredictable business for private insurance companies.[227] In fact, Congress had passed an experimental flood insurance program a decade earlier, the Federal Flood Insurance Act of 1956,[228] but lack of interest from the private sector prevented it from getting off the ground.[229] Without insurance, vulnerable floodplain communities are solely reliant on disaster relief—a situation Hurricane Betsy exposed in dramatic fashion.[230] The federal government stepped in to fill the void by creating the 1968 National Flood Insurance Program ("NFIP").[231] The rationale appeared logical:

219. *Levees: Conditions & Capacity*, AM. SOC'Y OF CIV. ENG'RS, http://www.infrastructurereportcard.org/a/#p/levees/conditions-and-capacity (last visited Apr. 28, 2015).

220. 2013 REPORT CARD, *supra* note 217, at 1.

221. *Dam Failures and Incidents,* ASS'N OF STATE DAM SAFETY OFFICIALS, http://www.damsafety.org/news/?p=412f29c8-3fd8-4529-b5c9-8d47364c1f3e (last visited Apr. 28, 2015).

222. ASS'N STATE DAM SAFETY OFFICIALS, DAM FAILURES, DAM INCIDENTS (NEAR FAILURES), *available at* http://www.damsafety.org/media/Documents/PRESS/US_FailuresIncidents(1).pdf.

223. Michael Grunwald & Susan B. Glasser, *Experts Say Faulty Levees Caused Much of Flooding*, WASH. POST (Sept. 21, 2005), http://www.washingtonpost.com/wp-dyn/content/article/2005/09/20/AR2005092001894.html.

224. Roger D. Congleton, *The Story of Katrina: New Orleans and the Political Economy of Catastrophe*, 127 PUB. CHOICE 5, 5-6 (2006).

225. Tarlock, *supra* note 170, at 166 (describing the pioneering work and legacy of Gilbert White in developing the flood defense moral hazard problem).

226. *See* Erwann O. Michel-Kerjan, *Catastrophe Economics: The National Flood Insurance Program*, 24 J. ECON. PERSPECTIVES 165, 165 (2010).

227. *See* Erwann O. Michel-Kerjan et al., *Policy Tenure Under the U.S. National Flood Insurance Program (NFIP)*, 32 RISK ANALYSIS 644, 647 (2012); *see also Catastrophe Economics*, *supra* note 226, at 166 (explaining that the unpredictable nature of disaster damages creates volatility between premiums and claims).

228. Federal Flood Insurance Act of 1956, Pub. L. No. 84-1016 (1956) (repealed 1968).

229. Michel-Kerjan, *supra* note 226, at 165.

230. *See* Scott Gabriel Knowles & Howard C. Kunreuther, *Troubled Waters: The National Flood Insurance Program in Historical Perspective*, 26 J. POL'Y HIST. 327, 332 (2014).

231. NFIP was created by the National Flood Insurance Act of 1968, 42 U.S.C. § 4001 (1968).

the federal government has the capital to initiate such a program, subsidize insurance for homeowners, and borrow from the U.S. Department of Treasury during costly flooding years.[232] The government can also spread risks across society while demanding that communities and homeowners implement flood risk mitigation measures as a condition to the receipt of federally subsidized insurance.[233] Theoretically, the program could incentivize migration away from high-risk floodplains while protecting communities during the transition. In reality, subsidized flood insurance incentivizes further development in floodplains. Sadly, that scenario was predicted by a federal task force charged with investigating the feasibility of such a program, but its major recommendations were ignored.[234]

The NFIP provides eligible communities with flood insurance, with rates tied to the degree of risk to which a particular community is exposed. In areas deemed "Special Flood Hazard Areas"—so-called when subject to a one percent annual chance of flood—new construction must adhere to certain flood management requirements, and flood insurance is required when purchasing a home with a federally-regulated mortgage.[235] Older buildings grandfathered into the program enjoy subsidized insurance rates and less stringent regulations, while new buildings pay below-market actuarial rates that more accurately reflect risk and must otherwise comply with flood mitigation requirements.[236] Importantly, if a homeowner in an eligible community declines to purchase flood insurance, any disaster relief payout in the event of a flood is reduced by the amount of insurance that could have been purchased.[237]

Unfortunately, the program is deeply flawed. Many communities willingly chose unimpeded development over subsidized insurance that was conditioned on building code modifications or stringent land-use regulations.[238] Within participating communities, many individuals remain uninsured. More than half of U.S. counties have insurance penetration rates lower than one percent (including many counties who experience repeated flooding), [239] possibly due to a lack of

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232. Michel-Kerjan et al., *supra* note 227, at 647.

233. *Id.*

234. The task force's report states bluntly: "A flood insurance program is a tool that should be used expertly or not at all. Correctly applied, it could promote wise use of floodplains. Incorrectly applied, it could exacerbate the whole problem of flood losses." Knowles & Kunreuther, *supra* note 230, at 333. The report emphasizes that a national flood insurance program would be most effective in conjunction with a broader national flood control strategy that managed the entirety of a river basin. *Id.*

235. DAN HUBER, CTR. FOR CLIMATE & ENERGY SOLUTIONS, FIXING A BROKEN NATIONAL FLOOD INSURANCE PROGRAM: RISKS AND POTENTIAL REFORMS 1, 3 (2012), *available at* http://www.c2es.org/docUploads/flood-insurance-brief.pdf.

236. *Id.*

237. Knowles & Kunreuther, *supra* note 230, at 336.

238. *Id.* at 337.

239. Michel-Kerjan et al., *supra* note 227, at 649.

enforcement capacity.[240] Those who purchase insurance typically do so for less than five years.[241] Buildings grandfathered into the program receive heavily subsidized rates, but even full actuarial rates do not cover the full risk of flood damage.[242] Rates set by the program are based on complex maps that struggle to incorporate evolving human and environmental changes that affect flood risk.[243] Creating and updating maps in this way requires a well-funded agency and sophisticated techniques, but funding for mapping has been low and inconsistent.[244] As a result, many maps are outdated and do not reflect true risk.[245]

In the aggregate, these limitations have created a program that struggles to accomplish its objectives. By 2013, the NFIP has been forced to borrow $27 billion from the U.S. Department of Treasury to cover the discrepancy between premiums and actual risk.[246] Insurance penetration rates are low even in areas where insurance is mandatory, so many communities are still vulnerable.[247] If participation in the program is low, then the promise of land use changes and other mitigation requirements is minimized. Meanwhile, there is little evidence that higher insurance penetration is associated with lower relief payouts, suggesting that the NFIP has not been successful in reducing disaster relief.[248] Most recently, the Disaster Relief Appropriations Act of 2013 provided $50.7 billion for Hurricane Sandy victims.[249]

The Biggert-Waters Flood Insurance Reform Act of 2012 represented a recognition that the NFIP and flood policy generally were structurally unsound and sought to improve mapping and mitigation enforcement capacities while moving premiums closer to actual risk.[250] Importantly, it also provided vouchers for low-income households whose rate increases would be severely felt.[251] The reforms did not last long—in March 2014, the Menendez-Grimm Homeowner Insurance Affordability Act rolled back many of Biggert-Waters' strongest provisions.[252] Thus, the approach to flood risk in the United States, despite increasing costs and vulnerability, has remained largely unchanged since the 1960s: a reliance on deteriorating infrastructural projects likes dams and levees to

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240. Tarlock, *supra* note 170, at 168 (noting that banks have been lax in enforcing the mandatory insurance requirement for mortgages).

241. *See generally* Michel-Kerjan et al., *supra* note 227, at 650-57.

242. HUBER, *supra* note 235, at 3

243. *See* Knowles & Kunreuther, *supra* note 230, at 347.

244. *Id*. at 344.

245. HUBER, *supra* note 235, at 4.

246. Knowles & Kunreuther, *supra* note 230, at 328.

247. *See* HUBER, *supra* note 235, at 3; Knowles & Kunreuther, *supra* note 230, at 343.

248. HUBER, *supra* note 235, at 7.

249. Disaster Relief Appropriations Act of 2013, Pub. L. No. 113-2, 127 Stat. 4 (2013); Knowles & Kunreuther, *supra* note 230, at 346.

250. Biggert-Waters Insurance Reform Act of 2012, Pub. L. No. 112-141, §§ 100216, 100225 (2012); Knowles & Kunreuther, *supra* note 230, at 329.

251. Knowles & Kunreuther, *supra* note 230, at 347.

252. *Id.* at 329.

prevent floods from occurring, and subsidized insurance and disaster relief when they inevitably do.

C. WILDFIRE LAW

Section I explored trends in wildfire occurrence in the United States, observing that the number of fires is decreasing as the burn acreage is increasing.[253] This shift from low-intensity fires at historic return intervals to infrequent but high-intensity fires may be the result of climate change to some extent,[254] but is chiefly the product of a systematic policy of wildfire suppression that results in the accumulation of highly flammable fuel loads in forests.[255] Accordingly, wildfires differ from droughts and floods. While the perfect legal framework could reduce (but not eliminate) vulnerabilities to droughts and floods, forests could significantly approach their historic fire return interval at low intensity if wildfire policy were less anthropodominant.

However, wildfire policy has favored an anthropodominant approach for the past century and bears a striking resemblance to laws that respond to drought and flood risks. Namely, increasing development in the wildland-urban interface produces a concomitant increase in wildfire costs to communities and taxpayers. The policy response is to neutralize the threat by developing and unleashing technological advancements in wildfire suppression. When that fails or proves counter-productive, governments provide disaster relief payments to offset damage costs and emergency funding to escalate wildfire suppression efforts.

Federal wildfire suppression emerged as the preferred wildfire management approach in the early twentieth century, during the same progressive management era that embraced ambitious levee construction projects to prevent floods.[256] The Forest Transfer Act of 1905 transferred forest management authority from the Department of the Interior to the Department of Agriculture,[257] signaling a shift towards prioritizing timber resources and the immediate human benefits of forest resources. Congress subsequently authorized the U.S. Department of Agriculture's ("USDA") Forest Service to receive emergency firefighting funds in advance, greatly increasing the agency's potential budget and enabling it to pursue an aggressive fire suppression policy.[258] In 1911, the Forest Service's powers were expanded when high firefighting costs were reimbursed and the

253. *See, e.g.*, *Total Wildland Fires and Acres (1960-2009)*, *supra* note 68.
254. *See, e.g.*, van Mantgem et al., *supra* note 70.
255. *See, e.g.*, Stephens et al., *supra* note 72.
256. *See* Thomas & Medlock, *supra* note 199, at 158; Jan W. van Wagtendonk, *The History and Evolution of Wildland Fire Use*, 3 FIRE ECOLOGY 3, 3, 4 (2007).
257. Transfer Act of 1905, 16 U.S.C. § 472 (1905).
258. George Busenberg, *Wildfire Management in the United States: The Evolution of a Policy Failure*, 21 REV. POL'Y RESEARCH 145, 149 (2004).

agency was given forest management influence over non-federal lands.[259] Those developments put the Forest Service on a wildfire suppression trajectory that it continues to pursue. Congressional preference for firefighting is so strong that agencies have a strong incentive to pursue wildfire suppression policies because they know their budget will be left alone or even increased: often funds budgeted for other programs, including fire prevention, are re-appropriated when fire suppression budgets run dry,[260] and Congress later makes up the difference.[261] The Forest Service's fiscal year 2015 proposed budget, for example, requests $708 million for fire suppression efforts when annual costs from 2011 to 2013 averaged closer to $1.7 billion.[262] The incentive is so great that, in extreme cases, firefighters have allowed fires to grow in order to receive increased media attention and emergency appropriations.[263]

Fire suppression strategies were complemented by technology and infrastructure improvements in firefighting. In the 1930s, roads, communication lines, and observation posts were built in forested areas, and the Forest Service organized large networks of firefighting crews.[264] Soon thereafter, crews were provided with airplanes, helicopters, and surplus military hardware to combat fires across the country. States signed cooperative fire policy agreements that reinforced the policy of fire suppression and the federal government's role in it.[265] The privatization of fire suppression efforts began in the 1980s and has since created a "fire industrial complex," in which private contractors are employed to fight fires with high-tech equipment and large crews.[266] Despite a higher cost for taxpayers, firefighting agencies and private companies are incentivized to propagate the fire suppression paradigm to justify their expenditures.[267]

Exacerbating the wildfire suppression policy agenda is an increase in wildland-urban interface development. Forty-four million homes are currently located in fire-prone areas, and this figure is estimated to reach sixty million by 2030.[268] Not only does a well-publicized fire suppression policy create a moral hazard problem whereby development increases in fire-prone areas due to a false sense of security, but at-risk development and private assets also create a moral

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259. *Id.* at 150.

260. Freking, *supra* note 2 (noting that $400 million to $500 million allocated for other projects would be set aside for fire suppression, while the Secretary of Agriculture lobbies for more money to fight wildfires).

261. TIMOTHY INGALSBEE, FIREFIGHTERS UNITED FOR SAFETY, ETHICS, & ECOLOGY, GETTING BURNED: A TAXPAYER'S GUIDE TO WILDFIRE SUPPRESSION COSTS 14 (2010), *available at* http://www.iawfonline.org/A%20TAXPAYERS%20GUIDE%20TO%20WILDFIRES.pdf.

262. U.S. DEP'T OF AGRIC., FISCAL YEAR 2015 BUDGET JUSTIFICATIONS 9-9 (2014).

263. Karen Bradshaw, *A Modern Overview of Wildfire Law*, 21 FORDHAM ENVTL. L. REV. 445, 460 (2011).

264. Busenberg, *supra* note 258, at 151.

265. *Id.* at 152.

266. INGALSBEE, *supra* note 261, at 15.

267. *See* Karen M. Bradshaw, *Backfired! Distorted Incentives in Wildfire Suppression Techniques*, 31 UTAH ENVTL. L. REV. 155, 158 (2011).

268. INGALSBEE, *supra* note 261, at 3.

dilemma for firefighters who must make decisions concerning the direction and priority of firefighting efforts.[269] An audit of firefighting expenditures found that private property protection drove eighty-seven percent of fire suppression priorities,[270] despite federal fire management policy suggesting that private property and the environment should be appropriately balanced.[271] While not on the scale of the NFIP, the government also provides subsidized wildfire insurance for wildland-urban interface residents, and the private insurers that issue the policies have little incentive to require fire damage mitigation measures in exchange for coverage.[272] In theory, private homeowners could be held liable for cost recovery claims (where litigants who bear the costs of wildfire suppression or wildfire damage can receive compensation from the responsible party), thereby increasing home ownership costs in fire-prone areas. In reality, state cost-recovery suits are generally aimed at utility companies and, in many states, require a negligence determination.[273] Tort laws are therefore unlikely to impede the pace of development in the wildland-urban interface. Unabated development in these areas can be a serious public health concern as well. One study found that disaster relief recipients had substantially higher rates of post-traumatic stress disorder and major depression than the population at large.[274]

Wildfire disaster relief forms the third prong of modern wildfire law. The Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 allows the President to provide relief to fire victims.[275] Between 2012 and 2013, for example, FEMA distributed nearly $104 million in federal relief funds.[276] Other federal, state, and local agencies contribute as well; in 2003, total rehabilitation costs for a California fire exceeded $530 million.[277] Wildfire relief shows compassion and can be traced back to the early 1800s,[278] but it may also create

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269. Bradshaw, *supra* note 263, at 459 (citing George Nickas, *Preserving and Enduring Wilderness: Challenges and Threats to the National Wilderness Preservation System*, 76 DENV. U. L. REV. 449 (1998)).

270. INGALSBEE, *supra* note 261, at 11.

271. *See* FIRE EXEC. COUNCIL, GUIDANCE FOR IMPLEMENTATION OF FEDERAL WILDLAND FIRE MANAGEMENT POLICY (2009), *available at* http://www.nifc.gov/policies/policies_documents/GIFWFMP.pdf.

272. Bradshaw, *supra* note 263, at 464-65; *see also* Richenda Connell et al., *Evaluating the Private Sector Perspective on the Financial Risks of Climate Change*, 15 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 133, 139 (2009).

273. *See generally* Charles Riordan, *Calming the Fire: How a Negligence Standard and Broad Cost-Recovery Can Help Restore National Forests After Wildfires*, 41 B.C. ENVTL. AFF. L. REV. 233, 259 (2014).

274. Grant N. Marshall et al., *Psychiatric Disorders Among Adults Seeking Emergency Disaster Assistance After a Wildland-Urban Interface Fire*, 58 PSYCHIATRIC SERVS. 509, 514 (2007).

275. Robert T. Stafford Disaster Relief and Emergency Assistance (Stafford) Act, Pub. L. No. 93-288 (codified as amended at 42 U.S.C. §§ 5121 *et seq*. (2013)).

276. H. BUDGET COMM., WILDFIRE DISASTER FUNDING ACT (July 9, 2014), *available at* http://budget.house.gov/uploadedfiles/wfdfa.pdf (report authorized by Chairman Paul Ryan).

277. *See* LISA DALE ET AL., W. FORESTRY LEADERSHIP COAL., THE TRUE COST OF WILDFIRE IN THE WESTERN UNITED STATES 5 (2010), *available at* http://www.blm.gov/or/districts/roseburg/plans/collab_forestry/files/TrueCostOfWilfire.pdf.

278. *See, e.g.*, Michele L. Landis, *"Let Me Next Time Be 'Tried By Fire'": Disaster Relief and the Origins of the American Welfare State 1789-1874*, 92 NW. U. L. REV. 967, 968-69 (1998) (describing an 1827 bill appropriating $20,000 for victims of a fire in Alexandria, Virginia).

perverse incentives. When individuals expect wildfire disaster relief, for example, they reduce their own spending on private mitigation activities like fire-resistant rooftops and vegetation clearing near the home.[279] This is especially problematic for poor tenants; landlords may be less likely to invest in fire prevention upgrades, and undocumented immigrants can also be denied emergency services and shelter in the aftermath of a fire.[280]

The landscape of wildfire policy in the United States is therefore a grim scene. The costs of wildfire suppression strain government budgets, while disaster relief funds, insurance schemes, and fire prevention programs do little to deter continued development in the wildland-urban interface or to otherwise reduce wildfire risk. Wildfire damages are increasing, fires are becoming larger and more severe, and forests are accumulating excessive fuel density that contributes to high-intensity burns. In 2003, the Healthy Forests Restoration Act made an attempt to ameliorate these deficiencies by promoting fuel reduction programs and prescribed burning.[281] But critics named it the "No Tree Left Behind" Act because it uses fuel reduction projects to justify logging old growth forests and limits judicial review of such projects.[282] As of August 2014, Congressional debate on wildfire policy was focused on determining which funding mechanism is most appropriate to support wildfire disaster relief.[283] An entirely new approach to wildfire, it seems, is not on the agenda.

D. COMMONALITIES

Section II concluded by observing that after the Neolithic Revolution, agriculture-based societies suffered from the impacts of droughts, floods, and wildfires for three common reasons. First, individuals, communities, and the society as a whole were relatively immobile, thereby making it impossible or highly unlikely that migration away from high-risk areas would occur. Immobility, in turn, led to over-reliance on, and overconfidence in, human installations that seek to control nature. Irrigation schemes, dams, dikes, and other flood control structures, and deforestation were attempts to make nature adapt to human systems, instead of humans adapting to natural systems. Second, ancient societies vulnerable to

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279. *See* Michael McKee et al., *Using Experimental Economics to Examine Wildfire Insurance and Averting Decisions in the Wildland-Urban Interface*, 17 SOC'Y & NAT. RES.: INT'L J. 491, 501 (2004).

280. *See generally* Albert S. Fu, *The Façade of Safety in California's Shelter-In-Place Homes: History, Wildfire, and Social Consequence*, 39 CRITICAL SOCIOLOGY 833, 835 (2013) (describing undocumented immigrants being denied assistance because they could not provide documentation).

281. *See generally* Toddi A. Steelman & Melissa Elefante DuMond, *Serving the Common Interest in U.S. Forest Policy: A Case Study of the Healthy Forests Restoration Act*, 43 ENVTL. MGMT. 396 (2009).

282. *See generally id.*; Reda M. Dennis-Parks, *Healthy Forests Restoration Act—Will It Really Protect Homes and Communities?*, 31 ECOLOGY L.Q. 639, 653 (2004).

283. *See* Peter Wong, *Wyden: Congress Can Pass Wildfire, O&C Bills This Year*, PORTLAND TRIBUNE (Aug. 20, 2014, 4:57 PM), http://portlandtribune.com/sl/230857-94878-wyden-congress-can-pass-wildfire-o-and-c-bills-this-year.

droughts, floods, and wildfires exhibited a lack of diversification in their approach. Whether due to complete reliance on one crop or drainage canal, disaster mitigation and adaptation tended to focus on one coping strategy at the expense of a diverse, integrated risk-reduction approach. Finally, communities showed a lack of awareness of the surrounding environment and the extent to which anthropocentric policies could be sustained over time. Opportunities were missed and vulnerabilities overlooked.

Applying this framework to twenty-first century U.S. drought, flood, and wildfire laws shows a similar pattern. Immobility is perhaps the most obvious, as development continues in the most drought-prone, flood-prone, and fire-prone areas. Water law does not encourage relocation; Eastern water rights are appurtenant with ownership of riparian lands, those in the West are tied to the water source, and undeveloped groundwater regimes encourage unsustainable extraction rates.[284] Agricultural policy, meanwhile, favors crop and insurance subsidies as well as drought disaster relief that reinforce the status quo. Large hydrological installations like dams, levees, and canals encourage immobility in both drought-prone and flood-prone areas by bringing water to arid lands and holding it back in floodplains, providing somewhat false assurance that these areas are fit for large-scale agricultural and urban development. Flood insurance and disaster relief also spreads the risk of otherwise unsound settlement across society, further discouraging mobility. A long-standing policy of wildfire suppression that prioritizes private property protection is similarly ineffective in slowing the growth of development in the wildland-urban interface; insurance programs and disaster relief exacerbate its effects. The upshot of these policies is that instead of either promoting migration away from high-risk areas or forcing communities to bear the risks they expose themselves to, drought, flood, and wildfire laws tend to deter migration and distort risk.

It would be impractical to assume that the only reasonable response to a landscape of droughts, floods, and wildfires is to avoid high-risk areas entirely. However, if development in arid regions, floodplains, and the wildland-urban interface is to continue, an integrated, diversified approach must account for the great complexities of natural systems and the ways in which human progress can safely and sustainably be incorporated into them. Instead, modern drought, flood, and wildfire policies conform to three basic approaches: First, controlling nature with dams, levees, irrigation, and wildfire suppression; second, spreading risk across society through subsidies and insurance programs; and third, providing ex-post disaster relief. There are a nearly limitless number of additional and alternative approaches that can be considered to increase societal resilience to droughts, floods, and wildfires, some of which are explored in Section IV below. Considering the track record so far, pursuing some of them may be worthwhile.

284. *See* Krieger, *supra* note 164.

That the basic framework of drought, flood, and wildfire laws has remained the same for the past several decades speaks to the disconnect between humans and the environment. Efforts to control nature necessarily rely on a belief that control is possible. But diminishing water supplies, deteriorating and failing infrastructure, and the rise of high-intensity fires reveal that belief to be premature at best. The solvency of insurance programs depends on premiums reflecting actual risk, but the private sector has recognized that droughts, floods, and wildfires are too complex to reliably predict—a reality that government-backed insurance programs are struggling with.[285] Finally, emergency funding and relief payments receive broad support because it is easy to sympathize with victims of disasters. As explained in Section I, the recurrence of droughts, floods, and wildfires demonstrates that if a disaster strikes that communities were not prepared for, that disaster was decidedly man-made. Despite tremendous growth in scientific understanding and technological development, drought, flood, and wildfire laws exhibit the same vulnerabilities from which Neolithic societies have suffered for centuries.

IV. LEARNING FROM THE PAST: TOWARDS AN INTEGRATED APPROACH TO DROUGHTS, FLOODS, AND WILDFIRES

Hunter-gatherers survived in nature for hundreds of thousands of years by staying mobile, diversified, and aware. While this article does not propose a return to a nomadic lifestyle, the resilience of human ancestors provides a lens through which a successful policy framework can be viewed. By promoting these core principles of resilience, drought, flood, and wildfire laws can move away from an anthropocentric adaptation paradigm that seeks to control nature, distort risks, and provide relief after-the-fact, and towards a paradigm that works with nature, reduces risks, and mitigates damages. There are many approaches that would contribute to such a transition, and the recommendations below fall into three broad action categories: discontinuing counter-productive practices, reinforcing extant policies that receive inadequate support, and introducing measures that demonstrate potential to fit the resilience model. There are doubtless many actions not discussed here that would increase resilience as well, and the actions below are not presented as an inseparable package. Rather, the framework approach to droughts, floods, and wildfires itself can adopt the resilience model by removing policies impeding resilience and introducing policies promoting it (like mobility), integrating a broad set of policy options (to achieve diversification), and remaining responsive to environmental dynamics and change.

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285. *See generally* Knowles & Kunreuther, *supra* note 230; HUBER, *supra* note 235.

A. DROUGHTS

As discussed in Section III, the complexity of droughts and drought response mechanisms brings together a variety of stakeholders and legal fields. These are, primarily, state water laws and federal agricultural policies. Vested interests with water rights, government-backed expectations, and political power present a significant challenge to status quo disruption. The options presented here, however, seek not to disturb existing interests as much as incentivizing mitigation and adaptation. If, however, it becomes apparent that existing or proposed water uses would decrease resilience to drought (by, for example, appropriating water at unsustainable rates), it is important to note that states have the constitutional power (and in some cases, obligation) to modify the status quo or reject ill-advised changes. The Supreme Court held in *Illinois Central Railroad Company v. Illinois* in 1892 that states may dispose of submerged lands only when disposal does not impair the public interest.[286] The case established the public trust doctrine, imposing on states a duty to protect the public's interest in water resources and submerged lands. The public trust doctrine's relationship to state laws of water allocation, such as regulatory permitting schemes and water markets, was clarified by *National Audubon Society v. Superior Court* in 1983 when permitted plans to divert water from Mono Lake—California's second largest lake—to the city of Los Angeles were deemed subject to the state's ongoing duty to protect the public interest.[287] Despite otherwise legal appropriative rights, the Court concluded that "the human and environmental uses of Mono Lake—uses protected by the public trust doctrine—deserve to be taken into account. Such uses should not be destroyed because the state mistakenly thought itself powerless to protect them."[288] Thus, states not only have the power to protect the public interest within current doctrines of water allocation, they have an obligation to do so. Drought resilience is doubtlessly within the scope of the public interest, making the public trust doctrine a powerful tool for states whose existing legal doctrines exacerbate or do little to mitigate drought conditions.

There are various mechanisms to rein in water consumption within existing water law frameworks as well. In prior appropriation jurisdictions, many states are recognizing instream flows—appropriations that abolish the requirement that water be diverted in order to maintain flow levels—as an effective tool to ensure adequate reserves exist in times of drought;[289] governments and conservation groups can purchase water rights and simply leave them in place. Similarly, regulated riparian states can integrate minimum flows into the fabric of the permitting process, protecting a baseline needed for ecological integrity and

286. *See* Ill. Cent. R.R. Co. v. Illinois, 146 U.S. 387, 453 (1892).
287. *See* Nat'l Audubon Soc'y v. Super. Ct., 33 Cal. 3d 419, 441 (Cal. 1983).
288. *Id*. at 452.
289. THOMPSON JR. ET AL., *supra* note 145, at 216.

scarce conditions.[290] Regardless of jurisdiction, water rights can also be conditioned on the availability of water resources, reserving authority to reduce diversions in drought conditions.[291] Legislation, such as "wild and scenic rivers" laws or endangered species laws, can similarly be used to mitigate excessive consumption.[292]

In this sense, states already have many of the tools they need to mitigate drought, exhibiting diversified approaches that are so crucial to resilience. What is lacking then is an awareness of the surrounding environment and the ways that the options already in existence are inappropriately utilized. This lack of awareness is most obvious when looking at groundwater management. In California, for example, groundwater depletion data is not made public, denying scientists, some government agencies, and the general public access to information that could make sense of complex hydrogeological dynamics.[293] That, combined with having little-to-no restrictions on groundwater extraction,[294] amounts to turning a blind eye to environmental signals. Across the United States, groundwater depletion is rarely addressed and poorly documented,[295] though not without consequence. If water stored in the High Plains (Ogallala) Aquifer of the Great Plains is exhausted (and projections show it to be sixty-nine percent depleted in fifty years), it would take 500 to 1,300 years to replenish a resource relied on to provide irrigation and drinking water throughout the United States.[296] States can start by making information that already exists available, and move towards funding, or at least permitting, further research into surface and groundwater depletion and recharge. Modifying or creating state institutions to address groundwater may increase environmental awareness as well.[297]

The federal government also has a role to play in water resources allocation. While statutes such as the Clean Water Act, Endangered Species Act, and Wild and Scenic Rivers Act have the potential to preserve instream flows in times of drought,[298] the United States lacks an integrated water resources management plan that provides a coherent vision and places disparate water-related laws and

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290. *See, e.g.*, FLA. STAT. § 373.0421 (2010).

291. THOMPSON JR. ET AL., *supra* note 145, at 219.

292. *Id.*

293. Tom Knudson, *The Public Eye: As Drought Persists, Frustration Mounts Over Secrecy of California's Well Drilling Logs*, SACRAMENTO BEE (July 6, 2014, 12:00 AM), http://www.sacbee.com/2014/07/06/6534974/as-drought-persists-frustration.html.

294. *But see* Reid Wilson, *California Debates New Regulations for Diminishing Groundwater Amid Historic Drought*, WASH. POST BLOG (Aug. 6, 2014), http://www.washingtonpost.com/blogs/govbeat/wp/2014/08/06/california-debates-new-regulations-for-diminishing-groundwater-amid-historic-drought/.

295. U.S. DEP'T OF INTERIOR, *supra* note 166, at 1.

296. David R. Steward et al., *Tapping Unsustainable Groundwater Stores for Agricultural Production in the High Plains Aquifer of Kansas, Projections to 2110*, 110 PROCEEDINGS NAT'L ACAD. SCIS., E3477, E3477 (Sept. 10, 2013), *available at* http://www.pnas.org/content/early/2013/08/14/1220351110.full.pdf.

297. *See id.* at E3480.

298. THOMPSON JR. ET AL., *supra* note 145, at 219-20.

institutions within a coordinated policy framework. A National Water Commission equipped to consolidate research and articulate an integrated national policy direction would be a good start;[299] ironically, before the last Commission was disbanded in 1973, it issued a report criticizing poor coordination and investigation of water resource issues in the United States.[300] The European Union's Water Framework Directive, for example, has provided a framework within which innovative ecological monitoring systems have emerged.[301] The federal government can also play a crucial role in facilitating interstate water management by encouraging and brokering negotiated agreements, providing a national voice on basin commissions, and funding research on transboundary water issues. For example, the federal government joins Delaware, New York, New Jersey, and Pennsylvania as one of five voting members of the Delaware River Basin Commission.[302] In times of drought, the Commission is authorized to reduce water diversions.[303]

Federal agricultural policy will greatly influence the degree to which drought resilience in the United States improves. There is an apparent trade-off between showing compassion for the agricultural sector that feeds the nation, and discontinuing policies that spread drought risks across society and thereby disincentivize mitigation.[304] Certainly, to the extent that commodity subsidies, crop insurance, and disaster relief do not provide incentives to relocate agricultural production away from drought prone areas, challenging choices need to be made to balance existing reliance on these policies with the need to preserve water consumption during drought. Simply abolishing subsidies is not a viable option. Drought resilience, however, can be enhanced just as well through inducements as deterrents. The Agricultural Act of 2014, for example, creates an insurance program for diversified farming operations that work with ecological processes by diversifying agricultural products and methods.[305] Diversified farming operations retain water better than industrialized farms, thereby making

299. *On the Need for a National Water Commission for the 21st Century: Hearing Before the H. Subcomm. on Water & Power of the H. Comm. on Res.*, 108th Cong. (2003) (statement of Peter H. Gleick), *available at* http://pacinst.org/publication/hearing-on-the-need-for-a-national-water-commission-for-the-21st-century/.

300. NAT'L WATER COMM'N, WATER POLICIES FOR THE FUTURE 115 (1973).

301. Tarlock, *supra* note 170, at 174 n. 140 (citing Daniel Hering et al., *The European Water Framework Directive at the Age of 10: A Critical Review of the Achievements with Recommendations for the Future*, 408 SCI. TOTAL ENV'T 4007, 4008 (2010)).

302. DEL. RIVER BASIN COMM'N, DELAWARE RIVER BASIN COMPACT 3, 4 (1961), *available at* http://www.state.nj.us/drbc/library/documents/compact.pdf.

303. *Id.* at 8.

304. *See generally* Adler, *supra* note 19 (exploring contradictory policy goals of spreading risk and increasing drought resilience).

305. *2014 Farm Bill Drilldown: Subsidy Reform and Fair Competition,* NAT'L SUSTAINABLE AGRIC. COAL. (Feb. 14, 2014), http://sustainableagriculture.net/blog/farm-bill-subsidy-reform/.

them more resistant to drought.[306] A crop relocation program would be an even stronger measure to increase drought resilience. Providing tax breaks, higher subsidies, direct loans, preferential disaster relief, or other incentives to farmers willing to relocate their crops from water-scarce areas to water-abundant areas, or to areas where crops consume less water, would reduce stress on arid regions and improve agricultural mobility in response to drought.[307]

Crop subsidies can also do more to increase drought resilience. In particular, subsidies can consider the water footprint, or virtual water demand, of crops. Water footprint assessments can be used to determine where and how much water is being consumed by various activities, in order to redistribute water consumption towards more water efficient and economically productive uses.[308] The virtual water trade refers to the invisible water consumed to create exports or imports. By using this approach, states or countries can increase drought resilience by importing water-intensive goods to water-scarce regions, instead of producing those goods domestically.[309] Countries in the arid Middle East, for example, have dramatically reduced their water consumption by simply importing grains instead of growing them.[310] Crop subsidies in the United States that influence commodity markets can similarly be employed to promote or dissuade domestic crop production based on water footprints. The United States has one of the highest virtual water deficits in the world;[311] rectifying that imbalance would significantly increase drought resilience.

A consideration of water footprints and virtual water would also call into question the wisdom of an oligopoly-controlled meat industry in the United States. Part of the water footprint problem can be attributed to high meat consumption per capita (4.5 times the global average), as well as high water consumption per unit (14,500 m^3/ton per kilogram of bovine meat, compared to 9,900 m^3/ton in the United Kingdom).[312] Because water footprint increases with every caloric conversion in the supply chain, animal meat is a water inefficient

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306. Claire Kremen & Albie Miles, *Ecosystem Services in Biologically Diversified Versus Conventional Farming Systems: Benefits, Externalities, and Trade-Offs*, 17 ECOLOGY & SOC'Y 153, 162 (2012).

307. *See, e.g.*, Joep F. Schyns & Arjen Y. Hoekstra, *The Added Value of Water Footprint Assessment for National Water Policy: A Case Study for Morocco*, 9 PLOS ONE 1, 1 (June 2014) (describing the economic benefits of crop relocation in Morocco).

308. IHE DELFT, VIRTUAL WATER TRADE: PROCEEDINGS OF THE INTERNATIONAL EXPERT MEETING ON VIRTUAL WATER TRADE, VALUE OF WATER RES. REP. SERIES 12, 14 (A.Y. Hoeksrta ed., 2003).

309. *Id.*

310. *Id.* at 137.

311. M.M. MEKONNEN & A.Y. HOEKSTRA, UNESCO-IHE INST. FOR WATER EDUC., 2 NATIONAL WATER FOOTPRINT ACCOUNTS: THE GREEN, BLUE AND GREY WATER FOOTPRINT OF PRODUCTION AND CONSUMPTION 4 (2011), *available at* http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol2.pdf.

312. M.M. MEKONNEN & A.Y. HOEKSTRA, UNESCO-IHE INST. FOR WATER EDUC., 1 NATIONAL WATER FOOTPRINT ACCOUNTS: THE GREEN, BLUE AND GREY WATER FOOTPRINT OF PRODUCTION AND CONSUMPTION 27 (2011), *available at* http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf.

method of food production.[313] The meat packing industry's grip on regulatory change is so strong, however, that the 2014 Agricultural Act's omission of a law that would have undermined the Department of Agriculture's regulatory authority was considered a huge success for producers.[314] Therefore, direct regulation of the meat industry (to introduce water efficiency standards, for example) appears unlikely. Nonetheless, employing an inducement approach can incentivize production and consumption of agricultural products lower on the food chain.

Many other measures could contribute to diversifying the drought resilience policy portfolio. Vertical farming in urban areas could be less water-intensive and conducted in water-abundant regions, promoting agricultural mobility.[315] Simply fixing what infrastructure already exists could alleviate water stress—an estimated 240,000 water mains break every year in the United States.[316] That approach would be expensive but necessary, absent more fundamental lifestyle changes.[317] Other improvements to water efficiency, reuse, and stormwater capture also show promise.[318] Ultimately though, drought resilience will be maximized by pursuing policies that encourage mobility (e.g., crop relocation, virtual water trading), diversification (e.g., development of a national integrated water resources management framework), and awareness of changes in the environment (e.g., diversified farming operations, groundwater monitoring).

B. FLOODS

Flood law in the United States rests on three pillars: federal management of large infrastructural projects to control floods, an insurance program that spreads the cost of high-risk development across society, and disaster relief. As detailed in Section III, this approach does not appear to create a sufficiently resilient framework. Infrastructure inevitably deteriorates and sometimes fails, while subsidized insurance and disaster relief do not promote flood mitigation measures

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313. *See generally* Arjen Y. Hoekstra, *The Hidden Water Resource Use Behind Meat and Dairy*, 2 ANIMAL FRONTIERS 1, 1 (Apr. 2012) (examining the water footprint of meat and dairy products).

314. *See 2014 Farm Bill Drilldown, supra* note 305; *see also* Christopher Leonard, *Meat Industry 1, Obama Administration 0*, SLATE (Mar. 4, 2014, 7:52 AM), http://www.slate.com/articles/life/food/2014/03/meat_racket_excerpt_how_the_grain_inspection_packers_and_stockyard_administration.html (reviewing the meat industry's resilience to regulatory reform).

315. Tim Heath & Yiming Shao, *Vertical Farms Offer a Bright Future for Hungry Cities*, THE CONVERSATION (July 21, 2014, 6:10 AM), http://theconversation.com/vertical-farms-offer-a-bright-future-for-hungry-cities-26934.

316. *Drinking Water: Conditions & Capacity*, AM. SOC'Y CIV. ENG'RS, http://www.infrastructurereportcard.org/a/#p/drinking-water/conditions-and-capacity (last visited Apr. 28, 2015).

317. The Environmental Protection Agency estimates that rehabilitating water systems would cost $335 billion. *Drinking Water: Investment & Funding*, AM. SOC'Y CIV. ENG'RS, http://www.infrastructurereportcard.org/a/#p/drinking-water/investment-and-funding (last visited Apr. 28, 2015).

318. *See* PETER GLEICK ET AL., NAT. RES. DEF. COUNCIL, THE UNTAPPED POTENTIAL OF CALIFORNIA'S WATER SUPPLY: EFFICIENCY, REUSE, AND STORMWATER (2014), *available at* http://www.nrdc.org/water/files/ca-water-supply-solutions-capstone-IB.pdf.

like migration away from floodplains or modifications to the built environment. Existing policies do not promote mobility, diversification, or awareness of environmental dynamics. When exploring solutions, two realities must be reconciled. From a cultural point of view, humans enjoy living next to bodies of water. This may derive from an evolutionary need to be located next to water,[319] or may simply be attributed to a common affinity for the aquatic aesthetic.[320] Living close to water bodies is not purely a cultural advantage, however. Floodplains are sometimes the only reliable source of arable land,[321] while port facilities on rivers and coasts provide access to international trade through global shipping networks. Ports provide jobs and income for regions and the United States as a whole,[322] as do industries that capitalize on freshwater and coastal tourism.[323] While a wholesale migration away from floodplains could dramatically reduce vulnerabilities, the value of flood resilience must be weighed against the benefits of floodplain development. Those trade-offs notwithstanding, complete migration is not the only measure capable of promoting flood resilience. Recalling the hunter-gatherer resilience model, policies that promote mobility, diversification, and awareness can provide incremental reductions in vulnerability.

The absence of a national integrated water resources management framework has significance in the flooding context as well. Along with irrigating farmland and controlling water supply, flood control and resilience are other benefits provided by large water projects. That these projects are not placed in a basin-wide management framework makes holistic consideration of costs and benefits unlikely. For example, the interstate water conflict between Georgia, Alabama, and Florida mentioned above centers around the management and downstream impacts of Lake Lanier, a lake originally created for flood control purposes, not water supply.[324] A national vision for water management that integrates flood resilience into a broader water management framework would promote policy diversification and environmental awareness by creating a foundation for basin-level management to build on, while appropriately recogniz-

319. *See, e.g.*, FINLAYSON, *supra* note 81, at 37.

320. One way to measure this reality is through a comparison of residential housing prices. In one study, for example, a lakefront view increased property values by 126.7%, while an unobstructed ocean view increased property values by 58.9%. Earl D. Benson et al., *Pricing Residential Amenities: The Value of a View*, 16 J. REAL ESTATE FIN. & ECON. 55, 68 (1988).

321. *See* Reycraft, *supra* note 114, at 99.

322. The port of Los Angeles, for example, claims to generate 3.3 million jobs in the United States, as well as $27 billion in state and federal tax revenue. *Economic Impact*, PORT OF LOS ANGELES, http://www.portoflosangeles.org/finance/economic_impact.asp (last visited Apr. 28, 2015).

323. The direct and indirect contribution of Miami tourist expenditures in 2013 was $34.2 billion, for example. GREATER MIAMI CONVENTION & VISITORS BUREAU, 2013 VISITOR INDUSTRY OVERVIEW 1, 23 (2013), *available at* http://www.miamiandbeaches.com//media/files/gmcvb/partners/research%20statistics/annual_report_2013.

324. *See* Robert Hasekell Abrams, *Settlement of the ACF Controversy: Sisyphus at the Dawn of the 21st Century*, 31 HAMLINE L. REV. 686, 686 (2008).

ing that water affects many different policy areas including flooding. Coordination and direction of these disparate policy areas can improve information gathering and processing. The European Union's Water Framework Directive, for example, includes a Floods Directive that requires member states to develop risk-management plans.[325] The Floods Directive induced drought resilience policies at the national level.[326]

A coherent vision or an integrated management framework could contribute to alleviating the piecemeal construction and maintenance of the thousands of dams and levees in various states of disrepair as well. Episodic water resource development acts fund local infrastructure projects, but neither the Army Corps of Engineers nor any other agency is authorized to prioritize projects or organize them strategically.[327] In this way, current funding structures show a general disregard for environmental feedbacks and, therefore, basin-level flood resilience. A coherent federal framework that coordinates flood control funding and incorporates basin-level data and information into future planning would improve resilience and, by creating a mechanism that allocates funding based on risk-based environmental rather than political factors, reduce the overall costs of infrastructure spending as well.

Working with nature, not against it, can simultaneously increase flood resilience while decreasing reliance on aging infrastructure by recognizing and cultivating the ecosystem services that natural flood protection systems provide. Natural flood protection incorporates natural elements that can prevent floods from occurring (e.g., forested areas redirect or absorb rainfall, reducing surface runoff and river discharge levels) or mitigate their impact when they do (e.g., wetlands provide retention space for floodwaters).[328] Natural flood protection addresses two prongs of the resilience model: natural flood protection provides an alternative to infrastructure projects and diversifies the flood policy portfolio while increasing awareness and integration of environmental processes by directly incorporating them into flood policy. Some communities have already embraced the concept,[329] but many areas that show high potential for natural

325. Tarlock, *supra* note 170, at 173.

326. Scotland used the Floods Directive to create the Flood Risk Management Act, which considers the potential of natural features to mitigate flood risks. Tarlock, *supra* note 170, at 174 n. 141 (quoting Chris Spray et al., *Bridging the Water Law, Policy, Science Interface: Flood Risk Management in Scotland*, 20 WATER L. 165, 171-72 (2009)).

327. *See id.* at 175.

328. Stoyan Nedkov & Benjamin Burkhard, *Flood Regulating Ecosystem Services—Mapping Supply and Demand, in the Etropole Municipality, Bulgaria,* ECOLOGICAL INDICATORS 67, 68 (2012).

329. The Santa Clara Valley's Water District, for example, integrates natural flood protection into a broader water management plan. *Natural Flood Protections*, SANTA CLARA VALLEY WATER DIST., http://www.valleywater.org/services/naturalfloodprotection.aspx (last visited Apr. 28, 2015); *see also* ENVTL. PROT. AGENCY, WETLANDS: PROTECTING LIFE AND PROPERTY FROM FLOODING (2006), *available at* http://water.epa.gov/type/wetlands/outreach/upload/Flooding.pdf (describing various natural flood protection approaches in the United States).

flood protection development are missing the opportunity.[330] Flood laws can foster a more natural approach by providing grants, loans, or other incentives to public and private floodplain managers.

Addressing obstacles to mobility may be a more challenging endeavor. Aside from the cultural and economic incentives of living in flood-prone areas, there are significant legal hurdles to overcome. Governments that take steps to dampen development in flood-prone areas put themselves at risk of takings jurisprudence that protects property owners from being surprised by regulations affecting their property or from bearing a disproportionate burden of the regulation. In *Lucas v. South Carolina Coastal Council*, for example, the Supreme Court held that a state regulation that prohibited development on barrier islands that are both highly flood-prone and provide flood protection to coastal communities was a taking requiring compensation.[331] Even administrative permit conditions may be limited in promoting flood resilience. In *Koontz v. St. Johns River Water Management District*, the Supreme Court ruled that requiring the applicant to fulfill certain mitigation requirements to obtain a permit (such as wetlands restoration) constituted an impermissible government taking.[332] Clearly then, laws and regulations that dissuade development or mitigate damages in flood-prone areas will have to reconcile existing interests, a formidable but not insurmountable challenge. For example, Davenport, Iowa, uses building codes and natural flood protection systems to restrict development in Mississippi River floodplains, gradually relocating development to upland areas.[333]

Fitting the National Flood Insurance Program ("NFIP") into a more resilient flood policy framework is also a surmountable challenge. The fact that insurance penetration is low even in high-risk areas has several implications.[334] First, it suggests that the moral hazard problem—in which providing insurance at premiums that do not reflect risk incentivizes further development in floodplains—may be more theoretical than observed. One would expect property owners to jump at the chance to receive flood insurance at rates that do not reflect actuarial risk; that they have not suggests that planning for extreme events is not a priority relative to opportunity costs, and that subsidized insurance was not a significant factor in the migration to begin with. If migration toward flood-prone areas is caused by other factors, then targeting the NFIP to redirect development may be ineffective. Low insurance penetration also implies that the NFIP may not be the best vehicle to promote local mitigation measures like land-use controls and building code reforms. Diversifying the policy portfolio to include flood mitiga-

330. A variety of tools and models are available to assist communities in assessing the potential benefits of flood protection ecosystem services. Nedkov & Burkhard, *supra* note 328, at 67.

331. Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1031 (1992).

332. Koontz v. St. Johns River Water Mgmt. Dist., 133 S. Ct. 2586, 2590 (2013).

333. Tarlock, *supra* note 170, at 156 & n. 21 (citing DAVENPORT, IOWA CODE §§ 15.44.010–.270 (2000)).

334. *See* Michel-Kerjan et al., *supra* note 227, at 645, 647.

tion measures in exchange for assistance from other federal aid programs is therefore appropriate.

For environmental justice reasons alone, however, it would be unwise to scrap the NFIP altogether.[335] Rather, targeted improvements can make the NFIP a contributory piece of flood resilience. First, the program needs to show improved awareness of the surrounding environment by reinforcing the capacity of technology experts involved in the flood mapping process. Increasing the number and expertise of staff, as well as the sophistication of their tools, would help premiums reflect actual risk. Second, legislation—such as the 2012 Biggert-Waters Act—should ensure that actual risk is indeed the goal, and promote long-term solvency of the program. Solvency can partly be achieved by improving the flood mapping process to ascertain risk, improving mechanisms that enforce mandatory participation, and further incentivizing mitigation. If all available mitigation measures were adopted, flood damage could be reduced to three percent of present-day levels.[336] Moving in that direction could be achieved by tying long-term insurance to properties or through building code regulations that raise the bar on flood projections.[337] Adoption of even a few of these proposals would increase diversification of flood resilience approaches.

Improving the ability of the NFIP to reduce flood damage would have the corollary effect of reducing reliance on disaster relief. While disaster relief may have some unintended consequences that impede flood resilience (e.g., delaying mitigation because rehabilitation funds will be available), it is unlikely that governments will cease providing disaster relief for two reasons. First, politicians receive immense pressure to provide relief in the days and weeks following disasters, evidenced by higher disaster declarations and relief payouts in election years.[338] Second, the precedent set by disaster relief creates expectations that relief will always be provided, requiring ever higher relief payouts to receive political rewards.[339] These dynamics hold for flooding disasters as well as droughts and wildfires. One solution to the spiral could be a well-publicized cap on disaster relief, putting the public on notice that increasing disaster funds will not be available.[340] A cap relieves politicians of the pressure to increase relief funds, while encouraging mitigation in high-risk areas. Another solution, however, would be to set aside a portion of disaster relief funds for payouts that

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335. Many low-income communities are located in high-risk areas that lack mitigation features. These communities are not well-positioned to migrate to lower-risk areas. *See, e.g.*, J. Chakraborty et al., *Social and Spacial Inequities in Exposure to Flood Risk in Miami, Florida*, NATURAL HAZARDS REV. 1, 1 (Aug. 2014).

336. HUBER, *supra* note 235, at 8.

337. *Id.* at 9.

338. Erwann Michel-Kerjan & Jacqueline Volkman-Wise, *The Risk of Ever-Growing Disaster Relief Expectations* 4 (Risk Mgmt. & Decision Process Ctr., Wharton Sch. U. Pa., Working Paper 09, 2011), *available at* http://opim.wharton.upenn.edu/risk/library/WP2011-09_ReliefExpectations.pdf.

339. *Id.*

340. *Id.* at 20.

promote mobility away from floodplains or arid regions and the wildland-urban interface. Offering to purchase properties at higher than market value, for example, would encourage conversion of high-risk properties into natural flood protection areas and create a path for property owners to migrate without incurring unreasonable expenses. Relief payments can also be conditioned on building mitigation measures into reconstruction at subsidized costs. Funding for these approaches would be prohibitively expensive under most political conditions, but disaster relief provides an opportunity to capitalize on funds that would otherwise inhibit mobility.

The current framework of flood resilience in the United States—infrastructure, government insurance, and disaster relief—is both flawed and entrenched. The resilience model, however, can be used to reduce vulnerabilities and move towards a more proactive, integrated approach. A national vision or coordinating agency for flood resilience would increase environmental awareness through systematic research and information-sharing while ensuring that localized flood protection measures are placed in a broader context. Ecosystem services can be utilized to diversify policy options while moving away from a reliance on existing infrastructure. Flood insurance can more effectively be utilized to promote mitigation and dissuade floodplain development, while disaster relief can be harnessed to induce mobility and land-use conversion to increase resilience.

C. WILDFIRES

The resilience model applied to wildfire law in the United States suggests that two basic modifications to the current approach are needed. On the one hand, managing forests to prevent high-intensity fires by reducing fuel loads or permitting low-intensity fires is straightforward. Moving away from heavy reliance on wildfire suppression would diversify policy options and represent acceptance of environmental feedbacks. On the other hand, slowing migration to, and development in, the wildland-urban interface will require a more complex, gradual approach to induce mobility.

In many ways the limitations of wildfire suppression have already been recognized. Prescribed burns, for example, were authorized as far back as the 1960s.[341] Today, the USDA's National Cohesive Wildland Fire Management Strategy outlines a vision for the twenty-first century that acknowledges the limitations of suppression as well as the benefits of prevention: "To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire."[342] The strategy is

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341. Busenberg, *supra* note 258, at 152.

342. U.S. DEP'T OF INTERIOR & U.S. DEP'T OF AGRIC., THE NATIONAL STRATEGY: THE FINAL PHASE IN THE DEVELOPMENT OF THE NATIONAL COHESIVE WILDLAND FIRE MANAGEMENT STRATEGY 1 (2014).

relatively progressive and well-informed, showing awareness of the surrounding environment and the impacts of a long-standing preference for wildfire suppression, while proposing a diverse set of policy options.[343]

Unfortunately, the National Cohesive Wildland Fire Management Strategy shows signs of preserving the status quo as well, most strikingly by enumerating wildfire suppression as the highest priority.[344] While the strategy is appreciative of approaches that work with nature instead of against it, it is not aggressive in prioritizing them and does not explore options to reduce development in the wildland-urban interface.[345] Simply put, in order to achieve policy diversity and integration of environmental processes, the ratio of wildfire suppression spending to wildfire prevention spending must be balanced. While prescribed burns are not always politically popular,[346] they provide an opportunity to return fire intervals to historic rates, mimicking some of the benefits of naturally occurring low-intensity fires. Similarly, mechanical fuel reduction programs can be both labor-intensive and costly,[347] but offer significant job creation potential and damage savings down the line. Focusing on economic dimensions provides political cover to restructure funding priorities towards proactive wildfire policies. Once prioritized, wildfire prevention funds should be protected from encroachment by excessive wildfire suppression costs. The 2009 Federal Land Assistance, Management, and Enhancement ("FLAME") Act made an attempt to protect wildfire prevention funds, but it was undermined by subsequent cuts in the overall wildfire budget.[348] Renewed calls for fuel reduction programs too often focus on logging as a solution,[349] but Section II above demonstrates that simply cutting down the forest is not a prudent management approach. Integrated forest management that considers natural forest cycles and the ecosystem services they provide will better contribute to wildfire resilience by diversifying policies and incorporating environmental dynamics.

Wildfire resilience can also be achieved by reducing assets in the wildland-urban interface. Deterring development in, or inducing migration away from, forested areas encounters similar takings challenges and resistance from the

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343. *See id.* at 6.

344. *See id.* at 1.

345. Despite acknowledging the rate of growth. *See id*. at 38.

346. A prescribed burn that escaped control near Los Alamos, New Mexico, for example, caused $1 billion in damages. Busenberg, *supra* note 258, at 153.

347. Estimated costs of mechanical fuel reduction range from $35 to $1,000 per acre. Considering that there may be 28 million acres of forest ripe for fuel reduction in the American West alone, total costs could be upwards of $980 million to $28 billion. U.S. DEP'T OF AGRIC., FOREST SERV., A STRATEGIC ASSESSMENT OF FOREST BIOMASS AND FUEL REDUCTION TREATMENTS IN WESTERN STATES 1 (2003), *available at* http://www.fs.fed.us/research/pdf/Western_final.pdf.

348. *See* Rocky Barker, *FLAME Act Fails to Curb Fires; Simpson Wants Them Declared as Disasters*, IDAHO STATESMAN (Aug. 28, 2013), http://archives.mtexpress.com/index2.php?ID=2007147772&var_Year=2013&var_Month=08&var_Day=28#.VPDXWlPF-iZ.

349. *See id.*

vested interests concerning floodplain development detailed above. But deterrence can be promoted through a similar combination of migration-focused disaster relief and financial incentives (e.g., tax breaks and improved loan terms) and incremental land-use regulations. While wildfire prevention policies like prescribed burns, mechanical fuel reduction, and community mitigation are being pursued to varying degrees, there is a legal and policy vacuum with respect to mobility-focused approaches. This vacuum is not explained by a lack of need, as nearly a third of all housing units are located in the wildland-urban interface, a figure expected to rise.[350] Not only does development increase damage when fires occur, it also increases the likelihood that fires will start in the first place: people now cause eighty-five percent of wildfires.[351] As with flooding, inducing population relocations to increase wildfire resilience will incur trade-offs, but they can be incrementally achieved through incentives over time.

Other measures to increase wildfire resilience mirror reforms to drought and flood law. Any government role in wildfire insurance should be met with premiums that reflect actual risk. Disaster relief should be capped to reduce expectations and promote adoption of mitigation features, as well as channel funds toward migration and conservation incentives. The increasing incidence of high-intensity wildfires and consequent damages paint a fairly simple portrait of a landscape being improperly managed. Assets should be moved out of harm's way, known solutions should receive more attention, and the natural cycle of forest growth and fire return should be incorporated into the fabric of wildfire law and policy.

CONCLUSION

Droughts, floods, and wildfires have been features of the American landscape for millennia. From the Pleistocene to the Holocene to what many now call the Anthropocene, humans and their evolutionary ancestors have been faced with extreme natural events and forced to adapt or suffer the consequences. Twenty-first century climate change is exacerbating the cyclical ecological forces driving droughts, floods, and wildfires, but that alone is nothing new. Casting droughts, floods, and wildfires to the sidelines of a larger and more complex contemporary climate change debate threatens to miss the point: measures to increase resilience to extreme natural events are available now with or without climate change action, and conversely, vulnerabilities will remain if climate change mitigation is the only approach taken.

350. U.S. DEP'T OF AGRIC., FOREST SERV., WILDFIRE, WILDLANDS, AND PEOPLE: UNDERSTANDING AND PREPARING FOR WILDFIRE IN THE WILDLAND-URBAN INTERFACE 10 (2013), *available at* http://www.fs.fed.us/openspace/fote/reports/GTR-299.pdf.

351. *Id.* at 15.

For hundreds of thousands of years, hunter-gatherers survived and evolved as a result of extreme droughts, floods, and wildfires. They did so despite extraordinary ecological changes they could not dream of controlling, adapting themselves to the new realities of their environment. Some approaches worked, and inevitably some did not. But a hominid record that stretches millions of years reveals a model for resilience to extreme natural events like droughts, floods, and wildfires. First and foremost, they were mobile. For some hunter-gatherer societies this meant the entire community migrated to a more favorable environment; for others, the relocations were temporary. Whatever the extent, societies that prioritized mobility were successful in removing people and assets from harm's way. Second, their approaches were diversified. Societies were adept at recognizing and exploiting many potential food sources and ecosystem services. Mobility and diversification, in turn, were made possible by a sophisticated awareness of the surrounding environment. Ecological changes and opportunities were recognized and effectively integrated into community decision-making processes. These characteristics of the Paleolithic hunter-gatherer—mobility, diversification, and awareness—allowed societies to survive for thousands, if not millions of years.

The Neolithic Revolution brought a fundamental shift to the human lifestyle. Agricultural systems require settlement and management of a static area. When a drought, flood, or wildfire strikes the region, escape to more favorable conditions is not possible. The vulnerabilities of this approach are exacerbated by reliance on one or a limited number of shortsighted resilience strategies, such as cutting down a forest or building a dam. What mitigation options remain are not capitalized on due to a low level of awareness of the surrounding environment and its feedbacks, or because there is an inability to effectively translate awareness into meaningful policy change. These characteristics of vulnerable civilizations are apparent in the legal frameworks of the United States. The totality of drought, flood, and wildfire laws and policies conforms to three basic approaches: (1) controlling nature; (2) spreading risk across society; and, (3) providing ex-post disaster relief. The first approach utilizes impressive feats of human engineering and ingenuity, but inadequately considers the consequences of modifying natural systems. Relying on infrastructure is equally problematic, because built structures are prone to deteriorate and fail. Spreading risks across society by subsidizing insurance premiums for people and property in high-risk areas is compassionate and may promote other policy interests, but for purposes of building resilience to extreme natural events, it is not productive and may actually be counterproductive. The current trend of distributing generous disaster relief packages to affected communities is similarly compassionate but ineffectual in building resilience. Taken together, the paradigm of disaster law in the United States boils down to strategies that control nature or, should that fail, reactively soften the blow.

Promoting mobility in the current framework does not mean relocating an entire metropolis. Simply not rewarding development in high-risk areas would encourage alternative thinking. More proactive policies to entice relocation would also diminish the number of people and amount of assets at risk, and they would pay for themselves down the road. The pool of policy options available to build resilience is expansive, encompassing integrated national strategy development to local-scale ecosystem services maximization. American communities and the country as a whole will be substantially less vulnerable if changes in the environment are continually monitored and translated into holistic policy changes. This will not only avert disaster either—there are opportunities and synergies between humans and the natural environment that are currently being missed. It is unlikely that the densely populated agricultural societies of the Anthropocene will return to a nomadic hunting and gathering lifestyle. Nonetheless, millions of years of human evolution and adaptation to droughts, floods, and wildfires tell a success story that has long been disregarded. For the sake of collective resilience to extreme events, taking another look and a new approach is necessary. Despite the differences in human lifestyles, droughts, floods, and wildfires have been constant features of humans in their environment. The resilience model of the past provides a paleo perspective on contemporary legal frameworks and can helpfully inform the future.