The Routledge Handbook of Sustainable Cities and Landscapes in The Pacific Rim

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First published 2022

ISBN: 978-0-367-47114-9 (hbk)
ISBN: 978-1-032-18994-9 (pbk)
ISBN: 978-1-003-03353-0 (ebk)

Chapter 4

Introduction to Section 1

Vulnerable communities, resilience, and climate justice

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DOI: 10.4324/9781003033530-5

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

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INTRODUCTION TO SECTION 1
Vulnerable communities, resilience, and climate justice

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On January 21, 2021, it had been a year since the United States recorded its first case of COVID-19; the City of Wuhan, China, marked one year since undergoing its 76-day lockdown; and the world had over 100 million documented cases and more than two million people had died. The global pandemic developed to an unexpected grand scale posing a tremendous shock and disturbance to our human systems in all aspects, in particular the economic stresses and public health systems disruptions; the hardest hit are vulnerable groups. For example, among the reported deaths in the United States by November 27, 2020, fatalities for Native Americans were 2.6 times higher than Whites and African Americans and Hispanics were 2.8 times higher than Whites (CDC, 2020). As people of color have undergone systemic racism for generations, the social and environmental factors associated with health outlook—access to clear air and water, access to nutrient and fresh produce, access to healthy diet and lifestyle, access to quality affordable medical care, and access to education and information—have largely contributed to social determinants of health and inequitable outcomes (Bambra et al., 2010). Those populations that have been the victims of institutional injustice in society are among the socially vulnerable communities who are likely to bear the inequitable burdens from climate change impacts such as extreme heat, colds, floods, droughts, and fires. The need to address climate justice locally and enhance community resilience is crucial to ensure sustainable development in any city.

Communities around the world are facing multiple stressors and disturbances, whether they are chronic or abrupt—pandemic, climatic change, natural hazards, environmental degradations, economic depressions, wars and conflicts, systemic injustice, and technological insecurity—and the state of sustainability has become more complex and uncertain. Over the decades of disaster studies, the concept of vulnerability has been developed to assess societal risks to hazards. In recent decades, in order to understand how systems cope with disturbance and uncertainty, the concept of resilience has evolved from ecological resilience and applied to community resilience. Together, the concepts of sustainability, vulnerability, and resilience are interconnected; yet, each presents distinct frameworks for understanding society and interaction with the environment. This section includes six chapters that provide theoretical framing, methodology, case studies, and implications in understanding vulnerable and resilient communities, providing paradigms and guiding principles in how we may

DOI: 10.4324/9781003033530-5

operationalize those concepts in research and practice for building cities and landscapes with communities to address sustainable development goals and climate justice.

Systemic vulnerability

Systemic vulnerability refers to structural drivers and pressures constructed in risk society overtime contributing to conditions of exposure to hazards and vulnerability to extreme events and disasters (Blaikie, 1994). Blaikie's *Pressure and Release (PAR)* model illustrates the dynamics in societies that contribute to root causes of *systemic vulnerability* to society, including the ideologies in political and economic systems that limit access to power, structures, and resources. Those pressures appear in various forms (e.g. lack of appropriate skills or local markets) and forces (e.g. freedom of press and rapid urbanization) and eventually generate unsafe conditions, such as a fragile physical environment or local economy, vulnerable society, and insufficient public actions in coping with disasters. Bobbette (Chapter 9) uses a case in Indonesia to explain in depth how vulnerability is the result of historic and geographic processes of dispossession—the *systemic vulnerability* in society.

Vulnerability can be further examined as the combination of sensitivity to hazards with a lack of adaptive capacity to adjust to potential hazards, to take advantage of opportunities, or to respond to consequences (Cutter et al., 2003; Polsky et al., 2007). The *Hazards-of-Place (HOP)* model (Cutter, 1996) integrates social and ecological vulnerability assessment frameworks of a place. Social vulnerability indicators to climatic and natural hazards include demographic (e.g. age, gender, race, education, occupation, and disability), social (e.g. household structures, social resources accessibility and dependency), economic (e.g. poverty status, income, local and regional economic development), and political statuses (e.g. migrants) in addition to urban context (e.g. housing density and structure, urban and rural populations) (Cutter et al., 2003; Cutter et al., 2013; Flanagan et al., 2011). Ecological vulnerability reflects the geophysical conditions and the state of health in ecosystem structures and functions in responding to disturbances in systems. In addition to social-ecological integration, vulnerability reflects multiple levels of interlinked social-ecological-technological systems (SETs) (Chang et al., 2021; Grimm et al., 2017). The technological system refers to infrastructures and technologies that society invented, including engineered gray and green infrastructure design. Applying SETs framework in spatial planning allows a comprehensive understanding of intersections between the systems. The outcomes of SETs framework include enhancing risk communications between communities and stakeholders and facilitate decision making in order to prioritize resources for vulnerable communities to cope with climate change (Cheng et al., 2017). For example, Yao et al. (Chapter 8) touches on how integrating technological systems can serve as assets for enhancing social capital and building community resilience for vulnerable populations in hazard-prone areas.

Climate change is associated with increased intensity and frequency of extreme weather events (IPCC, 2014). Flooding is prevalent in many parts of the Pacific Rim cities. Many communities are facing climate change-induced flooding and our cities and landscapes are challenged to provide decentralized flood mitigation and nature-based solutions for climate change adaptation strategies within limited urbanized watersheds (Cheng et al., 2017). Flooding hazards can be categorized into three types: coastal, fluvial, and pluvial (NOAA, 2021). Coastal flooding is associated with extreme tidal conditions and storm surge connects to high winds and extreme storms caused by typhoons or hurricanes. Fluvial flooding refers to riverine and inland waterways flooding. Pluvial flooding is associated with urban drainage systems that exceed their capacity in managing stormwater. Climate change has posed

impacts on infrastructure systems that were designed based on past climate trends, challenging cities to cope with pluvial flooding (Rosenzweig et al., 2018). All three types of flooding hazards are often intertwined in cities as extreme storm events and runoff can exceed the capacity of designed urban drainage infrastructure systems.

Sensitivity and adaptive capacity are often combined to describe social vulnerability to hazards (Cutter et al., 2003). Sensitivity refers to inherent properties of individuals or communities characters that are susceptible to harm or adverse effects from hazards such as female, children, the elderly, disability, family size, population density, and one's livelihood heavily depending on natural resources extraction or cultivation. Adaptive capacity refers to access to resources that can overcome sensitivity and increase capacities to cope with disturbances. Adaptive capacity is associated with increased social capital and resilience. Several socio-economic and demographic indicators for adaptive capacity include income, education, access to medical facilities, mobility, migrant status, home ownership, housing structures, etc. Cheng et al. (Chapter 5) revealed that the concept of social vulnerability is about the capacity to cope with stresses, whether the factors are derived from environmental, political, governance, and all the rest that composes community and society. When socially vulnerable groups are exposed to hazards, their vulnerability increases and are likely to suffer most, whether they are living in the low-lying areas exposed to seasonal floods or forced migrants living in fragile conditions with a lack of access to resources. Salvacion et al. (Chapter 6), Pal and Suresh (Chapter 7), and Yao et al. (Chapter 8) provide case studies applying vulnerability theory and assessment empirical studies on coastal and fluvial flooding primarily with implications on governance, infrastructure design, and community resilience in several Asia Pacific countries. They demonstrate the complexity of adaptive capacity in the face of climate disturbances that requires place-specific and distributed responses in local context.

Community resilience to climate change

Climate change is a complex phenomenon that possesses several characteristics. First, climate change happens across a spatial scale. Its causes and effects cross neighborhoods, municipalities, regions, and nations. It is a global issue as well as for regional and local communities. Second, climate change happens across a temporal scale. Causes that occurred five decades ago continue to have effects today due to the lag time of accumulated effects of greenhouse gases (CDC, 2020). Third, there is a great uncertainty in how we understand and predict climate change. Since the Intergovernmental Panel on Climate Change (IPCC) published the first climate change assessment report in 1990, the world has gained more knowledge and momentum in facing this challenge. Ongoing work continues to trace the past impacts and project to the future in various confidence levels and scenarios. Lastly, there is no single solution to resolve the effects of climate change. This is due to the production of greenhouse gases, which are the major causes of climate change, being intertwined with our SETs, which range from energy, transportation, agriculture, manufacture, land use, urban development patterns, buildings, and landscapes designs, as well as social systems in education, health, domestic and foreign policies, economy, and justice systems. It has links to every component of the system we live in. Finally, the choices we make today will affect climate change impacts in the future—the path dependency theory—and there are multiple probable futures directing the path we chose today (Bergek, 2014).

The concept of resilience describes a capacity of a system to absorb shocks from disturbances (Holling, 1973; Walker & Salt, 2006). Resilience theory is widely adapted to address

climate change as it relates the properties of climate change in several aspects: (1) resilience theory deals with cross-temporal and spatial scales where climate change occurs; (2) resilience theory deals with complex social-ecological systems that climate change has impacts on; (3) resilience theory deals with uncertainty generated by the character of climate change.

Vulnerability is the key to understanding risks, managing disasters, and enhancing adaptive capacity. When communities have insufficient coping capacity for the shocks and disturbances in the coupled natural and human systems, they are likely to become more vulnerable to the adverse effects of uncertainty and extreme variation, which climate change has promised. Nevertheless, vulnerability is not merely an inverse of resilience. The sustainability of urban development goals relies on the transformative capacity of community resilience (Olsson et al., 2014). Urban resilience theory considers connections with sustainability through transformative capacity when society is able to bounce forward beyond the threshold of unsustainable state and toward a future of resilience that is co-defined with communities (Folke, 2006; Meerow et al., 2016). Social justice and equity is a foundation for sustainable development and shall be addressed when communities face chronic and abrupt disturbances and climate change impacts. Community resilience can be referred to as the capacity to take crisis into windows of opportunity for transformative change to address *systemic vulnerability* and restore and enhance ecosystem services in building sustainable and resilient cities and landscapes (Ahern, 2011; Cheng, 2014; Doorn et al., 2019). Choi (Chapter 10) describes the context of vulnerability in the urbanization process and how civilization may transform through building urban resilience capacity through rethinking urbanization toward futures.

It is critical to learn the fine difference between the concepts of vulnerability and community resilience. Vulnerability describes the underlying conditions and characteristics of the populations and their environment that create harmful circumstances and consequences when exposed to hazards. Vulnerability and resilience are related but not equal concepts. Communities that are considered vulnerable may in fact resilient to climate change impacts. Community resilience emphasizes the capability to cope with disturbances, heal from wounds, overcome vulnerability, and transform toward sustainable futures.

Climate justice intersects vulnerability, resilience, and sustainability

Climate change aggravates the intensity and frequency of extreme events and the associated hazards such as heat and cold waves, fires, droughts, floods, hurricanes, and potentially cascading hazards such as landslides, air pollution, and infrastructure failures, and poses significant threats to society, in particular to vulnerable communities (IPCC, 2014). Climate justice in the global context through venues such as United Nations Climate Change Conferences has revealed disparity of contribution to the greenhouse gas emissions between the developed and developing countries and inequitable distribution of climate change impacts where the least developed countries suffered most (e.g. island nations facing seal level rises). The aftermath of 2005 Hurricane Katrina in Louisiana, USA, was a wakeup call for climate justice in local communities of the United States when over 1,800 people died, thousands were strained in the shelters, and millions were displaced—majority of them were considered socially vulnerable groups (e.g. people of color, the poor, the elderly, and children) (Colten, 2006). The economic loss was $161 billion, which was about 1.2% of the US's GDP then. In the Philippines, an average of 20 typhoons hit the country. 2013 Typhoon Haiyan was the most costly and the second deadly typhoon in history resulting in 6,300 causalities and economic losses worth $3 billion dollars, over 10 times more than the country's GDP. As

population continues to grow in cities worldwide, more people are likely to be exposed to a range of extreme events and climate change-associated hazards. Vulnerable communities are likely to suffer more if climate justice is not addressed.

Climate justice has been used as a framework in global climate change policy negotiation primarily between developed and less-developed countries to address inequitable distribution between greenhouse gas producers and climate change impacts bearers. In addition to global climate justice debates, it is as critical to understand the local-scale climate justice and address the needs of vulnerable populations. In the United States, for example, a lack of efforts in making equity an accountable outcome in city's sustainability plans for hundreds of American cities reveals the fact that social justice and equity goal in sustainable development have not been addressed for decades (Schrock et al., 2015), thus contributing to the persistence of *systemic vulnerability* in many communities and perpetuating climate justice locally. *Climate justicescape* is a framework developed to demonstrate spatial distribution of SETs vulnerability to climate change-associated hazards (Cheng, 2016, 2019a). *Climate justicescape* aims to reveal systemic vulnerability through spatial analysis and visualization tools. It can be applied in every scale from local to international applying to urban and landscape planning and design through identifying SETs vulnerability and vulnerable populations under climate change impacts, and revealing the disparities in coping capacity to climate change among vulnerable communities. The results can be used to inform policymakers for prioritizing resources needed and where to address climate justice such as strategically allocate green infrastructure investments in underserved communities (Cheng, 2016, 2019a, 2019b).

Figure 4.1 illustrates the intersections among the concepts of systemic vulnerability, community resilience, climate justice, and sustainability. Sustainability encompasses dimensions

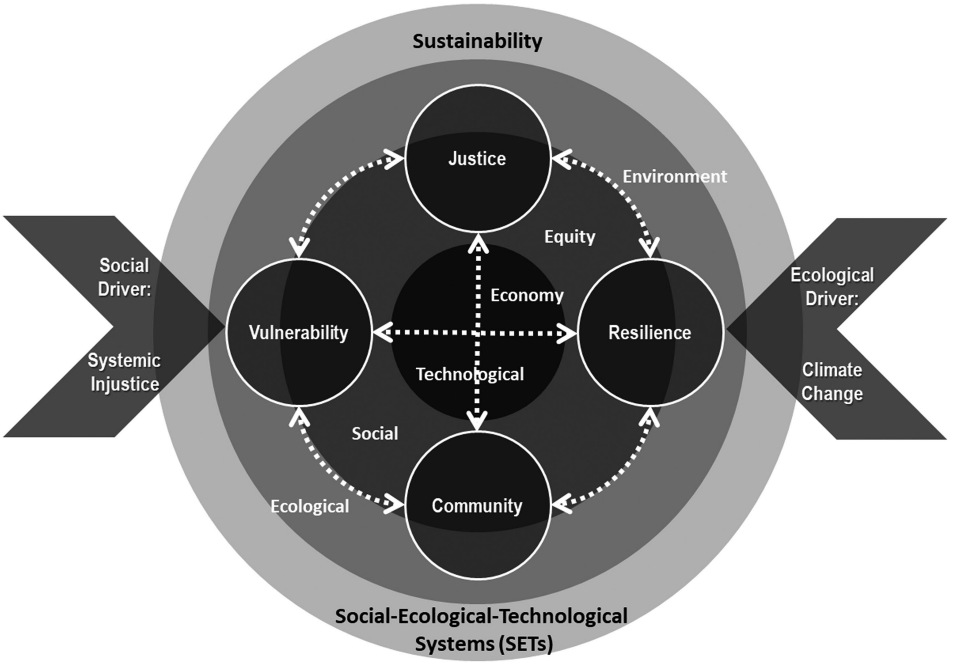

Figure 4.1 Illustration of the intersections among the concepts of systemic vulnerability, community resilience, climate justice, and sustainability

in environment, equity, and economy that are interlinked in SETs. Climate change and systemic injustice are major social and ecological drivers in SETs which contribute to systemic vulnerability and climate justice issues in addressing community resilience for sustainable development. Understanding the linkages between vulnerability, climate justice, and community resilience is crucial for building sustainable cities and communities and achieving *SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable*. Interventions and investment such as nature-based solutions for climate change adaptation and actions need to consider equitable process and outcomes and benefits to enhance community resilience, reduce vulnerable conditions to climate change, and ultimately lead to transformative change to address systemic vulnerability and achieve equity goals in sustainable development while cities are facing climate change challenges.

Organization of chapters

This section contains six chapters that explore the concept of vulnerability and connections with resilience of sustainable cities and landscapes. *Chapter 5* provides inquiries of concept definition and theoretical framing, followed by four cases in the Pacific Rim in the subsequent *Chapters 6–8* that include methods and empirical data for understanding and assessing vulnerability in local communities. *Chapter 9* provides an alternative narrative which connects to cultural sustainability in describing vulnerability of a community. The section concludes with *Chapter 10* that zooms out to city scale and global context to reimagine urbanization process and sustainable development for future cities.

Chingwen Cheng, Stephanie Pincetl, and Louise McKenzie in *Chapter 5: Understanding vulnerability in cities* ask ourselves as researchers and practitioners how we perceive vulnerability and in which positionality we take to address vulnerability. Vulnerability is perceived across various spatial scales in cities and across generations. Each place is unique yet interlinked and influenced by both local and global contexts. However, seeking generalizability may overlook real-world solutions for reducing vulnerable communities that is sensitive to local context and place-based innovations. This chapter provides nuisances for researchers and practitioners seeking difference rather than similarity among the vulnerable communities.

Arnold R. Salvacion, Ma. Catriona E. Devanadera, Fevi Rose C. Paro, Aaron Julius M. Lecciones, and John Ceffrey L. Eligue in *Chapter 6: Flood Vulnerability Assessment in Marinduque, Philippines using Fuzzy Logic and Principal Component Analysis* provide an empirical climate justicescape study for mapping social and ecological vulnerabilities to regular seasonal typhoons and associated floods at a regional level. The vulnerability assessment framework includes both the physical vulnerability such as rainfall, topography, and soil texture, and the social vulnerability associated with socio-economic and demographic characteristics. The highlighted climate justice areas are the priorities for climate actions and equity planning for reducing vulnerability and enhancing community resilience.

Indrajit Pal and S. Suresh in *Chapter 7: Integrated water management model for Coastal Resilient City Planning for Hydro-Meteorological Hazards* continue the inquiry in resilience building and focus on governance and institutional capacity for managing flood risk at a city level. The study in India brought up efficacy of traditional and integrated flood management and their incorporation into theoretical configuration as well as analyzed multi-level governance framework in the city resilience context. Understanding the knowledge construction processes and potential interconnection in Chennai's flood management has also been explained with the potential recommendations for integrated flood risk governance.

George C. Yao, Sheming Chen, Chingwen Cheng, and Wenjyun Chou in *Chapter 8: Creating flooding resilience in buildings for aging communities in Taiwan* provides insights into a particular vulnerable aging population and their resilience to floods at household level. Given the social and ecological vulnerabilities selected for the study area, this case study assessed relationship between social and technological vulnerabilities and how technological interventions may serve to enhance community's adaptive capacity and resilience in combating floods. The study suggests that using appropriate smart technology and infrastructure design may enhance the social network in the community, thus building community resilience overall.

Adam Bobbette in *Chapter 9: Re-imagining our Ancestors: Dispossession, Resilience, and Volatile Nature* illustrates in depth how cultural sustainability shapes community resilience in Indonesia and the broader Asia Pacific as a result of decolonization process. Communities at the sharp edge of resource extraction, such as sand mining on volcanoes, are reimagining what a built environment is and rethinking the meaning of community vulnerability and resilience.

Heejin Choi in *Chapter 10: Future Cities* brings the perspective back to the sustainable cities and landscapes with a vision into the futures for developing countries and megacities. The chapter challenged the urbanization process as a process for developing vulnerability in megacities. The history of civilization history has created systemic vulnerability socially, ecologically, and technologically. Toward a more sustainable future for all, humans need to reimagine how we proceed with urbanization.

Taken together, the six chapters in this section explore the concepts of systemic vulnerability and resilience of communities across the Pacific Rim while understanding the fundamental place-based coping capacity that each community embraces and will be required in order to adapt and respond to uncertain challenges from climate change, address climate justice, and transform toward sustainable futures.

Connecting theories and practices: continue the dialogues and place-based solutions

Sustainability and resilience theories have provided two distinct yet inter-related paradigms of systems thinking and practices that aim for the ultimate goals of sustained prosperity of human and ecosystems on earth. Climate change is a global threat and driver that challenges sustainability and resilience of civilization. This section in particular calls out the systemic vulnerability that is created in the process of civilization and constructed the risk society, putting vulnerable populations in particular under inequitable outcomes under multiple chronic and abrupt risks such as floods and heat hazards aggravated by climate change. The scale and implications of the theories can be applied in either rural or urbanized communities, from local to international scales, and aligned with the *SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.*

Through in-depth dialogues among practitioners and researchers at APRU SCL conference, it is apparent that there is a need for engaging diverse voices, especially from the less-heard and vulnerable populations, in the decision-making process of sustainable development. In addition, as resource for climate change planning has become a common practice, climate justice as a framework for integrating equity planning in climate action plans to enhance adaptive capacity and resilience of communities through place-based solution is particularly crucial to achieve *SDG 11.* Thus, addressing climate justice shall be the priority in community resilience planning and sustainable development across rural and city

connections. Resilience emphasizes the capacity to move forward and the ability to transform systems into new development pathways in the face of dynamic and uncertain changes in order to sustain the livelihood of diverse communities and all living beings. In particular for vulnerable communities, climate justice shall be addressed in order for humanity to truly embrace sustainable development for generations to flourish.

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