LOCAL FLOOD RESILIENCY IN AN ERA OF GLOBAL CLIMATE CHANGE: UNDERSTANDING THE MULTI-SECTORAL POLICY DIMENSIONS

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INTRODUCTION

In April 2014, Farmers Insurance Company sued the city of Chicago arguing that city officials failed to prevent flooding related to climate change. The insurance company filed nine class-action lawsuits alleging that dozens of Chicago-area municipalities are responsible for the damage caused by a two-day downpour in April 2013. The company argued that local officials were aware that climate change caused heavier rainfalls, but failed to prevent sewage backups in more than 600 homes by draining water from the region's system of tunnels and retention basins before the storm. Farmers Insurance Company asked the city of Chicago to reimburse the company for the claims

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it paid to homeowners for damages done to their basement walls, floors, and furniture.[2]

Although Farmers Insurance Company eventually dropped its lawsuit in June 2014, what the Chicago/Farmers Insurance Company lawsuit illustrates is something many municipal governments, and also private businesses will confront in the years ahead: the complex legal, policy, and business, risks associated with the global and local impacts of climate change[3] (both known and unknown). Most notably, river and coastal floods are among the United States' costliest natural disasters and represent a growing financial and institutional governance risk for the federal government. Administered by the Federal Emergency Management Agency, the National Flood Insurance Program, for instance, insures 5.4 million individual policies covering $1.3 trillion in flood-prone areas across the country.[4]

To better contextualize the complex legal, policy, and business risks associated with floods and related climatic change, this paper seeks to examine the multi-sectoral dimensions of flood resiliency in the local and the global context. We argue in this article that resiliency is emerging as a critical factor in understanding how local communities in Vermont and elsewhere can sustainably adapt to the complex social, ecological, and economic challenges posed by climate change. Using flood resiliency and water security as theoretical frames, this paper will examine the following issues and questions to provide a nuanced analysis of flood resiliency as an emerging public policy priority:

- Conceptualize resiliency and water security in an era of global climate change;
- Discuss the development of flood control policy in the United States over time;
- Examine flood resiliency as a local policy priority.

This article will conclude by highlighting three emerging flood resiliency-related research issues and questions for scholars and policy makers.

I. CONCEPTUALIZING RESILIENCY & WATER SECURITY IN AN ERA OF GLOBAL CLIMATE CHANGE

Many environmental challenges in contemporary society have been described as "wicked problems" due to their economic, ecological, and social

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2. Rob Moore, *What the Farmers Insurance Suit Tell Us About Climate Change*, NAT. RESOURCE DEF. COUNCIL (May 19, 2014), http://perma.cc/394T-46JU.

3. The terms climate change and global warming will be used interchangeably in this paper.

4. NAT'L ACADS. OF SCIS. ET AL., A COMMUNITY-BASED FLOOD INSURANCE OPTION 1 (2015), https://perma.cc/J9RM-ZDEV?type=image.

complexity. Issues such as climate change (but also water management and biodiversity conservation, among others) extend across air, land, and water; political jurisdictions; landscape boundaries; and traditional policy arenas. That wicked problems face chronic policy failure is not surprising when one considers how most environmental and other types of regulatory policies are usually structured. Regulatory policies tend to focus on specific media (air, water, land, etc.) or on individual substances.[5]

Climate change is arguably the most wicked problem. To address climate change, the international community will need to develop or enhance its ability to cope with, adapt to, and shape change without losing options for future adaptability.[6] Climate adaptation plans need to take into account resilience in terms of an integrated human and natural system, an issue that this paper will explore later.

Understanding resiliency in the context of local and global climate change and other environmental issues is important because existing policy responses to climate change frequently exacerbate the problem (what some economists refer to as the "rebound effect"). These existing policies ignore the social, ecological, and economic complexities of climate change, and also ignore the need to bridge across agencies, jurisdictions, and stakeholders in responding to climate change.[7]

A. Resiliency

"Resilience," in the simplest terms, can be defined as a system's ability to mitigate and withstand disturbances and continue to function afterwards. "Resilience thinking" emerged from the natural sciences with the pioneering work of ecologists C.S. Hollings, Lance Gunderson, and others.[8] The question of what "resilience" is and how it can be enhanced has emerged as the focus of significant research in a wide range of disciplines. There is an established body of work on the concept of resilience within the social sciences and the natural sciences. Additionally, an emerging field of interdisciplinary studies focuses on the resilience of integrated social–ecological systems.[9]

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5. Jennifer H. Allen, *The Wicked Problem of Chemicals Policy: Opportunities for Innovation*, 3 J. ENVTL. STUD. & SCI. 101, 102 (2013).

6. NAVIGATING SOCIAL-ECOLOGICAL SYSTEMS: BUILDING RESILIENCE FOR COMPLEXITY AND CHANGE 1, 3 (Fikret Bekes et al., eds., 2002).

7. Allen, *supra* note 5, at 107–08.

8. STATE OF THE WORLD 2013, IS SUSTAINABILITY STILL POSSIBLE? 354 (2013).

9. Barbara J. Downes et. al., *How Do We Know About Resilience? An Analysis of Empirical Research on Resilience, and Implications for Interdisciplinary Praxis*, ENVTL. RES. LETTERS (2013), http://perma.cc/6L4S-2N93.

The diversity of academic disciplinary interests in resilience means there is considerable variation in the ways resilience is understood and applied. As a result, "resiliency" has been referred to as both a descriptive and a normative concept. It is a way of thinking and a research approach on social, ecological, and social-ecological systems.[10] Walker et al. define "resilience" as ''the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore, identity."[11] Whereas Lebel et al. argue that sustainability can be promoted through building resilience by increasing the capacity to adapt to change and to renew and reorganize.[12]

B. Water Security

There is no single definition of "water security," but there is general agreement that it consists of three elements: water quantity, water quality, and extreme water-related events such as floods.[13] Moreover, water security takes into account the productive (e.g. ensuring the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems, and production) as well as destructive (e.g. maintaining an acceptable level of water-related risks to people, environment, and economics).[14]

To measure water security, policy and decision makers rely on a range of measures that capture the vulnerability of a region or population to water insecurity. Many of the measures used, however, are aggregates of data on a countrywide level. Consequently, the measures hide extreme drought and/or flooding variations on the regional level. They may also give misleading or inaccurate conclusions due to a lack of data from some countries and/or regions, or because of the differences in the way different countries define flooding, drought, or other water security concerns.[15]

The September 2014 flooding in the Kashmir region of Northern India and Pakistan illustrates flooding as a water security concern. This flood took more than 550 lives and uprooted thousands of residents on both sides of the highly politicized border.[16] Unfortunately, contentious South Asian regional

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10. *Id.*

11. Brian Walker et al., *A Handful of Heuristics and Some Propositions for Understanding Resilience in Social-Ecological Systems,* 11 ECOLOGY & SOC'Y (2006), http://perma.cc/HJ4D-TDWE.

12. Louis Lebel et al., *Governance and The Capacity to Manage Resilience In Regional Socialecological Systems*, 11 ECOLOGY & SOC'Y (2006), http://perma.cc/Q9HB-87JH.

13. KAREN HUSSEY, WATER SECURITY, ENCYCLOPEDIA OF SUSTAINABILITY 498 (2010).

14. David Grey & Claudia W. Sadoff, *Sink or Swim? Water Security for Growth and Development*, 9 WATER POL'Y, 545, 548 (2007).

15. HUSSEY, *supra* note 13 at 499.

16. Mandakini D. Surie, *Desecuritizing Transboundary Water in South Asia*, ASIA FOUND. (Sept. 17, 2014), http://perma.cc/LPX3-PA3F.

politics overshadow the fact that floods are a frequent occurrence in South Asia, where transboundary rivers such as the Indus, the Ganges, and the Brahmaputra have served as the cradles of civilization for centuries.[17]

Worshipped, revered, and the source of livelihoods for an estimated 700 million people for centuries, the Indus, Ganges, and the Brahmaputra rivers represent the economic, social/cultural, and environmental lifeline of the subcontinent. However, seasonal variations in the monsoon coupled with the effects of global warming and climate change have led to a growing number of intense floods in the region. Some of these floods include the 2008 Kosi floods in Nepal, the 2010 Indus floods in Pakistan, and the 2011 Uttarakhand floods in India.[18]

Despite the frequency and transboundary nature of these extreme events, cooperation between countries remains limited. The tendency to look at South Asia's water systems through the national security lens means that even basic information about transboundary rivers, including stream and sediment flow, water withdrawal, and water usage is notoriously difficult to access within countries and across borders. In India, for example, all data and information on the Indus, Ganges, and Brahmaputra rivers are classified information. On water-induced and climate-induced disasters, South Asian countries have chosen not to reveal critical information rather than use it to collectively manage the regional social, economic, and environmental risks linked to the annual monsoon cycle.[19]

The flooding in the South Asia's Kashmir region shows that water security is more than just the quality of water and quantity of water (either drought or flooding, for instance) in a certain community. There are also many social, economic, cultural, and environmental factors that influence the resilience of any given population to water problems.[20] Ken Conca observed this in his book:

> As with many other festering socioenvironmental problems, it has not been possible to hold either water or forest issues within the standard institutional vessel of sovereign, authoritative governments, fixed and meaningful borders, and unambiguous knowledge-based truths. . . . The world's water is indeed subject to deeply and increasingly transnational forms of governance.[21]

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17. *Id.*
18. *Id.*
19. *Id.*
20. HUSSEY, *supra* note 13, at 499.
21. KEN CONCA, GOVERNING WATER: CONTENTIOUS TRANSNATIONAL POLITICS AND GLOBAL INSTITUTION BUILDING 5 (2006).

II. UNDERSTANDING U.S. FLOOD POLICY: FROM CONTROL TO MANAGEMENT

U.S. policies on flood control have evolved through a series of governance transitions over the past 200 years.[22] During the 19th century, states and local governments assumed primary responsibility for flood control.[23] The federal government slowly took control over flood control policy during the 20th century,[24] while states have emerged as the primary authority, in collaboration with federal experts, over the past few decades.[25]

Flood control strategies have also evolved over time. Early in U.S. history, flood events were viewed as inevitable and passive adaptation was an accepted approach to deal with flood impacts.[26] Indeed, Native Americans simply adapted to floods by retreating to higher ground when rivers flooded. But as the country's population grew in the 19th century and human settlements increasingly developed in flood-prone areas, quick retreat or relocation during a flood event became impossible.[27]

A. Engineering to "Control" Floods

By the mid-19th century, state and local governments began focusing on engineered technological solutions to protect against flooding impacts.[28] The dominant paradigm, which would persist throughout most of the 20th century—and to a great extent remains imbedded today—was the expectation that the government would provide maximum protection from floods.[29] Policy measures in this period favored construction of structural defenses such as levees, dams, and jetties to protect citizens against flood damages.[30] Engineers deepened and straightened rivers to accelerate water flow past vulnerable areas and armored riverbanks with riprap and cement barriers to prevent erosion.[31] Because officials at the state or local level

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22. *See generally* 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 (2012) (discussing the evolution of flood control policy throughout United States history).

23. *Id.* at 158.

24. *Id.*

25. Debbie M. Chizewer & A. Dan Tarlock, *New Challenges for Urban Areas Facing Flood Risks*, 40 FORDHAM URB. L.J. 1739, 1752–55 (2013).

26. Tarlock, *supra* note 22, at 155–56.

27. *Id.* at 156.

28. Chizewer, *supra* note 25, at 1754–55.

29. Tarlock, *supra* note 22, at 151–52.

30. *Id.* at 151.

31. Greg O'Brien, *Making Mississippi River Over Again: The Development of River Control in Mississippi*, MISSISSIPPI HISTORY NOW (Mar. 2002), http://perma.cc/NWD6-3TH8.

initiated flood-control projects, there was little or no coordination across different watersheds.

Over time, the federal government assumed more responsibility over flood control policy, but the focus on structural controls continued.[32] A series of federal statutes, starting with the Flood Control Act of 1917, increased the federal government's authority to authorize and initiate the construction of flood control structures.[33] Congress passed a number of other flood-control-related statutes during the 20th century, each embracing structural solutions and each increasing federal authority over policy.

Flood policy statutes and individual flood control projects often arose in response to specific damaging flood events. For example, the Flood Control Act of 1928[34] came in response to Mississippi River flooding in 1927.[35] That Act also increased federal authority by giving the U.S. Army Corps of Engineers ("USACOE") primary authority to design and build such structures and made flood control a central mission of the USACOE.[36]

Most notably, the Flood Control Act of 1936 cemented the structural engineering approach to managing flood impacts and promoted the notion that engineered structural solutions would "improve" waterways.[37] By the 1930s, the favored approach to floodwater management shifted from the development of levee systems to building dams for floodwater retention.[38] The floodwater retention strategy gained prominence during the New Deal era and continued into the years following World War II.[39] Today, the USACOE maintains over 600 flood control dams across the country.[40]

Even with broader federal control over flood protection projects by the middle of the 20th century, there was little coordination across watersheds, and planning took place on a project-by-project basis.[41] For example, although the 1936 Act called for agency officials to conduct watershed studies when considering flood control related projects,[42] the USACOE identified specific structural projects but did not consider broader watershed

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32. Tarlock, *supra* note 22, at 158.
33. Flood Control Act of 1917, 33 U.S.C. §§ 701–03 (2012).
34. 33 U.S.C. § 702 (2012) (originally enacted as the Flood Control Act of 1928, ch. 569, 45 Stat. 534 (1928)).
35. O'Brien, *supra* note 31, at 4.
36. 33 U.S.C. § 702 (1928).
37. 33 U.S.C. § 701(a) (1936).
38. Tarlock, *supra* note 22, at 161–62.
39. *Id.* at 162.
40. NAT'L RES. COUNCIL, NATIONAL WATER RESOURCES CHALLENGES FACING THE U.S. ARMY CORPS OF ENGINEERS 8 (2011).
41. Tarlock, *supra* note 22, at 164.
42. 33 U.S.C. § 701 (2012) (instructing that "[a]ll examinations and surveys of projects relating to flood control shall include a comprehensive study of the watershed or watersheds.").

impacts.[43] "[The Act] did not promote modification of land uses that exacerbate erosion and runoff, much less restoration of natural land and water functions and interactions."[44] The primary concern under the Act was the selection of discrete projects based on careful cost-benefit analysis, rather than on broad based and integrated planning for an entire basin.[45]

B. Evolving Flood Policy Approach: From Control to Management

Despite the extensive development of structural defenses across the country, flood damages persisted throughout the 20th century, and many scientists and policy-makers started to question the dominant policy paradigm of flood "control." As early as 1940, geographer Gilbert White argued against the reengineering of waterways and demonstrated that a focus on structural solutions for flood control created difficult "moral-hazard" problems.[46]

A "moral-hazard" problem refers to a situation where undesirable and inefficient behaviors are encouraged by the expectation of protection, safety, or freedom from punishment.[47] The "moral-hazard" problem is typically associated with insurance, where the security that insurance provides eliminates any incentive to take reasonable steps to reduce the risk of a particular potential harm.[48] In the realm of flood control policy, the expectation that structural defenses such as dams and levees could prevent flood damage served only to encourage development in flood-prone areas.

Despite advancements in scientific understanding and the influence of those such as White, flood control planning throughout most of the 20th century focused on developing structural defenses on a project-by-project basis.[49] Policy slowly started to shift in the 1970s when congressional support for major water planning projects waned.[50]

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43. Robert W. Adler, *Addressing Barriers to Watershed Protection*, 25 ENVTL. L. 973, 1026 (1995) ([I]mplementation of this provision . . . led not to comprehensive watershed analysis, but to identification of discrete projects. The Act permitted, but did not require, interagency coordination and cooperation. Even when the provision caused agencies to consult, it did not force consensus. Instead the Corps was simply required to forward the views of other agencies to Congress along with the Corps' recommendations.).

44. *Id.* at 1027.

45. 33 U.S.C. § 701 (declaring that the federal government shall improve waters if the benefits outweigh the estimated costs).

46. GILBERT F. WHITE, HUMAN ADJUSTMENT TO FLOODS: A GEOGRAPHICAL APPROACH TO THE FLOOD PROBLEM IN THE UNITED STATES (1945).

47. RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 136–37 (8th ed. 2011).

48. *Id.*

49. Tarlock, *supra* note 22, at 164.

50. Chizewer, *supra* note 25, at 1751–53.

This coincided with a growing acceptance of the reality that government cannot prevent all flood damage. Congress soon decided to approve flood control initiatives only through periodic water-resources-development acts rather than comprehensive flood control statutes.[51] This decision left projects dependent on individual appropriations for funding.[52] Although federal funding for major projects has dwindled in recent years, emergency funding in the wake of flood events remains "substantial," reflecting the reactive nature of current federal flood control policy.[53]

With the ongoing failure of a policy based primarily on structural defenses clearly in view, Congress enacted the National Flood Insurance Program ("NFIP") in 1968.[54] The NFIP provided for federally subsidized flood insurance that was unavailable in the private insurance industry. The program is only available to residents in towns that have adopted land-use controls that limit development in floodplains and flood-prone areas.[55] The NFIP represented a shift away from strictly structural flood policies, but according to many experts the program "was flawed from the start, and its problems have progressively worsened."[56] When combined with structural flood control defenses, the new insurance program only further encouraged "moral-hazard" behavior—more development in high-risk areas.

Most critically, the rapid development of the science of hydrology and fluvial geomorphology from the mid- to the late-20th century lead to an emerging policy perspective. This policy perspective recognized that managing floodplains requires conservation-based measures that work with nature (e.g., seeing wetlands as an ecosystem service with unique ecological and economic/business value) and practice community-based climate resilience, rather than relying on techniques that simply attempt to tame waterways.[57]

For example, rivers need room to meander and gradually change course over time.[58] Channelization cuts off a river's access to the floodplain and prevents the river from maintaining its own equilibrium.[59] Structural solutions such as channelizing and armoring riverbanks can limit some

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51 *Id.*

52. *Id.*

53. *Id.* at 1753; *see generally* NICOLE T. CARTER & H. STEVEN HUGHES, ARMY CORPS OF ENGINEERS WATER RESOURCES ACTIVITIES: AUTHORIZATION AND APPROPRIATIONS 6–7 (2005) (stating that funding has been reduced and resources are limited).

54. 42 U.S.C. §§ 4001-28 (2012).

55. 44 C.F.R. §§ 60.1–60.3 (2015).

56. Tarlock, *supra* note 22, at 168.

57. NEW STRATEGIES FOR AMERICA'S WATERSHEDS, NAT'L ACAD. SCIS. 150–51 (1999).

58. *Id.* at 42–43.

59. *Id.* at 98.

damage from a small flood event, but they cannot completely prevent it.[60] In many cases, reengineering waterways results in the transference of flooding and erosion problems downstream.[61]

The perverse unintended consequences of traditional flood control engineering solutions may be best seen in the levee systems built in Louisiana to protect the residents who live in New Orleans and the coastal regions. Despite the years of investments in constructing and maintaining the levee systems, by the year 2100, 2,000 square miles of Louisiana's coastal landscape are expected to turn into open water, bringing the Gulf of Mexico to the back door of New Orleans with the Gulf of Mexico's expected rise of 4.3 feet across this Louisiana landscape (which has an average elevation of about three feet), everything outside the protective levees (which includes most of Southeast Louisiana) would be underwater by the year 2100.[62]

Moreover, there is growing scientific evidence that global warming-induced sea level rise is compounding the economic, social, and environmental risk from storm surges throughout the coastal contiguous United States. According to Climate Central, a nonprofit scientific organization, sea level rise due to global warming has already doubled the annual risk of coastal flooding of historic proportions across widespread areas of the United States.[63]

By 2030, many locations are likely to see storm surges combining with sea level rise to raise waters at least four feet above the local high-tide line, which has the potential to impact nearly five million U.S. residents living in 2.6 million homes.[64] More than six million people live on land below five feet and by 2050 the study projects that widespread areas will experience coastal floods exceeding this higher level. According to the Surging Sea lead author, Dr. Ben Strauss:

> Sea level rise is not some distant problem that we can just let our children deal with. The risks are imminent and serious. Just a small amount of sea level rise, including what we may well see within the next 20 years, can turn yesterday's manageable flood into tomorrow's potential disaster. Global warming is already making coastal floods more common and damaging.[65]

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60. *Id.* at 98, 100.
61. *Id.* at 95, 98.
62. Bob Marshall et al., *Losing Ground*, PROPUBLICA (Aug. 28, 2014), http://perma.cc/TSG4-9KF7.
63. BEN STRAUSS ET AL., SURGING SEAS: SEA LEVEL RISE, STORMS & GLOBAL WARMING'S THREAT TO THE US COAST (Mar. 2012), http://perma.cc/4B59-9LVR.
64. *Id.*
65. *Id.*

Moreover, by tracking historical records of rainfall, tide gauge readings, and hurricane tracks to assess the simultaneous occurrence of heavy precipitation on land and storm surges in the United States, a 2015 Nature Climate Change article suggests that the combination of these two (heavy rain and storm surges) can result in what the authors describe as "compound" floods.[66] Over the past century, the number of these compound flood events for many United States coastal cities has increased and this trend is likely to continue with even greater intensity, which has important implications for flooding risks in some cities including Boston, New York City, Tampa, Houston, San Diego, Los Angeles, and San Francisco, among others.

III. TOWARD A NEW POLICY STRATEGY OF FLOOD RESILIENCY: VERMONT CASE STUDY

Building resilience can be seen as an antidote to individual and community-level vulnerability and a self-sustaining approach to promoting sustainable community development. The more integrated nature of the global economy, society, and ecosystem increases the likelihood of transmitting and magnifying vulnerabilities on the local level. Our need to develop more sophisticated approaches to resilience needs to grow in parallel.[67]

Over the past thirty years, states and local governments have slowly reclaimed primacy in the realm of flood control policy.[68] As noted above, federal funding has waned and Congress has increasingly become weary of appropriating large sums of money for local projects.[69] Instead, the federal government now serves primarily as a consultant for state and local governments as they tailor flood control policies to the circumstances of their particular region.[70]

Across the country, flood policy is slowly shifting towards an adaptive management approach with the new buzzword of "resiliency" as the driver of policy.[71] The new goal of resiliency is based on the understanding that

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66. Thomas Wahl et al., *Increasing Risk of Compound Flooding from Storm Surge and Rainfall for Major US Cities*, NATURE CLIMATE CHANGE (2015), http://perma.cc/8BAP-L7G5.

67. JUDITH RODIN & ROBERT GARRIS, RECONSIDERING RESILIENCE FOR THE 21ST CENTURY 110–11 (2012).

68. Chizewer, *supra* note 25, at 1751–53; *see also* RICHARD A. COLE, IMPROVING WATERSHED PLANNING AND MANAGEMENT THROUGH INTEGRATION: A CRITICAL REVIEW OF FEDERAL OPPORTUNITIES 8–9 (2002).

69. *Id.*

70. *Id.*

71. *See generally* ARJEN BOIN ET AL., THE RISE OF RESILIENCE 1 (2010) (stating that resiliency is a buzzword changing policies).

some flooding is inevitable and that communities must be able to adapt to flood events by restoring natural systems, not necessarily by doubling down on structural defenses.[72] Still, the transition towards more ecologically sustainable adaptation techniques has been painfully slow and "the structural-defense paradigm remains firmly entrenched because of the strong expectations of safety and security it has engendered."[73] While there is still uncertainty about climate change and its potential impacts, significant disturbances such as storms, floods, and droughts are already occurring. This is particularly the case in the winter of 2015–2016 because of the so-called El Niño weather effect. While no clear link has been established between stronger El Niño phenomena and global climate change, many scientists believe that higher sea temperatures resulting from the greenhouse effect could strengthen the intensity of El Niño events and increase their rate of occurrence.[74] Since local communities may not be able to control the occurrence of those events, they need to create the capacity to deal with the resultant change.[75]

A. Flood Resiliency in the Context of Vermont

Nearly five years after Hurricane Irene and amidst growing evidence of climate change's impact in the U.S. Northeast region and beyond, there is a critical need to better understand what community based climate resilience can mean for Vermont. Greater resiliency at the community level means anticipating change and then shaping community responses in order to promote a more sustainable future without losing options in the process.[76]

As Sue Minter, former Hurricane Irene recovery officer and former Deputy Secretary of the Vermont Agency of Transportation noted:

> Resilience is about both our people and our environment. In a resilient Vermont, the built environment can coexist with the natural world, and people will adapt to a future with more frequent and intense storms. This requires deepening our understanding of these likely changes, and developing

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72. NAT'L ACAD. SCIS., *supra* note 57, at 63, 65.

73. Tarlock, *supra* note 22, at 166.

74. Wenju Cai et al., *Increasing Frequency of Extreme El Niño Events Due to Greenhouse Warming*, NATURE CLIMATE CHANGE (2014), doi:10.1038/nclimate2100, perma.cc/PGF4-8YUV.

75. Casilda Saavedra & William Budd, *Climate Change and Environmental Planning: Working to Build Community Resilience and Adaptive Capacity in Washington State, USA*, 33 HABITAT INT'L 246, 248 (2009).

76. *Id.*

> strategies to respond to a changing ecosystem and reduce future risks to human safety.[77]

Changes to flood control policy in Vermont over the past 20 years generally reflects two ongoing transitions: increased state and local control, and a slow shift towards modern risk-based adaptive management schemes aimed at increasing flood resiliency.[78] As is typical of many significant changes in flood policies in the United States, Vermont policy shifted in direct response to major flood events.[79]

The Vermont legislature passed Act 137[80] in 1998 in response to a number of major floods in the 1990s that burdened the state with millions of dollars in recovery costs.[81] This was a crucial first step in developing the state's overall scheme to protect river corridors, and it created a "Fluvial Erosion Hazard Program" requiring state officials to develop flood hazard mitigation and avoidance measures.[82] The Act also resulted in the creation of the Vermont "Rivers Program," which helps the state partner with community-based organizations to undertake comprehensive studies of the health of river systems.[83] Those assessments have helped the state Department of Environmental Conservation develop river corridor maps that help towns identify areas that should be protected from development through local land use regulations.[84]

On the heels of flooding in the Lake Champlain basin in the spring of 2011, Vermont took another step with the passage of Act 110. The Act directs the Agency of Natural Resources to establish a river corridor management program and a shoreland management program to provide all municipalities with maps of designated river corridors and to develop recommended best management practices for the management of river corridors, shorelands, and

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77. VT. NAT. RES. COUNCIL, RESILIENT COMMUNITIES SCORECARD: A TOOL FOR ASSESSING YOUR COMMUNITY 2 (2013), http://perma.cc/L9LJ-M3C2.

78. *See generally* David K. Mears & Sarah McKearnan, *Rivers and Resilience: Lessons Learned from Tropical Storm Irene*, 14 VT. J. ENVTL. L. 177, 189–99 (2013) (illustrating the increased role of state and local governments with flood recovery).

79. *See* VT. NAT. RES. COUNCIL, *supra* note 77; VT. DEP'T OF ENVTL. CONSERVATION, RIVER, RIVER CORRIDOR, & FLOODPLAIN MANAGEMENT PROGRAMS: BIENNIAL REPORT TO THE GENERAL ASSEMBLY PURSUANT TO ACT 110 3 (2013).

80. An Act Relating to the Development of a Disaster Relief, Recovery, and Mitigation Plan, 10 V.S.A § 905(b)(3)(A) (1998).

81. VT. AGENCY OF NAT. RES. RIVER MGMT. PROGRAM, MUNICIPAL GUIDE TO FLUVIAL EROSION HAZARD MITIGATION 1 (2010) (noting that "[d]uring the period of 1995-1998 alone, flood losses in Vermont alone totaled nearly $57 million").

82. *Id.*

83. VT. AGENCY OF NAT. RES., OPTIONS FOR STATE FLOOD CONTROL POLICIES AND A FLOOD CONTROL PROGRAM 1–5 (1999), http://perma.cc/9JQS-DYQH

84. *See generally* Mears, *supra* note 78, at 192 (discussing the development of river maps).

buffers.[85] Not long after the passage of Act 110, Tropical Storm Irene struck Vermont, dumping up to eight inches of rain in some areas over a period of twenty-four hours.[86] Flood damage was widespread throughout the state—destroying bridges, impacting 500 miles of road, damaging thousands of homes and businesses, and burdening the state with hundreds of millions of dollars in recovery costs.[87]

In direct response to Tropical Storm Irene, Vermont passed Act 138 to create the Flood Resilient Communities Program.[88] The new statute builds on the Act 110 river corridor management program by incorporating more incentives to encourage municipalities to adopt more progressive river corridor protection strategies.[89] These incentives are tied to the state's Emergency Relief and Assistance Fund ("ERAF"), which is used to help communities recover from flood damages and pay to repair and replace transportation infrastructure, debris removal, and other emergency measures.[90] Towns that adopt recommended zoning bylaws protecting river corridors are eligible for a larger contribution from the fund to help respond to future floods.[91]

In May 2013, Vermont passed Act 16 with the purpose of encouraging the development of more flood resilient communities.[92] The Act requires that after July 1, 2014, all Municipal and Regional plans must include a "flood resilience element" that provides a clear vision for how the region or specific town will mitigate against flood damage and respond to future floods.[93] Again, the legislature incorporated financial incentives into the Act. Towns that adopt a flood resilience element in their town plan and have it approved by their Regional Planning Commission are eligible for increased funding through the Municipal Planning Grant Program.[94]

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85. VT. AGENCY OF NAT. RES., *supra* note 77.

86. NADO RESEARCH FOUND., LESSONS LEARNED FROM IRENE: VERMONT RPCS ADDRESS TRANSPORTATION SYSTEM RECOVERY 3 (2013).

87. *Id.* at 3–4.

88. An Act Relating to the Regulation of Flood Hazard Areas, River Corridors, and Stream Alteration, 10 V.S.A. § 32 (2012); OFF. OF LEGIS. COUNCIL, SUMMARY OF THE ACTS AND RESOLUTIONS OF THE 2012 VERMONT GENERAL ASSEMBLY 8 (2012), http://perma.cc/4D82-QPPN.

89. MILLY ARCHER, VT. LEAGUE FOR CTRS. & TOWNS, MUN. ASSISTANCE CTR., FLOOD DAMAGE MITIGATION INCENTIVES FOR MUNICIPALITIES UNDER THE NEW ERAF RULE (2012), http://perma.cc/94KK-F276.

90. *Id.*

91. *Id.*

92. An Act Relating to Municipal and Regional Planning and Flood Resilience, 24 V.S.A. § 4302 (2013).

93. VT. DEP'T OF ENVTL. CONSERVATION, WATERSHED MGMT. DIV., SUMMARY OF ACT 16: MUNICIPAL AND REGIONAL FLOOD RESILIENCE PLAN LEGISLATION (2013), http://perma.cc/B3J5-QFZ2.

94. *Id.*

Land-use controls represent the key to the creation of more flood resilient communities, and because most land-use decisions occur on the local level, Vermont's state incentive programs for municipalities are particularly important. Legislators and state officials hope that the new incentives will help raise public awareness about river corridor and floodplain functions, and motivate landowners and municipalities to take proactive steps to reduce property loss, protect water quality, and build greater resilience to future flood damages.

Progress on flood policy in Vermont provides a clear example of a circumstance where the federal government serves as a facilitator and advisor in flood control planning. In the aftermath of Tropical Storm Irene, Vermont requested assistance from the federal government to help communities prepare for future flood events.[95] The Environmental Protection Agency ("EPA") partnered with the Federal Emergency Management Agency ("FEMA") to give Vermont support through EPA's Smart Growth Technical Assistance Program ("SGTAP").[96] That assistance resulted in a detailed memorandum offering a "menu of strategies and land use policy options for communities in Vermont and around the country to consider as they seek to improve resilience to future flooding events."[97]

IV. TOWARD A NEW MODEL OF FLOOD RESILIENCY 2.0: MEETING THE LOCAL AND GLOBAL CHALLENGES OF ENVIRONMENTAL GOVERNANCE

In addition to the complex legal, policy, and business risks associated with floods and other consequences of climatic change, the Farmers Insurance Company case study highlights three questions as policy makers, civil society, and other stakeholders struggle to define this emerging model of flood resiliency 2.0.

First, as the international community continues to engage itself with the global climate change convention negotiations in 2015 in Paris, how much progress on local flood resiliency efforts is realistic without strong and credible action on a wide range of global climate change, ecosystem, and environmental governance matters? While the lack of progress in terms of global climate governance has been well-documented both in the media and academic scholarship, what has received comparatively less attention is the

95. U.S. ENVTL. PROT. AGENCY, DISASTER RECOVERY AND LONG-TERM RESILIENCE PLANNING IN VERMONT: U.S. EPA SMART GROWTH IMPLEMENTATION ASSISTANCE PROJECT GUIDANCE DOCUMENT FOR THE STATE OF VERMONT 3 (2013).

96. *Id.*

97. *Id.* at 4.

scope of legal and institutional paralysis on a wide range of global environmental policy priorities.

According to a 2014 analysis published in Foreign Policy, the number of international agreements on environmental issues has declined significantly over the past fifteen years.[98] International environmental agreements (including amendments that revise prior agreements) reached their peak in the early 1990s and have declined significantly since then: 107 agreements in the 1960s; 143 in the 1970s; 175 in the 1980s; 353 in the 1990s; 244 in 2000s; and finally 70 so far in the 2010s.[99] To illustrate this decline, it is useful to compare 2014 (even with the highly successful climate change march in New York City in September 2014) with 1992 when the Earth Summit in Rio de Janeiro; U.N. Framework Convention on Climate Change; the Rio Declaration on Environment and Development; Agenda 21, a nonbinding sustainable development plan; and the 1992 Convention on Biological Diversity were all launched.[100]

Second, who needs to be financially "accountable" for the expected economic loss and damage associated with flooding and other climate change-linked consequences and risks? The 2007 Bali Action Plan stated the importance of mobilizing financial resources and investment to support climate change-related mitigation, adaptation and technology cooperation activities, including:

> improved access to adequate, predictable and sustainable financial resources and financial and technical support[;] . . . mobilization of public- and private-sector funding and investment, including facilitation of climate-friendly investment choices[;] . . . [f]inancial and technical support for capacity-building in the assessment of the costs of adaptation in developing countries, in particular the most vulnerable one . . . .[101]

Despite the obvious importance, it is unclear what constitutes a "sustainable" level of financial resources and investments in climate change-related mitigation, adaptation, and technology cooperation activities. On the lower end of the cost estimate, the World Bank estimates that up to $100

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98. Kate Galbraith, *Environmentalism is Dead*, FOREIGN POL'Y (Sept. 25, 2014), http://perma.cc/X3KH-FPN6.

99. *Id.*

100. *Id.*

101. United Nations Framework Convention on Climate Change, *Report of the Conference of the Parties at its Thirteenth Session*, 5, U.N. Doc. FCCC/CP/2007/6/Add 1* (Dec 3–15, 2007), http://perma.cc/C9AE-YB42.

billion in mitigation and $30–70 billion in adaptation spending will be required in 2030, eighty percent of which will have to be financed by the private sector. [102] At the high end of the estimate, the Stern Review suggests committing one percent of the global GDP, somewhere between $350 and $480 billion each year to cut Greenhouse Gas ("GHG") emissions. [103] At the middle of the cost estimate, the United Nations Framework Convention on Climate Change report states that additional mitigation-related investment[104] and financial flows of $200–10 billion as well as $20–30 billion in adaptation-related investment and financial flows would be necessary in 2030 just to return GHG emissions to current levels, with eighty-six percent of the investment and financial flows being generated from the private sector.[105] Whatever the financial level of resources that will be available on the global level, the Green Climate Fund is expected to be the primary funding vehicle.

An important new legal and organizational feature of the climate change convention, which may have a large impact on how the international community answers the question of "who pays or should pay," is the Warsaw International Mechanism for Loss and Damages. Following two years of deliberations, the 2013 Conference of Parties established the Warsaw International Mechanism for Loss and Damage as the primary vehicle under the Convention to promote the implementation of approaches to address loss and damage in a comprehensive and integrated manner.[106] A special U.N. committee has been established to develop the concept of loss and damage and institutionalize it over the next three years under the auspices of the U.N. Climate Change Convention.[107]

Third, how can the institutional void caused by the "mismatch between the assumptions of the legal system and the dynamics of ecological systems" be effectively addressed or at least better managed?[108] Despite important advancements in states like Vermont, there is still no coherent nationwide

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102. *See* WORLD BANK, DEVELOPMENT AND CLIMATE CHANGE: A STRATEGIC FRAMEWORK FOR THE WORLD BANK GROUP 26 (2008), http://perma.cc/3LCG-KVT5 (estimating costs and investment requirements for mitigation and adaptation).

103. NICHOLAS STERN, STERN REVIEW: THE ECONOMICS OF CLIMATE CHANGE 248–49 (2006), http://perma.cc/T78E-SBSP.

104. UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, INVESTMENT AND FINANCIAL FLOWS TO ADDRESS CLIMATE CHANGE 92 (2007), http://perma.cc/XLR7-WMPE.

105. *Id.* at 5.

106. *Warsaw International Mechanism for Loss and Damage Associated with Climate Change Impacts*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE (2013), http://perma.cc/7DNE-A9PK (last visited Dec. 8, 2015).

107. Sophie Yeo, *UN Inches Forward with Climate Compensation Plans*, CLIMATE HOME (Sept. 18, 2014), http://perma.cc/F8EE-5AFB.

108. Craig Anthony Arnold & Lance Gunderson, *Adaptive Law and Resilience*, 43 ENVTL. L. REP. NEWS & ANALYSIS 10426, 10427 (2013).

flood resilience strategy (nor, arguably, any substantial political support one) in the United States.[109] The legacy of the structural defense paradigm is strong, and the transition to adaptive management schemes has been extremely slow and inconsistent across the country.[110]

For many years, there has been a critical need for policymakers to develop a legal framework that is adaptive and able to adjust to scientific uncertainty and sudden changes in environmental conditions. Unfortunately, "current water resource management techniques remain wedded to a concept of 'stationarity' – the idea that natural systems fluctuate within an unchanging envelope of variability."[111] Not coincidentally, most federal environmental statutes were built based on the understanding that nature is relatively stable.[112] This results in policies that are preservationist, reactionary, and all together unprepared to adequately respond to environmental challenges faced by climate change.

Currently, "nature and human relationships with nature are to be regulated and managed based on historic conditions and linear patterns of change that are designed to return these systems to a particular (generally pre-disturbance) state."[113] In the realm of flood control policy, our focus on stabilizing and preserving river systems has "led to ecosystems that are much less resilient and more vulnerable to various shocks – ecologic or economic."[114]

The result is that new legal regimes aimed at increasing flood resiliency must overcome "simultaneous overlap and fragmentation, where more than one area of law with distinct mechanisms [applies] to mitigation and adaptation initiatives."[115] For example, maintaining a resilient river system would necessarily involve protecting impacts to the adjacent wetlands that attenuate flood waters (e.g., the Clean Water Act) and also limiting development in floodplains (e.g., local land use regulations).

Truly adaptive and resilient policies will embrace flexibility and allow for legal regimes that interact across statutory boundaries and allow for productive interaction between federal, state, and local authority. In effect, any flood resiliency policy and planning, whether locally or globally situated, need to be "resilient" in both theory and practice.

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109. Tarlock, *supra* note 22, at 172.

110. *Id.* at 166.

111. Robin Kundis Craig, *"Stationarity Is Dead" – Long Live Transformation: Five Principles For Climate Change Adaptation Law*, 43 HARV. ENVTL. L. REV. 9, 15 (2010).

112. Arnold, *supra* note 108.

113. *Id.* at 10426.

114. *Id.* at 10427–28.

115. HARI M. OSOFSKY & LESLEY K. MCALLISTER, CLIMATE CHANGE LAW AND POLICY 55 (Wolters Kluwer Law & Business 2012).