ADBInstitute

NAVIGATING RESILIENT POST-DISASTER RECOVERY IN ASIA AND THE PACIFIC

Edited by Piyush Tiwari, Dil B. Rahut, and KE Seetha Ram

ASIAN DEVELOPMENT BANK INSTITUTE

ADBInstitute

Navigating Resilient Post-Disaster Recovery in Asia and the Pacific

Edited by
Piyush Tiwari, Dil B. Rahut, and KE Seetha Ram

ASIAN DEVELOPMENT BANK INSTITUTE

ISBN 978-4-89974-295-1 (Print)
ISBN 978-4-89974-296-8 (PDF)
DOI: https://doi.org/10.56506/DWKU4071

Asian Development Bank Institute
Kasumigaseki Building 8F
3-2-5, Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan
www.adbi.org

CONTENTS

TABLES, FIGURES, AND BOXES

TABLES

FIGURES

BOXES

CONTRIBUTORS

Daniel P. Aldrich is a professor and director of the Security and Resilience Studies Program at Northeastern University, United States.

Carmelita G. Esclanda is chief development specialist at the National Economic and Development Authority of the Philippines

Abey George is an associate professor at the Kerala Institute of Local Administration, India.

Michael C. Huang is a senior research fellow at the Ocean Policy Research Institute, Sasakawa Peace Foundation, and a visiting researcher at the SciREX Center of the National Graduate Institute for Policy Studies, Japan.

Mikio Ishiwatari is a visiting professor in the Graduate School of Frontier Sciences Studies at The University of Tokyo, Japan.

Yoko Iwaki is a research fellow at the GRIPS Alliance of the National Graduate Institute for Policy Studies, Japan.

Erwin van der Krabben is a professor in land and area development in the Department of Geography, Planning, and Environment at Radboud University in Nijmegen, the Netherlands.

Jyothi Krishnan is the head of the Master of Social Work in Disaster Management Program at Loyola College of Social Sciences, India.

Saumen Majumdar is an associate professor at the Indian Institute of Management Tiruchirappalli, India.

Damaru Ballabha Paudel is a director at the Ministry of Foreign Affairs, Government of Nepal.

Jayash Paudel is an assistant professor of economics at the University of Oklahoma, United States.

Vanessa Peter is a founder of the Information and Resource Centre for the Deprived Urban Communities, India.

Wisnu Pradoto is an assistant professor in the Department of Urban and Regional Planning at Diponegoro University, Indonesia.

Dil B. Rahut is vice-chair of research and a senior research fellow at the Asian Development Bank Institute, Japan.

Santosh Kumar Rauniyar is a research fellow at the Ocean Policy Research Institute, Sasakawa Peace Foundation, and a visiting researcher at The University of Tokyo, Japan.

D. Ary A. Samsura is an assistant professor in the Department of Geography, Planning, and Environment at Radboud University, Netherlands.

S. Sariffuddin is a PhD candidate in the Department of Geography, Planning, and Environment at Radboud University, Netherlands and an assistant professor in the Department of Urban and Regional Planning, Diponegoro University, Indonesia.

Daisuke Sasaki is an associate professor at the International Research Institute of Disaster Science, Tohoku University, Japan.

KE Seetha Ram is a senior capacity building and training specialist at the Asian Development Bank Institute and a visiting professor at The University of Tokyo, Japan.

Budi Setiyono is a professor in the Department of Government and Political Science at Diponegoro University, Indonesia.

Jyoti Shukla is a senior lecturer in property at the University of Melbourne, Australia.

Tifani Siregar is a research associate at the Asian Development Bank Institute, Japan.

Piyush Tiwari is a professor of property at the University of Melbourne, Australia.

Dwiky Wibowo is a project consultant at the Asian Development Bank Institute, Japan.

FOREWORD

The Asia and Pacific region has witnessed a disturbing surge in the frequency and intensity of disasters in recent years. These catastrophic events have had far-reaching social and economic consequences, necessitating effective post-disaster management, reconstruction, and restitution. This edited book, *Navigating Resilient Post-Disaster Recovery in Asia and the Pacific*, explores and addresses the complex challenges and tremendous opportunities in this critical field.

This book aligns closely with the Sendai Framework for Disaster Risk Reduction 2015-2030. The Sendai Framework emphasizes the need for comprehensive disaster risk reduction strategies, all-of-society engagement, and building back better after disasters. The book addresses key aspects of the Sendai Framework by focusing on comprehensive post-disaster governance and decision-making processes. It also recognizes the importance of stakeholder engagement and participatory approaches, in line with the Framework's call for all-of-society involvement in disaster risk reduction. Lastly, the book aligns with the Framework's emphasis on building back better as it promotes resilience and sustainability in post-disaster recovery.

The opportunities in post-disaster recovery are significant. By adopting a holistic approach that considers economic recovery, social equity, the empowerment of women, and environmental preservation, we can rebuild in a way that is both sustainable and inclusive. Several chapters draw upon real-world case studies, empirical evidence, and policy insights from the Asia and the Pacific region to offer practical recommendations for policy makers, practitioners, researchers, and communities engaged in post-disaster recovery efforts.

There are several key messages that are conveyed by this book for policy makers. These messages include the importance of identifying capability losses and addressing the needs of vulnerable groups in reconstruction efforts, promoting community participation, providing adequate finance in a timely manner, and leveraging data and technology for effective post-disaster management. The book underscores the significance of promptly assessing capabilities, involving local communities, securing adequate funding, and utilizing data and technology to ensure successful and inclusive post-disaster recovery. Noting the above key messages, I encourage policy makers to understand the crucial role of affected individuals as stakeholders in shaping reconstruction policies and programs that go beyond rebuilding physical infrastructure to enhance the capabilities and well-being of affected communities.

I congratulate the Asian Development Bank Institute and the editors for their efforts to prepare this timely compilation. The authors' workshops and learning workshops for practitioners that preceded the book helped in reinforcing the message that while post-disaster reconstruction may be challenging, there is a way to build-back-better. I appreciate the esteemed authors who have contributed their expertise to the discussions. Their valuable research and insights have enriched the content, ensuring its relevance and applicability. Each author has made an indispensable contribution to this collective endeavor. I encourage policy makers to read this book, which I believe will serve as a catalyst for meaningful dialogue, innovative approaches, and evidence-based policies in post-disaster recovery.

Toshio Koike
Executive Director
International Center for Water Hazard and Risk Management

PART I

Navigating the Path to Resilience: Introduction to Sustainable Post-Disaster Reconstruction in Asia and the Pacific

CHAPTER 1

Sustainable Management of Post-Disaster Reconstruction in Asia and the Pacific: An Introduction

Piyush Tiwari, KE Seetha Ram, Dil B. Rahut, and Dwiky Wibowo

1.1 Introduction

The annual number of disaster-affected persons, comprising those who suffer illness or injury and those affected by destroyed housing or livelihoods, was 2,266 per 100,000 people during 2015–2021. The number of affected persons during that 7-year period was much higher than the number of affected persons during the previous decade of 2005–2014 (UNDRR 2023). This does not include those affected during 2020–2021 by the coronavirus disease (COVID-19) pandemic. Estimates by Mahler et al. (2021) suggest that COVID-19 pushed more than 100 million people into poverty in 2020. If the impact of COVID-19 were to be included, the number of affected persons due to disasters during the last 5 years would increase substantially. The economic impact of disasters as estimated by the United Nations Office for Disaster Risk Reduction (UNDRR 2023) during 2015–2021 has been about 1% of gross domestic product. More than 140,000 critical infrastructure units were damaged or destroyed due to disasters each year during 2015–2021 on average, and if disruption to education and health care that the pandemic caused were to be included, the scale of destruction to infrastructure would be much higher (UNDRR 2023).

A disaster is defined as "a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts" (United Nations 2016: 13). For the purpose of the Sendai Framework on Disaster Risk Reduction, disaster damage is defined as that which "occurs during and immediately after the disaster. This is usually measured in physical units … and describes the total or partial destruction of physical assets, the disruption of basic services and damages to sources of livelihood in the affected area" (United Nations 2016: 13). A more comprehensive term for the effect of disasters in the Sendai Framework is disaster impact, which "is the total effect, including negative effects (e.g., economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster. The term includes economic, human, and environmental impacts, and may include death, injuries, disease and other negative effects on human physical, mental and social well-being" (United Nations 2016: 13). Disaster management is defined as "the organization, planning and application of measures preparing for, responding to and recovering from disasters" (United Nations 2016: 14). Recognizing that "disaster management may not completely avert or eliminate the threats," the Sendai Framework emphasizes that the focus of disaster management is "on creating and implementing preparedness and other plans to decrease the impact of disasters and 'build back better'" (United Nations 2016: 14).

There is a two-way relationship between disasters and social and economic conditions. While disasters result in unintended social and economic consequences, social and economic activities (such as greenhouse emissions or irresponsible development activities) also cause disasters (Maarif 2010). The United Nations General Assembly endorsed the Sendai Declaration and the Sendai Framework for all-of-society and all-state institutions' engagement in preventing and reducing disaster risks. Emphasizing disaster risk mitigation through development of strategies, enhancing capacities of various tiers of institutions, and investment in preventive infrastructure and international cooperation, the Sendai Framework asks countries to develop their disaster management plans and strategies. According to

a recent report by UNDRR on progress related to the Sendai Framework, 125 countries have now developed their national strategies for disaster risk reduction, and 99 countries have subnational strategies (UNDRR 2023). However, the report also highlights that the least progress has been made on increased international cooperation for disaster risk reduction.

The emphasis on risk mitigation stems from the argument that each $1 invested in risk reduction saves up to $15 in post-disaster recovery (UNDRR 2021). While the impact of disasters can be reduced through ex ante investment and social and economic behavioral changes to reduce causes that lead to disasters, disasters cannot be fully eliminated. Arendt and Alesch (2015) argue that it is important to carefully choose strategies that are applied in anticipation of disasters, as this impacts the ways in which communities and agencies respond to abnormal situations that arise because of disasters. Building the capacity of communities to be resilient plays a crucial part in post-disaster reconstruction. An important component of this is "the post-event adaptive processes that facilitate the ability of the social system to reorganize, change, and learn in response to a threat" (Guarnacci 2016: 181). Resilience is defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNDRR 2009). A resilient community will be capable of responding and recovering effectively from disaster (Schwab 2014). Resiliency is also interchangeable with the term "community sustainability" (Arendt and Alesch 2015: 169). Therefore, it is important to embed the concept of resilience within the wider framework of sustainability.

This edited report focuses on post-disaster management, in particular reconstruction and restitution of destruction and losses that disasters cause. Three questions underpin the post-disaster reconstruction and restitution efforts: What needs to be reconstructed? Who will reconstruct it? How will reconstruction happen? Disasters differ in their frequency and intensity. Their impact on the affected persons has spatial and temporal dimensions. This raises issues related to the financing and duration of reconstruction. This also brings governance to the fore. "Governance" is defined as the activities to utilize resources and to formulate coordinated and/or less-conflicted policies among involved actors despite the diversity of their original missions and goals (Kapacu 2014). It is important to highlight that affected persons are the most important stakeholders in the process of reconstruction, and their role during formulation of policies and programs and their implementation can't be underestimated. Governance of post-disaster reconstruction is complex and necessitates multi-sectoral involvement, requiring resources and a range of skills. However, the research on post-disaster governance is limited, as the primary focus of research has been on prevention and preparedness (Kapucu 2014).

This chapter provides an overview of the edited report. The three questions just raised above are discussed first, and then a chapter-wise summary is presented.

1.2 What Needs to Be Reconstructed?

The most important question for post-disaster reconstruction and restitution is the scope of reconstruction. Quoting philosopher Aristotle, Nobel laureate Amartya Sen argues that social choice should be governed by "desire and reasoning to some end," and he refers to the end as people's capabilities (Sen 1995). Taking the argument of Sen forward and applying it to post-disaster reconstruction, the end-purpose should be to lessen the challenges that disasters impose and that make life difficult. These include economic problems for affected persons that push them into poverty and hunger, political problems that reduce or violate their basic liberty, safety, and security, and problems of maintaining the environment. These problems threaten the well-being of individuals as to the very sustainability of our economic and social lives. The purpose of post-disaster reconstruction would therefore be to reinstate

the capabilities of affected persons; the build-back-better approach would further require enhancing the capabilities beyond what they were prior to the disaster. The design of post-disaster reconstruction, however, has focused on the means rather than the end. Most reconstruction programs focus on building projects, whether these relate to private property or social and economic infrastructure. Some programs also include components such as temporary shelter, health and psychological assistance, and livelihood assistance. Tiwari et al. (2022) present principles for post-disaster reconstruction based on their examination of disasters in India and Japan. These include the following:

(i) Reconstruction that involves relocation should not be detrimental for households in securing income opportunities.
(ii) Housing should respond to the requirements of households. In this context, it is important that the community is involved in the process of designing their living environment.
(iii) During post-disaster reconstruction, it is crucial to avoid disrupting social systems that are based on trust and care for each other and particularly for children.
(iv) Post-disaster reconstruction should make efforts to ensure social equity and empowerment of women, which will not only have a positive impact on the health of women but would also improve the overall well-being of households.
(v) Mechanisms should be devised for protection of assets/houses and income of low-income households through public insurance or other safety nets.
(vi) Resettling households should be done in a way that does not disadvantage them through social stratification or affect their self-identity. This implies that as far as possible, reconstruction should be in place or, if relocation is necessary, it should not be at a distant location.

These principles emphasize the need to explicitly articulate the end objective that post-disaster reconstruction programs are aiming to achieve. Implicitly, these programs interpret reconstruction as rebuilding of physical losses. A capabilities approach is a promising framework and can aid in designing post-disaster reconstruction programs. An emphasis on the end objective, such as reinstating the capabilities of affected persons and the means that could help achieve that, can help in identifying the losses that need reconstruction. These losses of capabilities would go beyond the physical losses, and means to reconstruct would include resources, policies, and programs.

1.3 Who Will Reconstruct It?

Means that reinstitute capabilities, such as resources, policies, and programs, lead to the next question: Who will reconstruct? Given the multiple tasks, diverse resources, and skill sets required, several agencies would be involved. An institutional environment comprising policies and programs must facilitate coordination among agencies and active participation of stakeholders including affected persons. The characteristics of affected persons (such as education, health status, demographics) and the institutional environment determine how means will be converted into capabilities of the affected persons.

The cultural values and good relationships that exist among stakeholders prior to disasters are a critically valuable resource for building trust, mutual understanding, and mutual cooperation, for enhancing accountability, and for exchanging resources (including information) between agencies and among development actors. In fact, these cultural values and relationships are often the key determinants of the recovery process, especially during and after the crisis. The nature and extent of relationships and local networks that exist between communities, community building organizations, and local leaders prior to disasters influence the ability of broader consensus agreements, policy formulation, and implementation to meet communities' needs.

Mardiah (2018: 212) identifies the following as needing to be present for post-disaster collaborative governance to be successful: "(1) policy and regulatory frameworks; (2) social and cultural resources (e.g., trust, social relations, local wisdom, etc.); (3) political dynamic; (4) a history of local collaboration (e.g., through charitable activities, business associations, etc.); and (5) global (and regional) platforms' practices" (e.g., the Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction, and the ASEAN [Association of Southeast Asian Nations] Agreement on Disaster Management and Emergency Response). Resilient economic recovery focuses on maintaining well-being, restoring livelihoods, and redeveloping the local economy.

Finance is necessary for reconstruction, and the financial needs depend on the intensity of the disaster and its effects on individuals, society, the built environment, and the economy. The requirements of finance range from immediate to the long term. Sources also vary and include government budgetary allocation, international and national aid, and private and capital market funding. Each source of finance has its own risk–return profile and due diligence requirements. The institutional environment for coordination of fund flow, sources of funding, and timing of funding plays a crucial role in reconstruction of means that are essential for reinstating capabilities.

1.4 How Will Reconstruction Happen?

Common reasons for failure of most post-disaster reconstruction programs include lack of engagement with communities, lack of coordination among agencies on the ground involved in relief and reconstruction work, bureaucratic processes in approving budgets and implementing programs, and lack of capacity of aid workers and technical staff. However, the most important reason for failure is lack of understanding of the losses that affected persons face. Losses that are visible (deaths, destruction of houses and infrastructure) become the target of compensation and reconstruction, but the invisible losses (such as impact of loss of education, health and psychological effects, loss of community) remain unaddressed. The consequence is that, in general, the capabilities of affected persons are never restored, and the negative effect lasts generations.

This raises the issue of how reconstruction will happen. There is no doubt that the infrastructure, institutional mechanisms, and resources that are organized before the disaster as part of mitigation strategies have an impact on how post-disaster reconstruction would happen.

This edited report is a compilation of chapters written by experts from countries in Asia and the Pacific on country experiences in post-disaster management. These chapters present a critical review of what is being done to reconstruct the losses of disaster-affected persons, but they also present what can be done to improve in building back better. As discussed above, a theoretical framework is proposed that provides a new way of approaching the question of what needs to be reconstructed. Data is a major challenge, and, in the absence of data, it becomes difficult to identify who needs reconstruction and geographically where the need for assistance is greater. The edited report also presents a review on how data can be used. The management of disasters and reconstruction efforts has largely relied on knowledge obtained in the last 2 centuries. Still, there is a wealth of knowledge that Indigenous people can provide for disaster mitigation and post-disaster reconstruction. Finance is required throughout the post-disaster reconstruction. The source of finance varies over time. It is therefore prudent to identify the sources of finance, stage of reconstruction they fund, and innovations in the sources of finance. We admit that these chapters do not comprehensively cover all aspects of post-disaster reconstruction and restitution, but they do provide important resources for future policy and practical work in this area. The edited report also aims to fill the gap related to cross-border learning as identified by UNDRR by providing cases from various countries in Asia and the Pacific.

1.5 Structure of the Edited Report

The structure of the edited report is as follows.

Wibowo, Siregar, and Tiwari review the extant literature on post-disaster reconstruction in Chapter 2, which sets the context for the rest of the edited report. The chapter emphasizes the importance of investing in urban resilience to cope with disasters and prevent unsustainable development pathways, particularly for the urban poor living in high-risk areas. The chapter also stresses the need to focus on vulnerable individuals and groups during the recovery process and assess their needs when formulating recovery programs and policies. It highlights the importance of learning from past experiences in Asia and the Pacific and stresses the need for a robust framework for effective post-disaster recovery. Emphasizing interlinkages among actors and institutions during post-disaster recovery, the chapter proposes an integrated institutional model of local community, local governments, agencies, industries, national/international economies, and environments. This sets the foundation for the edited report by providing a comprehensive overview of the importance of investing in urban resilience and prioritizing the recovery of people's lives and livelihoods during post-disaster recovery efforts.

Majumdar complements Chapter 2 by presenting a review of financial instruments that are available for post-disaster reconstruction in Chapter 3. Majumdar's review identifies the financial resources that countries have used for post-disaster reconstruction, which have time and risk dimensions. In his chapter, he distinguishes between short, medium, and long-term financing requirements and evaluates to what extent public and private sources of funding can meet these requirements.

Shukla, in Chapter 4, proposes a theoretical framework for identification of losses associated with disasters that affected persons face using the lens of "capability theory." The chapter reviews existing economic and legal theories and acknowledges the need for an overarching theoretical framework to explain comprehensive and resilient restitution and compensation for those affected by disasters. The discussions in the chapter offer guidance to theorists, policymakers, and practitioners concerned with post-disaster management. Using the perspective of the capability theory, a disaster can be understood as the deprivation of elementary functions of a large group of people, requiring societal support to reinstate or improve the situation to its pre-disaster state. The theory emphasizes the loss of elementary functions, which can vary across individuals, while acknowledging the need for societal support, given that the cost of disasters is to be distributed. Shukla argues that inefficient and unequal institutional arrangements can make some people more vulnerable to disasters due to reduced freedoms, a consequence of unequal access to resources and/or unequal treatment. Therefore, a comprehensive and resilient post-disaster restitution and compensation mechanism should generate new functions that improve upon people's original state of functioning deprivation and strengthen disaster resilience at the societal, familial, and individual levels.

Applying the principle of equivalence, Shukla proposes that a fair compensation and restitution mechanism should ensure that affected people are put back in the same condition from before the disaster. However, from a developmental perspective, putting individuals back in their original state could mean continued deprivation of inaccessible functions and could defeat the objective of building resilient communities. Therefore, Shukla advocates, a resilient restitution process should generate new functions that improve people's resilience and well-being.

An important contribution of the chapter is that it argues for betterment across the three capability factors for individuals affected by disasters during post-disaster reconstruction: improved access to resources, uplifting personal characteristics, and improvements in institutional environments. This is a valuable guide for policy and practice concerned with post-disaster management.

In Chapter 5, Paudel explores the link between the 2015 earthquake in Nepal, residential property values, and the distribution of aid in response to the disaster. Using a difference-in-differences research design, Paudel finds that households exposed to large seismic shocks experienced a significant decline in property values. This short-term impact was disproportionately pronounced among economically vulnerable groups, such as female-headed households and large families.

The chapter highlights the importance of examining the impact of disasters in developing countries like Nepal, which are more susceptible to economic losses due to limited financial systems, education levels, and lack of global integration. Paudel's work also adds to the understanding of the mechanisms through which disasters affect economic well-being. For example, the chapter highlights that the earthquake led to a decline in work permits issued to Nepalese individuals for international labor migration.

Paudel also finds that the aid distribution was ineffective in mitigating the economic damages caused by the earthquake. In fact, earthquake-affected households were less likely to receive aid, which implies the possibility of leakage in aid distribution. The findings suggest that policymakers need to implement well-intentioned aid-based mechanisms effectively to help vulnerable households recover from natural disasters. This research provides important insights into programs designed for sustainable recovery after disasters, through relationships between the disaster, residential property values, and aid allocation, contributing to a better understanding of policies for disaster relief.

Post-disaster resettlement policies and practices have had a profound impact on the most vulnerable communities in Chennai, India, as highlighted by Peter in Chapter 6. The city has been vulnerable to several disasters, including the tsunami that ravaged the coastal areas in 2004 and the floods that engulfed the city in 2015. These disasters led to the rampant post-disaster evictions of affected families by the state, which have harmed the marginalized communities. The eviction of disaster-affected families from the city to its fringes, as a strategy for disaster management and risk mitigation, comes at a high social, economic, and cultural cost and is an act of sociospatial discrimination.

Despite the humanitarian actions taken by state and non-state actors toward ensuring sustainable recovery processes, the post-disaster evictions have reduced the resilience of communities by intensifying their existing vulnerabilities. The state-induced displacement has resulted in the denial of rights, which has delayed the recovery process and excluded affected people from social mobility and development. Moreover, the current practices governing resettlement and rehabilitation are either department based or project oriented, with none of the current schemes paying attention to human rights standards or due process, and none providing mechanisms for grievance redress for affected persons. This lack of legal or policy safeguards on resettlement by the Government of Tamil Nadu highlights the need for developing a community-led, gender-sensitive, child-friendly policy on resettlement and rehabilitation that adopts a human rights–based approach and recognizes, respects, and upholds the rights of affected persons.

Peter argues that the adoption of a strong community-led approach will ensure the reduction of vulnerabilities and increased resilience for the vulnerable communities. For any development program aimed at the vulnerable sections of society to succeed, enhanced participation can only guide its way to success. Therefore, it is crucial to adopt a multipronged approach by introducing legal and policy safeguards to uphold the rights of vulnerable communities by institutionalizing community-led mechanisms. Without a policy mandate, there will be no compulsion to include and consult communities in the process of resettlement, and the resettlement process will continue to remain predetermined by government departments, stifling the voices of the affected communities. Thus, there is an urgent need for the Tamil Nadu government to take a more proactive role in ensuring the human

rights of vulnerable communities are respected and upheld during the post-disaster resettlement and rehabilitation process.

Using the theoretical framework presented in Chapter 4, Shukla and Tiwari examine the non-asset losses that affected persons faced in the aftermath of the Black Saturday bushfires in 2009 in Victoria (Australia) in Chapter 7. The data from 18 semi-structured interviews of affected persons and those involved in reconstruction helps in identifying the losses that are not reconstructed through usual mechanisms even though these are crucial for human lives and resilience. The results suggest that the Black Saturday bushfires in 2009 resulted in loss of identity, dignity, livelihood, and control over people's environment besides the loss of life and property. Shukla and Tiwari argue that these losses are complex and that restitution would require not only tangible resources but also a social, economic, and political environment that will support rebuilding of lost capabilities.

In Chapter 8, Sarifuddin et al. explore the role that the property market plays in flood risk management. Using land and building tax history data from Pekalongan, a coastal city in Indonesia, the authors investigate voluntary residential relocation in response to coastal flooding. The authors found that flood risk resulted in the decision to relocate by a higher number of middle-income people. Lower-income inhabitants were unable to relocate due to economic reasons. The authors suggest that understanding housing displacement and replacement in response to coastal flood risk is important for property-based flood risk management.

The chapter argues that autonomous adaptation, or voluntary action by the property market, is needed for adapting to coastal flooding. The authors recommend that the property market be considered as an alternative instrument in flood risk management and that it may complement the government's planned adaptation. The study has limitations, including the lack of demographic data and information on property prices. Despite these limitations, the authors suggest that the study supports the current discussion on spatial adaptation from a property market point of view and may provide insight into individual behavior in response to coastal flood risk. Overall, the chapter sheds light on the importance of understanding the housing displacement and replacement patterns in response to coastal flood risk and highlights the need to consider the socioeconomic factors that may influence these decisions.

In Chapter 9, Krishnan and George discuss the complex issue of post-disaster recovery in the southern state of Kerala in India. Contrary to traditional disaster research that treats disasters as sudden-onset events with a beginning, middle, and end, critical sociology views disasters as socially produced, emphasizing the political economy and ecology of disasters. Krishnan and George argue that the same social, economic, and political forces that shape the occurrence of disasters also play a role in post-disaster recovery.

This chapter highlights the importance of viewing post-disaster recovery as an opportunity not only to reconstruct what was damaged but also to improve conditions for a more resilient future. The concept of building back better combines rehabilitation and enhancement of the built environment with psychological, economic, and social recovery in a holistic way. The chapter focuses on the recovery processes following the displacement and relocation of people affected by landslides during the Kerala floods of 2018, the Kavalappara landslides of 2019, the relocation of households affected by coastal erosion in the Trivandrum district, and the rehabilitation of individuals affected by the 2004 Indian Ocean tsunami. The authors recommend that the aim of recovery is for governments to work with communities to rebuild their social fabric and economic status and to reconstruct their natural and built environments, which requires an appreciation of social and ecological vulnerabilities. The authors emphasize that there is need for a rightful discourse around the themes of power, class, inequality, and marginalization, which play a crucial role in shaping the recovery process. By moving beyond the

reconstruction of basic facilities, the state can extend the boundaries of rehabilitation to address the root causes of disasters and achieve sustainable and equitable recovery.

Huang et al., in Chapter 10, examine the impact of disasters at the economy level and investigate what policies can be leveraged to build back better and achieve larger sustainability objectives. They use a recursive general equilibrium model to assess the economic impact and cost-effectiveness of implementing effective fiscal policies in Nepal following the 2015 earthquakes. The study aims to establish a comprehensive framework to visualize the potential impact and cost of recovery policies for Nepal, which includes a sectoral compensation/subsidy policy. The chapter recommends the implementation of build-forward-better policies, which include investment in renewable energy for a steady power supply to increase resilience and reduce vulnerability. An important conclusion from the chapter is that Nepal can open its economy to international trade and benefit from growing trade volume to reduce the burden of domestic production during the aftermath of a disaster.

Indigenous people or the First Nations people have used a range of approaches to mitigate and manage disaster. Their knowledge can significantly improve the current understanding of disasters and their management. Shukla, in Chapter 11, illustrates the importance of Indigenous knowledge on environment management. The chapter presents a synthesis of popular discourse concerning Indigenous ways of environment conservation. Moreover, the local and Indigenous knowledge systems program of the United Nations Educational, Scientific and Cultural Organization (UNESCO) promotes local and Indigenous knowledge and its inclusion in global climate science and policy processes. This emphasizes the role that Indigenous knowledge can play in the management and post-disaster reconstruction.

Ishiwatari, Aldrich, and Sasaki discuss the evolving financial support policies for housing reconstruction in Japan following natural disasters in Chapter 12. The chapter argues that financial support for housing reconstruction is crucial in the recovery process for people affected by disasters. However, no clear criteria exist on how governments and affected people should share the responsibility and costs of housing reconstruction. The chapter also provides a review of the evolution of Japan's financial support policies for housing reconstruction, starting from the Great Hanshin-Awaji (Kobe) Earthquake in 1995, when the Japanese government created legislation supporting the reconstruction of private daily lives. Until then, the central government had provided no support for personal assets damaged by disasters for the survivors. The Tottori Prefecture government supported housing reconstruction following the Western Tottori Earthquake in 2000, recognizing housing reconstruction as the key to community rehabilitation. The national government also extended support for housing reconstruction in 2007. The chapter also discusses Japan's experience following the Great East Japan Earthquake in 2011, when reconstruction also required relocation. The national government financed the costs of developing relocation sites to which affected people moved from affected areas. In addition, local governments established their own unique support systems of rebuilding individual houses to prevent population outflows.

The chapter argues that financial support for reconstruction of private property can be justified to support local communities in rehabilitation. Without financial support for housing reconstruction, people would leave their original communities, leading to the collapse of communities. However, there are no clear criteria for cost-sharing between governments and victims, and Japan is still discussing an appropriate level of financial support. The chapter suggests that governments need to support vulnerable groups such as elders and low-income groups who cannot afford to reconstruct their houses. Finally, the chapter highlights the importance of analyzing integrated approaches of nonmonetary and financial support to housing assistance including transition shelters and insurance.

In Chapter 13, Esclanda highlights the role that big data and new methodologies can play in post-disaster response and recovery. Without data, problems remain invisible and are not solved by policy frameworks. Data availability on affected persons and their losses can support current disaster management activities and their monitoring. Using a systematic literature review, the chapter analyzes the use of big data in post-disaster response and recovery. For such efforts, data from social media, crowdsourcing, satellites, sensors, and the combination of various data types have been processed using machine learning, spatial planning, and social media analytical tools. The chapter also highlights the challenges in data collection, formulation of methods for recovery assessment, convincing citizens to openly share their data, and integrating different technologies and methodologies for better results.

Chapter 14 concludes the edited report by summarizing key lessons learned from various chapters in managing post-disaster reconstruction and restitution.

References

Arendt, L. A., and D. J. Alesch. 2015. Long-Term Community Recovery from Natural Disasters. Boca Raton, Florida: CRC Press.

Guarnacci, U. 2016. Joining the Dots: Social Networks and Community Resilience in Post-Conflict, Post-Disaster Indonesia. *International Journal of Disaster Risk Reduction* 16: 180–191.

Kapucu, N. 2014. Collaborative Governance and Disaster Recovery: The National Disaster Recovery Framework (NDRF) in the U.S. In R. Shaw, ed. *Disaster Recovery: Used or Misused Development Opportunity*. Tokyo: Springer.

Maarif, S. 2010. Bencana dan Penanggulangannya: Tinjauan dari Aspek Sosiologis (in Bahasa Indonesia). *Jurnal Dialog Penanggulangan Bencana* 1(1): 1–7.

Mahler, D. G., et al. 2021. Updated Estimates of the Impact of COVID-19 on Global Poverty: Turning the Corner on the Pandemic in 2021? World Bank Blogs. 24 June. https://blogs.worldbank.org/opendata/updated-estimates-impact-covid-19-global-poverty-turning-corner-pandemic-2021

Mardiah, A. N. R. 2018. Interface between Disaster and Development: Local Economic Revival through Collaborative Post-Disaster Recovery Governance and Network in Indonesia. Doctoral dissertation, University of Leeds.

Sen, A. 1995. Rationality and Social Choice. *American Economic Review* 85(1): 1–24.

Tiwari, P., J. Shukla, N. Yukutake, and A. Purkayastha. 2022. Measuring Housing Wellbeing for Disaster Victims in Japan and India: A Capability Approach. London: Property Research Trust.

United Nations. 2016. Report of the Open-Ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction.

UNDRR (United Nations Office for Disaster Risk Reduction). 2009. UNISDR Terminology on Disaster Risk Reduction. http://www.unisdr.org/we/inform/terminology

____. 2021. International Cooperation in Disaster Risk Reduction: Target F. www.undrr.org/publication/international-cooperation-disaster-risk-reduction-target-f

____. 2023. The Report of the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. UNDRR: Geneva, Switzerland.

CHAPTER 2

A Review of Literature on Post-Disaster Reconstruction for Communities and Individuals

Dwiky Wibowo, Tifani Siregar, and Piyush Tiwari

2.1 Introduction

Through a review of extant literature on post-disaster reconstruction in various countries, this chapter identifies key lessons for policies and programs that aim to reconstruct and reinstate losses of affected persons. The chapter also proposes a conceptual framework that highlights interlinkages between components of post-disaster reconstruction programs, personal characteristics of affected persons, social and institutional environment, and well-being. The review and the framework emphasize that the aim of post-disaster reconstruction should be to reinstate the well-being of disaster-affected persons.

The Asia and Pacific region faces enormous challenges in safeguarding itself from natural disasters. It is a densely populated area, comprising a significant portion of the global population, with an increasingly aging population and a growing dependency ratio among seniors. This demographic shift has significant implications for managing and building resilience against disasters, as older adults are disproportionately affected by such events. Moreover, a substantial proportion of the region's population resides in urban areas, and the urban poor are particularly susceptible to the consequences of natural disasters. Hence, resilience is crucial for the urban poor, who often lack resources and support systems, making them more vulnerable. The purpose of this chapter is to provide policymakers with a concise overview of the critical challenges and successful practices in compensating and restoring post-disaster situations in this region.

The Asia and Pacific region is highly prone to natural disasters, accounting for nearly 45% of global occurrences and over 75% of the global population affected by such disasters (UNFPA 2018). Climate change exacerbates this vulnerability, especially for Pacific island nations that face mounting pressure to adapt swiftly. Furthermore, the region grapples with prolonged crises and conflicts, which compound the effects of natural disasters, and hosts more than half of the world's refugee population (UNFPA 2018). In comparison to other regions, individuals in the Asia and Pacific region are five times more likely to experience the impact of natural disasters (Yi 2017). The economic losses due to natural disasters have amounted to trillions of dollars in the region, with costs of damage rising steadily. The frequency and severity of natural disasters in the Asia and Pacific region underscores the imperative for effective and fair strategies for compensation and restoration.

In countries like Japan, the population is aging at a faster rate, making the population more susceptible to natural disasters. This demographic shift has significant implications for disaster management and resilience, as older adults are disproportionately affected by natural disasters. For instance, demographic vulnerability to flood fatalities has been observed to be higher among older adults. Studies in public health have traditionally focused on the vulnerability of children in emergencies like floods, but older adults also face unique challenges. These may include difficulties in receiving disaster information and warning signals, a lower tendency to comply with evacuation orders, physical limitations in evacuation, and an increased risk of health deterioration during disasters. Furthermore, older adults may live in isolated places or have limited interest in seeking information, making them more vulnerable to natural disasters. Policymakers must understand the magnitude of an aging population and its correlation

with natural disasters in the Asia and Pacific region. Addressing the needs of older adults will require effective and equitable compensation and restitution strategies.

Previous research in the field of natural hazards has primarily focused on examining the vulnerability of children and older adults to flood disasters in a limited number of developed countries. Insufficient evidence has been gathered regarding demographic vulnerability, and there has been a surprising neglect of studying the vulnerability of these age groups in developing Asian countries, despite the concentration of flood-affected individuals in this region. It is important to recognize that the vulnerability of children and older adults is context-specific, influenced by household dynamics, health conditions, and social networks. The vulnerability of these age groups varies across different countries, necessitating further research to identify their specific vulnerabilities in diverse regions. Moreover, it is crucial to acknowledge that vulnerability is not a fixed state, and this fact should be considered when assessing present-day vulnerability. Policymakers must therefore incorporate the unique vulnerability of older adults and children into their disaster management strategies, particularly in developing Asian countries.

In recent years, the frequency and severity of natural disasters have increased, and this pattern is expected to continue due to climate change and urbanization. By 2030, it is projected that 325 million impoverished individuals will reside in the 49 countries most susceptible to hazards (UNDRR and WMO 2021). Uncontrolled urbanization poses a significant risk, as development in high-risk areas like hillsides or floodplains often occurs without adequate planning. Consequently, the urban poor, particularly those in informal settlements, face escalating threats to their lives, health, and livelihoods. To safeguard against the reversal of hard-earned development progress and to sustain economic growth, it is essential to invest in building resilience in urban areas and their inhabitants to withstand the impacts of natural disasters and climate change.

Investing in urban resilience is paramount for effectively dealing with natural disasters and preventing cities from being trapped in unsustainable development paths that expose them to increasingly intense and frequent urban shocks and pressures. Resilience refers to the capacity of systems, entities, communities, or individuals to adapt to changing conditions and withstand shocks while maintaining essential functions. In the context of cities, this entails ensuring that infrastructure, communication systems, and supply chains that support the well-being of residents can endure disruptions and continue to operate. Unplanned and rapid urbanization often leads to development in high-risk zones, rendering the urban poor highly vulnerable to the impacts of natural disasters. Failing to prioritize investments in city resilience jeopardizes economic progress and risks undoing the strides made in poverty reduction.

2.2 Effect of Disasters

The impact of natural disasters in the Asia and Pacific region is substantial and extensive, as evidenced by the fact that nearly 75% of those affected by such disasters worldwide reside in this region (UNFPA 2018). The region is also exceptionally vulnerable to the consequences of natural disasters, as depicted by the statistics: a staggering 18,344,410 individuals have had their livelihoods disrupted or destroyed, and 5,357,949 people have experienced damage or destruction to their dwellings in this region as of 2018 (UNDRR 2020). These disasters not only result in physical destruction and economic losses but also have significant repercussions on the lives of the affected individuals, particularly girls and women. Research has demonstrated that during crises, girls and women bear a disproportionate burden and face an elevated risk of violence and exploitation. In communities affected by disasters, girls are more likely to drop out of school, depriving them of educational opportunities. Similarly, women often shoulder the responsibility of caring for their families and rebuilding homes and livelihoods. Additionally, due to disparities in knowledge, mobility, decision-making power, and access to resources and training, women experience higher mortality rates and are more susceptible to injuries (UNEP

2011). It is imperative for disaster risk reduction and response efforts to consider the specific needs and vulnerabilities of girls and women, ensuring their equal participation and leadership in decision-making processes.

2.3 Disaster Management Cycle

Countries in the Asia and Pacific region, being highly susceptible to disasters, have continuously worked on strengthening their national disaster risk management (DRM) systems by drawing lessons from both domestic and international disasters (Pal and Shaw 2014). According to the United Nations Office for Disaster Risk Reduction (UNDRR), DRM encompasses the implementation of policies and strategies aimed at preventing new disaster risks, reducing existing risks, and effectively managing residual risks, thereby enhancing resilience and minimizing disaster losses. The DRM framework provides practical opportunities for targeted policy interventions and investments that cut across sectors and jurisdictions and extend to communities, including the most vulnerable populations (Jha and Stanton-Geddes 2013).

To effectively handle disasters and comprehend the different phases of disaster management, the disaster management cycle has served as a crucial tool (Rana et al. 2021). Figure 2.1 illustrates the conventional or basic disaster risk management cycle.

Figure 2.1: Basic Disaster Risk Management Cycle

Sources: Adapted and modified from Carter (2008) and Rana et al. (2021).

Before going into the main segments within the disaster management cycle, it is important to note that two major factors are likely to trigger action in some or all of these segments, namely post-disaster review and results of exercise or simulations (Carter 2008). Post-disaster review should be carried out as early as possible in the recovery period. Such review will often reveal shortcomings in plans.

Similarly, influences similar to those of post-disaster review can emerge from the results of exercises or simulations if they are accurately evaluated and the lessons from them are correctly drawn.

The disaster management cycle consists of three main phases: pre-disaster, during disaster, and post-disaster activities. Pre-disaster activities encompass prevention, mitigation, and preparedness. The occurrence of a disaster is marked by its impact and the subsequent response. The impact can vary significantly depending on the type of disaster. For instance, earthquakes have a short impact time, while cyclones can last longer. Response activities, such as rescue and relief efforts, are implemented immediately before and after the disaster's impact. The post-disaster phase includes recovery and development. Recovery involves assisting communities in returning to normal functioning after a disaster. Conducting post-disaster reviews is crucial during the recovery process to inform future development initiatives. Integrating development into the disaster management cycle ensures that the lessons learned from disasters are effectively incorporated into future policies. These activities collectively contribute to disaster management and the reduction of risks. While discussions continue regarding the modification of the disaster management cycle, it remains widely used due to its convenience and effectiveness.

The Sendai Framework for Disaster Risk Reduction, adopted by the United Nations General Assembly in 2015, offers a comprehensive approach to disaster management by fostering an understanding of disaster risk and taking preventive actions. Countries worldwide are developing disaster management plans aligned with this framework. Japan, for example, has implemented various measures to enhance disaster management, particularly focusing on early warning systems and communication. They established a rapid and accurate information dissemination system for potential tsunamis, including issuing alerts. Moreover, the government prioritized raising public awareness about tsunami risks and the importance of early evacuation. These actions aim to enhance community resilience in the face of natural disasters. Bangladesh has also made significant progress in integrating disaster management and risk reduction into its legislation, policies, and development plans, surpassing many other climate-vulnerable countries. Bangladesh's National Plan for Disaster Management from 2016 to 2020 is based on the principles of the Sendai Framework, emphasizing the crucial role of disaster risk reduction and resilience in achieving the Sustainable Development Goals. Additionally, the country's Standing Orders on Disasters 2019 align with the commitments outlined in the Sendai Framework and adopt a comprehensive and inclusive approach to disaster risk reduction that is internationally recognized.

Implementing disaster management plans that align with the Sendai Framework is crucial in reducing the risk and impact of disasters on communities. However, it is essential to note that the success of these plans relies not only on the actions of governments and international organizations but also on the active participation and engagement of community members, particularly children and women because they are considered as vulnerable groups. One example of a successful disaster management plan that incorporates community participation is the "Community-Based Disaster Risk Management" approach, which has been implemented in the Mekong Delta of Viet Nam (Sjöstedt and Sturegård 2015). This approach empowers communities to identify and assess their own risks and develop and implement strategies to reduce their vulnerability. Additionally, case studies have shown that involving women in the planning and implementation of disaster management strategies can lead to more effective and sustainable outcomes, as they often have unique perspectives and needs that should be considered (UNEP 2011). To build resilient communities and reduce the impact of disasters over the long term, it is crucial that disaster risk reduction is integrated into the development and implementation of policies such as urban planning and land use.

Box 2.1: Jakarta's Race Against Land Subsidence and Flood Vulnerability

Jakarta, the capital city of Indonesia, is one of the fastest-sinking cities in the world. The city's land is sinking at an alarming rate of up to 28 centimeters per year (Cao et al. 2021) due to the overextraction of groundwater, poor urban planning, and rising sea levels caused by climate change. The city's vulnerability to flooding has been exacerbated by this land subsidence, with large areas now at risk of flooding during heavy rainfall or high tides. The situation is particularly dire for Jakarta's poorest residents, who live in informal settlements on low-lying land most at risk of flooding. These impoverished vulnerable communities are also disproportionately affected by flooding and land subsidence due to poor access to services and assistance from the government. The city's rapid sinking, combined with its high population density and inadequate infrastructure, highlights the urgent need for comprehensive and integrated solutions to address the pressing challenges of urban resilience in Jakarta.

2.4 Lessons Learned

Although the Asia and Pacific region is prone to disasters, the process of learning from those experiences is still far from complete. Recovery and reconstruction post-disaster remains a great challenge for governments and communities affected by disasters. In this section, we emphasize the lessons learned on post-disaster reconstruction and recovery. Our discussion focuses on vulnerable groups, the role of private finance, and the crucial role of institutions and international agencies.

2.4.1 Vulnerabilities

In previous sections, we have discussed vulnerable groups who face different levels of risk and vulnerability to disasters. However, it is important to note that those vulnerable groups, such as women, seniors, and immigrants, are not only disproportionately affected when disaster strikes but also during the recovery and reconstruction after the disaster. Consequently, policies aimed at addressing post-disaster recovery must also consider these differential impacts and outcomes on various groups.

Women. Not only do women face a higher likelihood of experiencing the immediate consequences of disasters, as evidenced by the significant percentage of women (70%–80%) among those who lost their lives in the 2004 Indian Ocean tsunami in Indonesia, Sri Lanka, and India, but they also tend to be the most vulnerable in the aftermath. One reason for this vulnerability is that women's fundamental human rights and land rights are often overlooked. The Reconstruction of Aceh Land Administration System project, which aimed to assist the post-tsunami reconstruction in Aceh and North Sumatra, revealed that the tsunami disaster placed women in precarious positions, jeopardizing their livelihoods and assets due to inconsistent recognition of their land and property rights. As a result, women faced difficulties in registering and obtaining title certificates for inherited claims. Hence, considering the land ownership of people regardless of gender prior to relocation and asset compensation processes is crucial.

Certain cultural practices further disadvantage women. Following the 2010 flooding in Pakistan, numerous women faced limited mobility due to financial and familial constraints, which hindered their access to conventional aid, including food assistance, medical services (particularly reproductive health services), and even toilets. Additionally, many women lacked national identification cards, restricting their eligibility for relief schemes that required possession of such identification.

Moreover, women and girls, particularly those who are economically disadvantaged and marginalized based on factors like ethnicity, culture, or belief, face greater risks than men in terms of psychosocial trauma, long-term displacement, loss of homes and jobs, and chronic poverty. The aftermath of disasters often witnesses increased rates of domestic violence, alcoholism among men, and underage marriages, which further violate women and girls' rights and hinder their ability to seek appropriate support and response.

Fortunately, there is growing recognition of the differential impact of disasters on women and their specific needs, highlighting the necessity of inclusive planning for effective post-disaster recovery and reconstruction. Gender considerations are essential because gender-blind responses that neglect the realities faced by people of different genders in disasters can perpetuate existing inequalities and undermine the effectiveness of reconstruction efforts.

Additionally, despite the vulnerability of women during and after disasters, it is important to acknowledge that women are not solely victims. Substantial evidence demonstrates that women can serve as agents of change during and after disasters. Following the 2015 earthquake in Nepal, women played a vital role in the rebuilding process. Some women even received training as masons to contribute to the repair and reconstruction of houses, infrastructure, and cultural sites with earthquake-resistant techniques.

Box 2.2: Gender-Sensitive Approaches in Indonesian Disaster Response and Rehabilitation

Emergency operations after the eruptions at Indonesia's Mount Merapi in 2010 ensured gender sensitivity, such as through setting up a gender working group that cooperated closely with the government and consulted widely with women and men survivors. This resulted in women volunteers and police officers being strongly represented in the emergency operations, which is an important factor that explains the lower levels of gender-based violence in the aftermath of the Merapi eruptions compared to other disasters (Ministry of Women Empowerment and Child Protection, Indonesia 2011).

The Rehabilitation and Reconstruction Agency (Badan Rehabilitasi dan Rekonstruksi) of Aceh and Nias aimed to improve equality after reconstruction by transforming gender roles and relations. Its key components were in the two most challenging areas of gender equality in Indonesia, where progress had been slow:

(i) women's empowerment: ensuring women's active participation in reconstruction efforts, and
(ii) women's economic empowerment: promoting women's access to economic opportunities while placing an emphasis on equal distribution of economic resources.

Seniors. Compared to younger individuals, older adults are more susceptible to the adverse physical, emotional, social, and economic consequences of disasters. This vulnerability is particularly pronounced for those who have impaired physical or cognitive abilities, chronic illnesses, or who care for dependent individuals. Additionally, older adults who require home care, have limited social or economic resources, or are socially isolated are at higher risk (Brasher 2020).

One significant challenge faced by seniors is their limited physical capabilities compared to younger populations. Older individuals with hearing impairments or cognitive difficulties may struggle to comprehend information or follow instructions. They may feel overwhelmed by disasters, especially if they face difficulties with mobility, standing in lines, or sleeping in noisy shelters. For those who rely on wheelchairs, canes, or walkers, the inability to access stairs in the event of elevator failure due

to power outages poses further challenges. Furthermore, older adults are more susceptible to health issues resulting from extreme temperatures, particularly if there are prolonged disruptions to local electric or gas services (Centers for Disease Control and Prevention n.d.).

As a group, older people are more likely than their younger counterparts to experience significant health concerns. Preexisting health conditions, even minor ones, can rapidly escalate to critical levels during a disaster, affecting their recovery and survival. This is especially true for older individuals who depend on home care services such as meal delivery or essential medication distribution, which are often disrupted during and after disasters.

Moreover, older individuals often have strong emotional ties to their homes and communities. While this sense of attachment is valuable, it can become counterproductive if they become reluctant to evacuate or relocate in the face of high-level danger, potentially jeopardizing their safety.

Box 2.3: Seniors' Shelter Choices in Hurricane Sandy

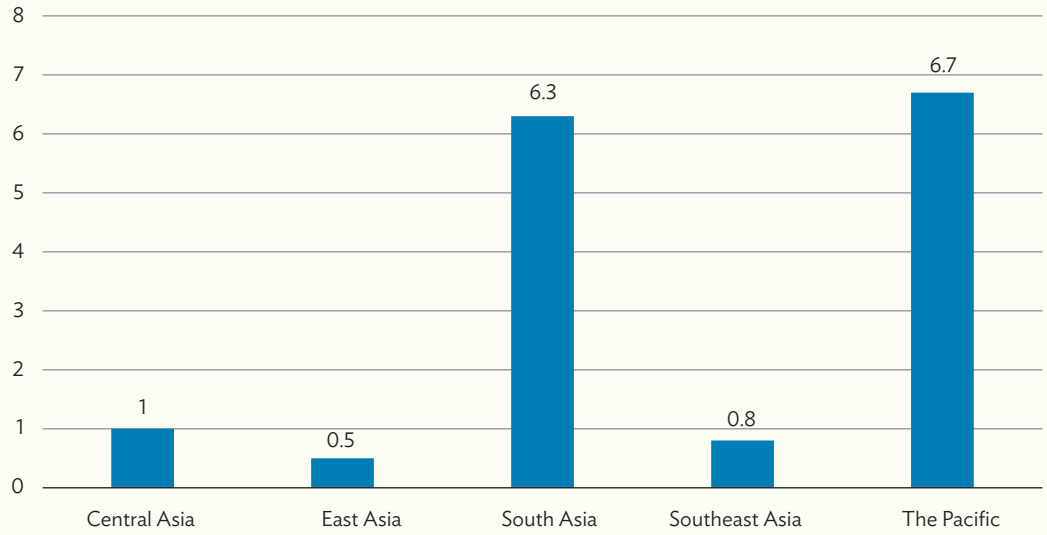
In October 2012, the storm surge of Hurricane Sandy hit New York in the United States, killing 53 people, flooding streets, tunnels, and subway lines, and cutting power in and around the city. A mandatory evacuation order was in place for residents in low-lying areas. However, many older people determined their own level of risk, resolving to shelter in a place where they felt supported, could be with their pets, and could limit their exposure to the trauma of evacuation (Goldman et al. 2014).

Low-income countries. Low-income countries face significant challenges in terms of their preparedness and financial resources to effectively manage risk and facilitate recovery, particularly at the local level. Insufficient budgets, limited human resources, and inadequate technical capacity impede the ability of local institutions in low-income and lower-middle–income countries to serve as first responders and integrate resilience into local-level investments. As a result, their capacity to cope with disasters is significantly lower compared to higher-income countries, leading to higher fatality rates. Additionally, the lack of economic resources further exacerbates these limitations. The insufficient capabilities of governments, particularly in low-income and lower-middle–income countries, highlight the importance of involving private sector financing. The following section explores the involvement of the private sector in the process of post-disaster reconstruction.

2.4.2 Private Finance, Institutions, and International Agencies

A significant number of regional governments lack sufficient and comprehensive funding arrangements for major disasters, leading to the amplification of adverse socioeconomic consequences caused by such events. Developing Asia, in particular, experienced over a quarter of the average annual global damage, totaling around $135 billion (Asian Development Bank 2021). As shown in Figure 2.2, we can also see that the damage from disasters is also giving a huge burden to countries in Asia and the Pacific. Thailand, for instance, incurred approximately $46.5 billion in damages and losses due to the 2011 floods, requiring government expenditure equivalent to 5% of their annual revenues (World Bank 2012). In the Solomon Islands, the 8.1 magnitude earthquake followed by a tsunami in April 2007 resulted in losses estimated at 95% of the government's budget and led to a temporary liquidity crisis until donor assistance arrived. These instances highlight the immense financial burden borne by governments in Asia and the Pacific when it comes to post-disaster recovery and reconstruction.

Figure 2.2: Damage from Disasters, 2000–2019
(% of gross domestic product, unweighted average)



Source: Asian Development Bank (2021).

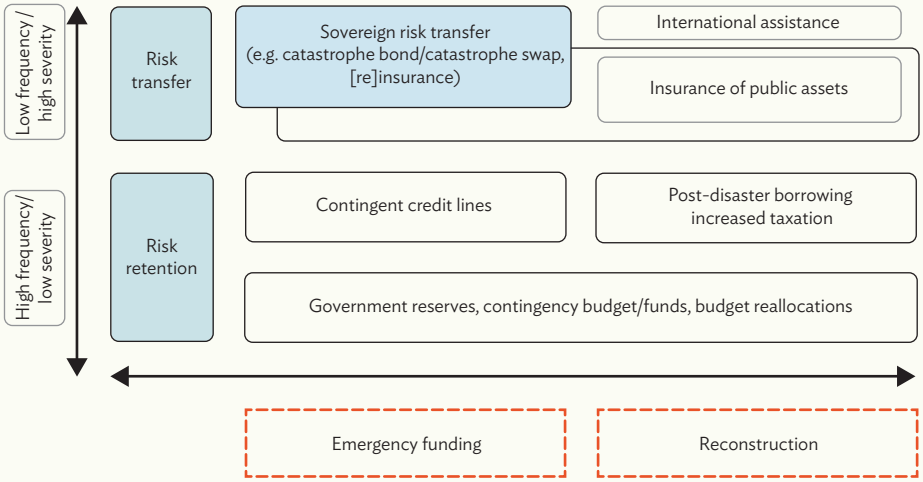
Small and low-income countries, as well as Pacific island countries, face significant challenges due to funding gaps and limited capacity to identify immediate needs. These countries are particularly vulnerable to natural hazards, with a high proportion of their populations exposed to such risks.

Even in normal circumstances, many governments struggle with executing funds in a timely and efficient manner. This challenge becomes even more pronounced after a disaster, as the event disrupts operations and leads to a surge in funding. Therefore, it is crucial to understand the budget execution processes and potential issues associated with them as a first step (International Bank for Reconstruction and Development / World Bank and Asian Development Bank 2017).

Furthermore, it is important to review and develop laws and regulations that govern post-disaster responses. For instance, many countries require a declaration of a state of national disaster or calamity to access catastrophe contingent credit lines or disaster reserve funds. In such cases, the circumstances under which a state of national disaster/calamity can be declared and the process for declaring it should be clearly defined.

Past experiences have highlighted the importance of governments employing a combination of instruments to protect against disasters of varying frequency and severity. This approach, depicted in Figure 2.3, is known as risk layering and categorizes financing mechanisms into two main groups: risk retention and risk transfer (International Bank for Reconstruction and Development / World Bank and Asian Development Bank 2017). It is advisable to adopt a bottom-up approach, where the government secures funds for recurring disaster events (retention) and subsequently enhances its post-disaster financial capacity to address less frequent but more severe events (transfer). This method of risk layering ensures the utilization of cost-effective sources of funding before resorting to more expensive instruments in exceptional circumstances (International Bank for Reconstruction and Development / World Bank and Asian Development Bank 2017).

Figure 2.3: Risk Layering of Disaster Risk Financing



Source: World Bank (2020).

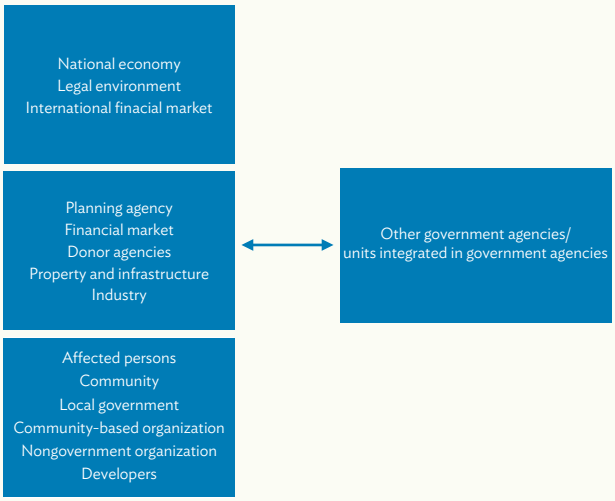
2.5 Way Forward

From the discussion in the sections above, it is clear that to achieve an effective and efficient post-disaster recovery process, a robust framework is necessary. The World Bank's Global Facility for Disaster Reduction and Recovery published the Disaster Recovery Framework Guide in 2015 and updated it in 2020 (GFDRR 2020). The guide consists of six modules: pre-disaster preparation for discovery, conducting post-disaster assessments, recovery policy, institutional arrangements, financial mechanisms, and implementation arrangements.

In this publication, we focus on the interlinkages among actors/institutions during the post-disaster recovery process and the need to start from the communities most affected by the disaster. Figure 2.4 illustrates the hierarchical model, starting from the local community and local governments, moving up to agencies and industries, and ending at the top with national/international economies/environments. This model highlights the necessity to understand all three layers covering people, institutions, and policies.

As discussed in the preceding sections, during and after disasters, those who are most adversely affected are usually the most vulnerable individuals. Yet, in the past, post-disaster reconstruction has mainly focused on the rebuilding of infrastructure. However, it is vital to also focus on the people, including vulnerable individuals and groups, and the recovery of their lives and livelihoods. An assessment of their needs should be done and the results should be used when formulating recovery programs and policies.

Figure 2.4: Interlinkages among Actors and Institutions in Post-Disaster Recovery



Source: Authors.

References

Asian Development Bank. 2021. Disaster Resilience in Asia, A Special Supplement of Asia's Journey to Prosperity: Policy, Market, and Technology Over 50 Years. *Asian Development Bank*. July. https://www.adb.org/sites/default/files/publication/703556/disaster-resilience-asia.pdf

Brasher, K. 2020. Age Friendly Approach to Disaster Recovery. *WHO, Age Friendly World*. May. https://extranet.who.int/agefriendlyworld/wp-content/uploads/2020/05/AgeFriendlyApproachToDisasterRecovery.pdf

Cao, A. et al. 2021. Future of Asian Deltaic Megacities under Sea Level Rise and Land Subsidence: Current Adaptation Pathways for Tokyo, Jakarta, Manila, and Ho Chi Minh City. *Current Opinion in Environmental Sustainability* 50: 87–97. https://linkinghub.elsevier.com/retrieve/pii/S1877343521000361

Carter, W. N. 2008. *Disaster Management A Disaster Manager's Handbook*. Manila, Philippines: Asian Development Bank.

Centers for Disease Control and Prevention. n.d. Disaster Planning Tips for Older Adults and their Families. CDC. https://www.cdc.gov/aging/pdf/disaster_planning_tips.pdf

Global Facility for Disaster Reduction and Recovery (GFDRR). 2020. Disaster Recovery Framework Guide. gfdrr.org. March. https://www.gfdrr.org/sites/default/files/publication/DRF%20Guide.pdf

Goldman, L., R. Finkelstein, P. Schafer, and T. Pugh. 2014. Resilient Communities: Empowering Older Adults in Disasters and Daily Life. *The New York Academy of Medicine*. July. https://media.nyam.org/filer_public/64/b2/64b2da62-f4e7-4e04-b5d1-e0e52b2a5614/resilient_communities_report_final.pdf

International Bank for Reconstruction and Development / World Bank and Asian Development Bank. 2017. *Assessing Financial Protection against Disasters: A Guidance Note on Conducting a Disaster Risk Finance Diagnostic*. Washington DC: World Bank Publications.

Jha, A. K., and Z. Stanton-Geddes. 2013. *Strong, Safe, and Resilient A Strategic Policy Guide for Disaster Risk Management in East Asia and the Pacific*. Washington, DC: World Bank.

Ministry of Women Empowerment and Child Protection, Indonesia. 2011. Policy Brief: Gender Equality in Disaster Management and Climate Adaptation. https://www.kemenpppa.go.id/lib/uploads/list/1f738-b3dcd-6.-gender-equality-in-disaster-management-and-climate-adaptation.pdf

Pal, I., and R. Shaw. 2014. Disaster Governance and Its Relevance. In I. Pal and R. Shaw, eds. *Disaster Risk Governance and Cross-Cutting Issues in India*. Singapore: Springer.

Rana, I. A., M. Asim, A. B. Aslam, and A. Jamshed. 2021. Disaster Management Cycle and Its Application for Flood Risk Reduction in Urban Areas of Pakistan. *Urban Climate* 1–12.

Sjöstedt, F., and V. Sturegård. 2015. *Implementation of Community Based Disaster Risk Management in the Mekong Delta, Vietnam*. Division of Risk Management and Societal Safety, Lund University, Sweden. https://northsearegion.eu/media/3882/implementation_of_community_based_disaster_ris.pdf

United Nations Environment Programme (UNEP). 2011. Women at the Frontline of Climate Change: Gender Risks and Hopes. https://wedocs.unep.org/20.500.11822/7985

United Nations Office of Disaster Risk Reduction (UNDRR). 2020. Monitoring the Implementation of Sendai Framework for Disaster Risk Reduction 2015–2030: A Snapshot of Reporting for 2020. https://www.undrr.org/publication/monitoring-implementation-sendai-framework-disaster-risk-reduction-2015-2030-snapshot

UNDRR and World Meteorological Organization (WMO). 2021. Joint Statement by WMO and UNDRR on the Creation of a Centre of Excellence for Climate and Disaster Resilience. https://www.undrr.org/news/joint-statement-wmo-and-undrr-creation-centre-excellence-climate-and-disaster-resilience

United Nations Population Fund (UNFPA). 2018. *Delivering Supplies in Crisis Situations in Asia*. https://www.unfpa.org/sites/default/files/resource-pdf/18-291-DeliveringSuppliesCrisis-Asia-finalweb.pdf

World Bank. 2012. Thai Flood 2011: Rapid Assessment for Resilient Recovery and Reconstruction Planning. *World Bank Open Knowledge Repository*. https://openknowledge.worldbank.org/handle/10986/26862

____. 2020. Disaster Recovery Framework Guide, Revised Version. https://documents1.worldbank.org/curated/en/692141603785003050/pdf/Disaster-Recovery-Framework-Guide.pdf

Yi, B. L. 2017. FACTBOX-Asia-Pacific: The World's Most Disaster-Prone Region. Thomson Reuters Foundation. https://news.trust.org/item/20171010030737-rqs41

Zaman, T., K. T. Tahsin, S. R. Rozario, A. B. Kamal, M. R. Khan, S. Huz, and M. Bodrud-Doza. 2022. An Overview of Disaster Risk Reduction and Anticipatory Action in Bangladesh. *Frontiers in Climate* 4. https://doi.org/10.3389/fclim.2022.944736

CHAPTER 3

Financing Post-Disaster Reconstruction

Saumen Majumdar

3.1 Introduction

Looking at the history of the word "disaster" reveals a wide variety of definitions as well as some consistent concepts. Etymologically, disaster comes from the Latin prefix *dis-* and Latin *astro*, which combine to form the Old Italian word *disastro*, an unfavorable star. Across Asia, similar terms exist: *aapada* in Hindi and Sanskrit, *biparyaya* in Bengali, *durantada* in Kannada, *saigai* in Japanese, *jaehae* in Korean, and *zainan* in Chinese. Disasters are counted as bad outcomes of the prevailing risks to the existence of humankind. Typically, disasters are either natural or social. Disasters triggered by climatological, hydrological, and meteorological hazards are termed as natural disasters, while accidents that threaten the lives and properties of citizens and the state such as fires, building collapses, exposure to hazardous substances, and chemical, biological, and radioactive accidents are termed as social disasters.

In the United States, the Disaster Relief and Emergency Assistance Act, also known as the Stafford Act, defines a major disaster as any natural catastrophe or fire, flood, or explosion in any part of the United States that, in the determination of the president of the United States, causes a level of damage, loss, hardship, or suffering of sufficient severity to warrant major disaster assistance. In Japan, the Basic Disaster Countermeasure Act defines a disaster as a typhoon, heavy rain, heavy snow, flood, tidal wave, earthquake, tsunami, volcanic eruption, other natural phenomena, or massive fire explosion and other causes of damage. In India, the Disaster Management Act of 2005 defines a disaster as a catastrophic occurrence that results in such loss of life or damage to property or environment that is beyond the coping capacity of the community of the affected area.

Countries across the world are always at risk of an impending natural or social disaster. In technical terms, this risk is commonly defined or quantified by the probability of an event occurring. Risk can also be differentiated into three elements: the probability of the hazard occurring, the extent of exposure of humans and property to the hazard, and the direct and indirect effects and costs of this exposure. Disasters damage both the physical and social infrastructure. Mitigative measures need to be in place for each category of risks. These measures are costly, and poorer countries can afford them only at the cost of compromising potential economic growth.

A common theme underlying these risks is that in the aftermath of the disaster, the impact exceeds the ability of the affected community to cope using their own resources. Hence, there is a need for external assistance, which this chapter seeks to explore. In the literature on disaster financing, two specific policy areas emerged: (i) policies to cater to the need for anticipatory financing mechanisms and (ii) policies to cater to the need for providing rapid financing in the aftermath of disaster. The salience for the latter grew over time, and it is now referred to in the literature as disaster risk financing. This chapter describes existing disaster risk financing opportunities and explores innovations to augment these opportunities.

The Centre for Research on the Epidemiology of Disasters (CRED) at the University of Louvain (Belgium) is one of the most exhaustive data repositories on natural disasters. According to CRED, Asia and the Pacific is the region most susceptible to natural disasters. Data from CRED shows that among

the top 10 countries with the most occurrences of natural disasters[1] from 1900 to 2023, six are in Asia and the Pacific. Data also shows that the number of natural disasters has been increasing over time while the number of people killed per disaster has been falling. According to the Intergovernmental Panel on Climate Change, heavy precipitation events are likely to increase in the future while cyclonic storms or extreme weather events are likely to become aggravated in the future. Coastal regions are frequently affected by floods, storms, and landslides, so with many of its countries having large coastlines, the Asia and Pacific region is vulnerable to these types of natural hazards. Mountainous terrains or regions along fault boundaries are frequently affected by earthquakes and volcanoes. Economies in the Asia and Pacific region such as Indonesia; New Zealand; the Philippines; Taipei,China; and Japan are especially vulnerable to such natural hazards.

The two most notable natural disasters affecting the Asia and Pacific region were the Indian Ocean tsunami in 2004 and the tropical cyclone in Bangladesh in 1991. While the former mostly affected the middle-income countries of the region, killing around 240,000 people, the latter devasted a poor country killing, around 140,000 people. Given the increased propensity to face natural disaster for countries in Asia and the Pacific, the chapter reviews the possible financial arrangements available for mitigating the adverse consequences arising from such events.

3.2 Financial Relief

It has been well established that fatalities arising out of disasters are typically higher in low-income and non-democratic countries (Stromberg 2007; Sen 1999). One reason for this tendency is that higher-income countries are more likely to invest in preventive measures to mitigate adverse effects related to disasters. Moreover, these countries have the financial wherewithal to reconstruct during the post-disaster phase. Countries with free press and commitment toward civil liberties are less likely to suffer following disasters, as their governments are more proactive toward averting catastrophic situations and tend to prioritize relief measures, possibly because they are under constant scrutiny.

Poverty and inequality also seem to be a factor for higher mortality and destruction arising out of natural disasters. Poor people are in general likely to live in squatter settlements of unregulated building structures, which are more prone to destruction from natural disasters. Not surprisingly, disaster-related deaths per capita are four times higher in low-income countries than in the rest of the world. The People's Republic of China and India, especially the former, have been able to lift a significant section of the people out of poverty. This augurs well, as South Asian countries are prone to natural hazards, so deaths and destruction are likely to be reduced.

As humankind expands its footprint throughout the world and as development leads to more economic structures being constructed around the world, consequent damages to these economic structures will be more. Consequently, there will be more need for post-disaster funding to recoup and rebuild. The global disaster damages are now estimated to be around $250–$300 billion each year (UNISDR 2015). This led the Group of Seven (G7) countries to deliberate on the need to set up a fund to mitigate the damages from disasters around the world. During the United Kingdom Presidency of the G7 in 2021, the government of Germany committed $160 million and the government of the United Kingdom $140 million for prearranged disaster risk financing for vulnerable communities. Various other countries also pledged commitments toward disaster financing. As voices for more funding became louder, the urgency to set up committed funds also grew. Perhaps that led to the birth of a new term: disaster risk financing.

[1] Natural disaster is defined in the CRED database as one in which 10 or more people are killed, 100 or more people are reported affected, or the government declares a natural disaster

3.3 Financing Options

The standard options available for individuals, businesses, and institutes are in the form of insurance markets, relief grants, or public loans. However, there is a huge funding gap; the demand for funds far outweighs the supply from public and private sources, the latter woefully short and not forthcoming due to institutional limitations. This funding gap is exacerbated often for small and medium-sized enterprises and for vulnerable households. They are typically found to lack any post-disaster contingency plans. Specifically, the small and medium-sized enterprises are ineligible for relief financing that is often targeted at the household level.

The public funding for post-disaster financing is often delayed due to the challenge of assessing financial risks after disasters. In the traditional Anglo-Saxon form of parliamentary democracy, fiscal policies have long inside lags while the outside lags are short. It takes a long time to get parliamentary approvals for disbursal of public funds. Financial products of the governments are often not innovative and are not designed to address constantly changing or chaotic situations after disasters. It also takes a long time to develop financial products that are adaptable to different situations. There are short, medium, and long-run needs for post-disaster financing. In the short run, immediately after a disaster strikes, there is a complete breakdown of market structure. Food and construction materials are not available. Their prices rise appreciably, far beyond the reach of households and small businesses. Access to cash is likely to be a problem as local banks are affected. Disruptions in the internet services preclude affected people and enterprises from conducting online transactions. Small businesses often end up closing altogether. Poor households suffer and end up depending on doles from charitable organizations and trusts.

There is a huge opportunity for the private sector to fill in the funding gap by channeling funds to the affected persons and small businesses. The private sector has been reluctant to do so, primarily because there is a lack of appropriate information about the households and the small businesses based on which the private financiers can assess their risks. Hence, it may be argued that there is a need for public–private partnership—between financiers, investors, and responders. There are two categories of post-disaster financing: ex ante and ex post. Table 3.1 delineates these funding opportunities based on funding types.

Table 3.1: Funding Options and Stakeholders

Funding Type	Timing	Examples	Participants
Risk transfer	Ex ante	Flood insurance/Catastrophe bonds	Insurance and reinsurance firms, national and local governments
Credit lines	Ex post	Loans	Financial intermediaries
Grants/Aid	Ex post	Relief funding, government disaster block grant or planned expenditure	National government, charitable trusts
Remittances	Ex post	Family and friends	Family members, financial institutions
Hybrid financial instruments (forecast-based financing)	Ex ante	Catastrophe bonds	Credit risk agencies, insurance and reinsurance firms

Source: Authors.

Among the many risk finance tools available, private insurance is counted as the most important and prevalent. Within insurance, reinsurance also plays an important part in distributing risk and losses internationally. This depends on the breadth and depth of the prevailing financial architecture of the country. Regulation of the financial market is essential to promote financial stability. Hence, building up the regulatory capacity of the financial system, which hinges on less complex regulations, is desirable. Entry of well-capitalized financial institutions should be encouraged to achieve contestability in the financial sector. At the same time, timely exit of insolvent financial institutions should be allowed to maintain solvent and sound insurance providers. Almost all countries in South Asia and the Pacific permit current account convertibility. Many countries, including the People's Republic of China and India, do not allow capital account convertibility. This restricts the entry of foreign banking and insurance companies. This means fewer innovative insurance products in the market. The extent and effectiveness of the private insurance are crucially dependent on the income levels of the targeted population. There is also the lack of proper data and supporting institutions to record and collect the data necessary for efficient pricing.

There is also a need for private insurance business to modify their product deliverables over time, as the following Australian case review suggests. Australia, to start with, had a well-established insurance market with varied products. However, in 2011, a natural disaster of immense consequences struck the country. From December 2010 to January 2011, excessive rains led to swollen river systems across Queensland and New South Wales, leading to widespread flooding. Food supplies were disrupted, and prices went up across Australia. The supply of coal was disrupted with coal production falling by a third due to inundated mines. Total damages were estimated to be more than A$2 billion with a consequent reduction in the potential gross domestic product (GDP) of Australia of around A$30 billion. A whopping 38,460 individual claims were lodged with insurance companies. The total insurance claims were to the tune of A$1.51 billion. Another cyclonic event (Cyclone Yasi in 2011) further added to the insurance claims.

Australian Prime Minister Julia Gillard received approval from the parliament at the time to impose a flood levy of A$1 to A$5 per week on households to fund reconstruction efforts. Private insurers, faced with huge losses, invested their understanding of risks and tweaked their products to reflect the recent risk metrics. The government also launched the National Disaster Insurance Review (NDIR) to evaluate issues relating to the availability and affordability of insurance offered by the private insurers. Residents of flood affected areas were surprised to discover that their insurance did not cover flood-related damages. Hence, the NDIR was tasked to reexamine the extent of noninsurance and underinsurance and to suggest better comprehensive insurance products. The NDIR suggested measures to ensure comprehensive coverage of flood risks. It proposed to offer premium support and reinsurance for flood insurance coverage in flood prone areas. Not only did the prices of insurance policies decrease, but coverage was extended among all sections of the population.

As mentioned earlier, an important aspect of private insurance business revolves around the extent of penetration of the disaster insurance. In some countries like Mexico, insurance policies on earthquakes, volcanic eruptions, and hydro-metrological perils are packaged as add-ons to fire insurance. In Chile, earthquake- and tsunami-related risks are automatically covered with purchase of residential property.

There are instances where private insurance penetration is inadequate or private insurers are unwilling to insure due to lack of data. In these instances, governments may seek to promote greater coverage against disaster risks through legislative and regulatory measures. Regulations in some countries require private insurers to compulsorily provide disaster insurance coverage as an add-on to voluntary fire insurance policies. For example, in Belgium, home insurance policies cover all disaster-related outcomes such as flood, earthquake, etc., whenever a fire policy is purchased. Although not

compulsory, the actual sum insured is limited by design. If the limits are breached, the Caisse Nationale des Calamites (National Disaster Fund) may intervene to expand the coverage. Sometimes the private insurers charge a high premium to insure against risks such as flooded homes, in which case the Bureau de Tarification, Catastrophes Naturelles (Office of Pricing, Natural Disasters), a public institution, steps in to set premium rates and determine contractual conditions that are affordable to the individuals (OECD 2015).

In Indonesia, regulation of the private insurance businesses created PT Reasuransi MAIPARK, a reinsurance company, which has as its shareholders all the non–life insurance and reinsurance companies. The company determines the premiums based on set categories of buildings/floor heights, etc. The insurance cover is bundled with the available standard fire policies as per regulations of the Standard Indonesian Earthquake Policy.

Another way in which government intervention may make the difference is to provide subsidies or other financial incentives such as public–private collaboration on risk reduction. In this aspect, the Republic of Korea seems to be the pioneer, as the central and local governments offer partial premium subsidies for storms and flooding. The government subsidizes 50% of the insurance premium for crop and fisheries disaster insurance programs operated by the respective ministerial departments. In Japan, income tax deductions for earthquake insurance premiums are allowed. This is expected to incentivize the purchase of coverage. In Mexico, there exist legal frameworks for insurance (Ley General de Instituciones y Sociedades Mutualistas de Seguros) and income tax (Ley del Impuesto Sobre La Renta) that have provisions for tax incentives for the private insurers offering catastrophic insurance coverage. In other instances, public–private partnerships have been formed to promote insurance coverage. For example, in Germany, a program has been established to allow households in flood affected areas to obtain a flood resilience certificate that is based on extensive risk assessment by authorized experts. These certificates help the residents to improve the insurability of their properties.

In the risk transfer category, a third party such as an insurance provider or reinsurer undertakes the risk. Normally, post-disaster damages are met by insurers. But over the years, it became increasingly clear that climate-related damages were becoming costlier to the point that it was not possible to cover the cost of damages solely from insurance. For example, in 1992 in the United States, when Hurricane Andrew decimated parts of Florida, many insurance companies went bankrupt trying to cover $15 billion in damages. It became increasingly clear that traditional insurance instruments are inadequate in response. This led to the introduction of many reinsurance companies. They floated innovative catastrophe bonds, also called cat bonds, which helped to refinance the insured amounts. First issued by Hannover Re in 1994, cat bonds became popular thereafter with insurance companies, which found them to be a useful tool to transfer risk off their balance sheets for a range of natural disasters. Ever since their introduction, cat bonds have been floated for reinsuring natural disasters ranging from earthquakes in California and Japan to windstorms in Europe and extreme mortality resulting from pandemics. There have even been attempts to use them for covering human-made perils like a terrorist attack.

Georgia Levenson Keohane, author of *Social Entrepreneurship for the 21st Century: Innovation Across the Nonprofit, Private, and Public Sectors*, in an illuminating article in the *New York Times* (Keohane 2014), explains the concept of cat bonds thus:

> The theory of the cat bond is relatively simple: insurers transfer their risk to capital market investors who are betting *against* catastrophe; that a hurricane or an earthquake won't hit a particular place in a specified period of time. If this proves true, investors are repaid principal plus relatively high interest. If disaster strikes, however, the cat bond investors are

on the hook and lose their principal. In practice, the bonds have a number of complex parts. They typically require the creation of a special purpose reinsurance entity. They are also structured around sophisticated modeling of the risk of catastrophe, which must occur at a specific "event level" (i.e., intensity of wind gust, magnitude of earthquake), geographic area and time period to "trigger" a payout.

The world's first cat bonds were floated by the Metropolitan Transportation Authority to insure the public transport infrastructure under its domain. It entered into a deal with GC Securities and Goldman Sachs to create MetroCat Re. This newly formed reinsurer was responsible for financing the insurance coverage to the Metropolitan Transportation Authority. It collateralized the reinsurance coverage by selling $200 million in cat bonds to 20 investors. This is also the first instance where the payout trigger is solely linked to storm surge levels. Storm surge level is defined as coastal waters rising above a certain height at designated coastal places. If the levels are breached, the investors in MetroCat Re cat bond need to pay. If no such storm surges take place before a specified date, the investors get their principal investment and returns of 4.5% annually above Treasury rates. The bond issue was met with immediate success: over $40 billion has been issued so far. It has also become a very popular way to diversify risk for the investors as natural catastrophes are not correlated with economic conditions.

It is a normal practice among countries to earmark certain resources as budgetary allocations for financing disaster-related damages. Even with this provision, the government often ends up spending resources to tackle disasters, thereby having to shift budgetary resources away from planned public infrastructure expenses into reconstruction efforts. That leads to uncertainty as to whether planned public expenditures will really happen. To avoid such situations, the Mexican government created in 1996 a fund for natural disasters, also known as FONDEN. The Mexican government transferred all budgetary funds meant for disaster relief and reconstruction efforts into this entity. Details regarding FONDEN are discussed later in this section.

During the post-disaster reconstruction phase, households and small business require credit lines to finance such rebuilding efforts. In this respect, banks provide mortgage refinances and loans for small and medium-sized enterprises. Microfinance institutions also provide loans for such causes with innovative payback options. For example, in India, people from similar socioeconomic backgrounds come together for their mutual benefit to form a self-help group (SHG). These SHGs are allowed to borrow at concessional rates from the primary banks, provided they can certify that their debtors have not defaulted on their payments in recent times. In this way, a group of small businesses or households may avail themselves of cheap credit. Another advantage is that these entities (individual households and small businesses) are often unable to access formal bank credits or loans as they lack proper documentation or credit history. An advantage of SHGs is that peer pressure often leads to better collection of dues and serves as a form of collateral for loans. In industrialized countries, organizations such as the United States Small Business Administration offer low-interest disaster loans for businesses to use for repairs or replacement of inventory.

Many countries in the Asia and Pacific region like the Philippines, India, Pakistan, and Bangladesh, to name a few, benefit from remittances for internal growth as well as a precious source of foreign exchange. Typically, remittances are thought to rise following major natural disasters. Family members and neighbors are emotionally inclined to send remittances to help known people back home. For example, remittances from overseas contributed to around 25% of the funding used for mitigating damages caused by Hurricane Gilbert in September 1988 (Clarke and Wallsten 2003). Using data from the period 1970–2002 and observations from 74–87 countries for years 0 to −3 (year of disaster to year three prior), analysis found that hurricane damage led to large inflows of remittances in the poorest

developing countries (Yang 2008). In another study, Mohapatra et al. (2012) concluded that for each 1% of a disaster-affected population, remittances would increase by 0.5% of GDP contemporaneously and by another 0.5% in the next year. However, Bragg et al. (2017) contend that remittances increase in the quarter of the year when the disaster occurs but taper off appreciably in the subsequent quarters. Possibly, immediately after a disaster strikes, the remittance senders rush to send aid as part of emotional outreach. Subsequently, as they evaluate their own economic conditions and as realism prevails, the remittance senders compensate by decreasing their contribution.

State sponsored disaster insurance schemes are also prevalent in economies where private insurance businesses are unable to cater to the insurance needs of the region. The government provides insurance and meets the claims. The best example of this is the Consorcio de Compensación de Seguros (Insurance Compensation Consortium), a state-owned institution set up in Spain in 1941 to provide coverage for natural catastrophes and human-made events. The private insurance industry, in cooperation with the consortium, issues policies, collects the compulsory surcharge, and handles claims. Apart from private or state sponsored insurance schemes, there are targeted disaster insurance schemes in economies where government resources are severely constrained or the paying capacity of the vulnerable sections of the population is low. They may be sector specific such as agriculture or segment specific such as specific vulnerable sections. They may include weather index based parametric products or portfolio protection tools aimed at strengthening the resilience of rural banks, credit cooperatives, and microfinance lenders.

In most of Asia and the Pacific, agriculture still plays a vital role. Rural infrastructure and standing crops are most vulnerable to natural disasters. Farmers and the rural population are therefore most vulnerable to these risks. Not surprisingly, countries have designed specific agricultural policies to mitigate disaster-related risks. These are state sponsored crop insurance schemes. The Vietnam National Reinsurance Corporation, VinaRe, and Viet Nam's two largest insurers, Bao Viet and Bao Minh, administer the crop insurance financial products while Swiss Re provides the actuarial services. In India too, the National Agriculture Insurance Scheme provides for crop insurance. Insurance companies in India also offer innovative insurance products related to agriculture, such as weather based crop insurance schemes, which are another form of parametric based insurance product, as discussed earlier. The payouts in these schemes are triggered by excess or shortfall from a predetermined threshold level of weather-related parameters. These bonds, to be effective and relevant, require large granular weather data. Sparse data may lead to incorrect quantification of risks, which in actuarial terms is known as basis risk. These basis risks must be reduced in order to popularize these products among the Indian farmers. Toward this end, the Government of India is planning to establish a well-planned network of automated weather stations across India. The government also established a hybrid insurance product known as the Modified National Agricultural Insurance Scheme in 2010–2011. The payouts in this case depend on a combination of area yields and weather indexes.

There are many instances of innovative product designs by public–private partnerships developed through market-based collaborations between public institutions and private insurers. Examples of such collaborations include the Horn of Africa Risk Transfer for Adaptation and R4 Rural Resilience Initiative in Ethiopia. Under this scheme, individuals have the option to pay for their insurance premiums with their labor. Specific work programs are designed for employing the rural labor force. The wage compensation is used to pay for the premium. The work programs are strategically designed as local climate adaptive measures that help to reduce destruction from natural hazards.

In Saint Lucia, the weather index–based Livelihood Protection Policy has been in operation since 2012. A consortium of partners involved in the Climate Risk Adaptation and Insurance in the Caribbean project developed this product. Under the program, the island of Saint Lucia was divided into 39 grid

cells with all the individuals of the island listed in one of the cells based on their domicile status. The price of the coverage is fixed at 8% on the sum insured. There is a fixed limit on the maximum sum that may be insured. Using satellite-based technology, the rainfall levels and wind speed at the center of each grid are monitored daily. As the coverage is triggered by the severity of the weather event, payouts are directly credited to the insured's bank account.

Another innovation in weather-based insurance is forecast insurance. Germany developed it in 2010 as a part of the International Climate Initiative to provide insurance coverage to producer associations, agro-export companies, fisheries, and other institutions in Peru. Known as the Extreme El Niño Insurance Product, it is an example of forecast insurance. The payouts in this scheme are triggered by extreme increases in the levels of sea surface temperatures in the Pacific that occur during an El-Niño year. Determinations of El Niño (the warm phase) and La Niña (the cool phase) are made based on sea surface temperature data collated by the United States National Oceanic and Atmospheric Administration, which maintains a time series of monthly average sea surface temperature measurements spanning from 1950 to the present. A sustained increase in sea surface temperatures in a specific region of the Pacific is an indicator of El Niño, which is likely to result in an elevated level of precipitation in the region. Logistic regression is used to identify critical values of the index that correspond to high rainfall events, representation of strong El Niño events. The sea surface temperature is observed months before the onset of heavy rainfall. Hence, the payouts help the insured to finance backup and remedial measures well before catastrophic flooding reaches full force. It is to be noted that the insurance must be purchased one year in advance before any index confirms the occurrence of an extreme El Niño phenomenon. The Extreme El Niño Insurance Product is one of the innovative insurance products that provides insurers with payouts meant for ex ante loss prevention.

Many countries choose, for various reasons, to not have capital account convertibility. They have in place various restrictions on capital mobility. These countries undoubtedly lose on financial deepening and often lack innovative financial products. In some countries, the insurance sector is not fully open, implying restrictions are placed on the entry of foreign insurance firms. Wherever there is a lack of innovative insurance products, wherever private funding of the disaster risk financing tools is lacking or unaffordable, or wherever paying capacity or affordability (income) of the residents is low, government sponsored schemes are needed to cover basic living expenses and losses linked to disaster impacts. Mostly, these government schemes address the financial vulnerabilities of the poor section of the economy. These schemes are designed for fulfilling short-term needs and are appropriated or released to ensure timely disbursement of disaster funds for emergency assistance, social protection, recovery, and reconstruction. These schemes may be financed ex ante or ex post from government reserve funds or any other predetermined arrangement.

Some of these government schemes are emergency relief measures meant specifically for providing relief rather than compensation. In Hong Kong, China there exists the Emergency Relief Fund, which is used for providing urgent relief to households affected due to occurrence of any disaster. The fund is replenished by an annual allocation from the planned revenue of the government and donations from the public. The People's Republic of China, on the other hand, established the Central Natural Disaster Livelihood Subsidy Fund at the central government level. Only after a disaster is designated as category level IV by a separate independent committee, the fund authorities disburse funds for projects addressing urgent relief or reconstruction needs. Typically, the total cost of the project is shared between the central government and local financial administration.

In certain cases, a property may be uninsurable due to being situated in flood prone areas. In such cases, governments may provide compensation schemes for uninsured properties damaged by floods or earthquakes. For example, government sponsored institutes in the Netherlands and Norway

provide compensation for damages to uninsured properties. In some cases, the federal authorities at the national level fund disaster relief and recovery efforts at the state or local level. In most cases, these are in the form of supplementary financial aid over and above what the state or local body may provide. For example, in Canada, local government and municipalities may request financial assistance from the federal government under the Disaster Financial Assistance Arrangement. Through this arrangement, the federal government shares the cost with the local government on certain prearranged norms. A similar arrangement is also in place in Australia, where the Natural Disaster Relief and Recovery Arrangements prescribes support to state and territory governments on a sharing basis. The sharing norms are determined by the revenue earning capacity of the states or territories, with a smaller federal government share for states that earn higher revenues. In India, both the central and state level funds are available to provide relief expenditures on account of natural disasters. Even the state level fund is partly funded by the central government.

As the lender of the last resort, governments across the world tend to bear disaster risk exposure and tend to absorb any peak risk liabilities. To hedge against these risk exposures, governments have used measures such as enhancing budgetary allocations, post-disaster taxation, and post-disaster debt financing. These measures are in turn limited by other things such as debt carrying capacity of the country, GDP growth rates, the domestic and foreign interest rates for accruing internal and external debt, the total factor productivity of the country, the degree of diversification, the current account balance, and the exchange rate management of the country.

As mentioned previously, there are two broad ways available to a country to mitigate risk exposures: ex ante and ex post financing. These financing options have varied response timing to address short-term (emergency response), mid-term (recovery), and long-term (reconstruction) disaster impacts. For example, among the ex ante financing mechanisms, dedicated reserve funds created by sovereign authorities, contingent credit facilities with financial institutions or international organizations, and catastrophe bonds or other cat-linked securities are designed to address short-term needs. Among the other ex ante measures, insurance and reinsurance address long-term impacts for the reconstruction phase and help to indemnify against damages to government assets such as buildings and infrastructure.

The Philippines, known to have high frequency disaster risks, has established the National Disaster Risk Reduction and Management Fund, which is boosted through annual allocation from the national budget subject to some restrictions. Another source of funding was established in 2011, when the government of the Philippines and the World Bank established the Disaster Risk Management Development Policy Loan with a Catastrophe Deferred Drawdown Option. This contingent credit line with an upper limit of $500 million was used by President Benigno Aquino in December 2011 to fund disaster-related expenses caused by Tropical Storm Sendong (Washi).

As part of an integrated disaster risk management framework, Mexico in 1996 created FONDEN, a funding source for the Mexican states and federal government to cover disaster-related damages. FONDEN has three main financial components:

(i) The FONDEN Program for Reconstruction. Funded from federal budgetary allocation, the program mainly aids post-disaster reconstruction by way of cash transfers to the FONDEN Trust.
(ii) The FONDEN Trust. The financial arm of the disaster risk management framework, it dispenses the reconstruction costs and pays for the acquisition of risk transfer tools, such as insurance and catastrophe bonds.
(iii) The Revolving Fund. This is an emergency fund meant for the affected population in the post-disaster phase.

In 2006, FONDEN issued parametric catastrophe bonds as well as reinsurance coverage for three zones against earthquake risks for a total of $450 million. In 2009, it issued a $290 million multi-peril parametric catastrophe bond. In 2012, FONDEN issued MultiCat 2012, a three-tranche catastrophe bond for $315 million. In 2011, FONDEN secured a $400 million indemnity-based excess of loss reinsurance treaty. Mexico is a pioneer in employing a range of financial tools for disaster risk management activities. It can do so with a strong legal and institutional framework in place. It will be beneficial for countries in Asia and the Pacific to emulate the Mexican example of risk assessment and risk financing.

Uses of insurance and reinsurance for indemnifying losses are also prevalent in many countries. In the Philippines, the General Insurance Fund is responsible to indemnify or compensate the government for any loss of its properties due to disasters. In Indonesia, local governments insure public assets, as does Russia, which insures critical infrastructure like nuclear power plants.

Ex ante disaster financing incurs a huge opportunity cost. For this reason, it is preferable to have a balance between allocating funds for ex ante and ex post financing. Advanced countries confident of arranging funds post disaster often tend not to allocate funds for ex ante reserve funds. They use ex post financing mechanisms such as in-year budget reallocations, longer-term realignment of investment budgets, taxation, debt financing, and international assistance. Countries like Germany, New Zealand, and the United States use budgetary reallocations to manage costs related to large-scale damages. The Czech Republic used a special universal anti-flood tax in 2011 to cover losses caused by the 2010 floods.

The smaller Pacific island economies of the Marshall Islands, Samoa, Solomon Islands, Tonga, and Vanuatu developed a pilot catastrophe risk transfer program with support from Japan for $45 million beginning in 2013. Payouts based on parametric trigger formulas are used to cover the cost of emergency responses. This Pacific Disaster Risk Financing and Insurance Program is an example of regional risk pooling. The program was preceded by the Caribbean Catastrophe Risk Insurance Facility, a mutual insurance company of Caribbean islands' governments. Formed in 2007, it was initially funded by the participating nations. A portion of the capital is kept aside as reserves. The rest of the capital is used to purchase reinsurance and catastrophe swaps. This facility is used to mitigate short-term needs in the immediate aftermath of a disaster.

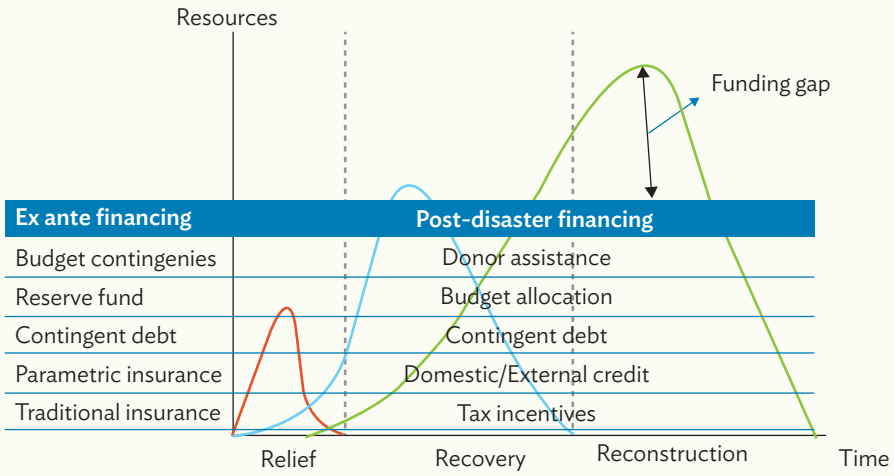
3.4 Conclusion

Any disaster has the potential to disrupt the smooth conduct of financial infrastructure. Financial system metrics such as capital adequacy, liquidity, management quality, and systems capability are important characteristics of financial architecture and financial stakeholders that need to be resilient even in the face of disruptions. Financial regulators need to monitor these financial metrics to ensure that the financial system works smoothly even through disruptions. If these operational risks are not under supervisory control, then even the best designed financial and insurance products are bound to fail.

Adequate fund availability for disaster relief is indispensable for mitigating the risks from disasters. Beyond this, it is equally important to provide fair, timely, and efficient disbursement of funds. They should be targeted to the most vulnerable sections of the population. To maintain transparency and accountability of public funds, clear ex ante procedures for disbursal of funds should be laid down and followed. Many countries in the Asia and Pacific region already have well-established procedures for disbursing funds. Some countries use a centralized web-based enterprise resource planning system for disbursing funds to achieve efficiency. The advance of digital tools and introduction of artificial intelligence tools can unlock future potential to mitigate and indemnify countries against natural

risks even further. Based on the reviewed financing mechanisms, Figure 3.1 provides a summary of different instruments that are suitable at distinct stages of disaster recovery. Two important factors that the figure highlights are (i) the need for funding increases with time and stage of recovery and (ii) the different sources of finance depending on their risk appetite that can be leveraged. The other key point that the figure makes is that there still is a gap in available funding, particularly to meet the requirements that arise in later periods.

Figure 3.1: Post-Disaster Financing Sources



Source: Authors.

References

Bragg, C., G. Gibson, H. King, A. A. Lefler, and F. Ntoubandi. 2017. Remittances as Aid Following Major Sudden-Onset Natural Disasters. *Disasters*. https://doi.org/10.1111/disa.12229

Clarke, G. R., and S. Wallsten. 2003. Do Remittances Act Like Insurance? Evidence from a Natural Disaster in Jamaica. January. Washington, DC: World Bank. http://dx.doi.org/10.2139/ssrn.373480 (accessed 22 February 2017).

Keohane, G. L. 2014. Preparing for Disaster by Betting Against It. *New York Times*. 12 February. https://archive.nytimes.com/opinionator.blogs.nytimes.com/2014/02/12/preparing-for-disaster-by-betting-against-it/?searchResultPosition=7.

Mohapatra, S., G. Joseph, and D. Ratha. 2012. Remittances and Natural Disasters: Ex-Post Responses and Contribution to Ex-Ante Preparedness. *Environment, Development and Sustainability* 14(3): 365–387.

OECD (Organisation for Economic Co-operation and Development). 2015. *Disaster Risk Financing: A Global Survey of Practices and Challenges*. Paris: OECD Publishing. http://dx.doi.org/10.1787/9789264234246-en

Sen, A. 1999. Public Action to Remedy Hunger. Arturo Tanco Memorial Lecture, 2 August, London. https://indianliberals.in/forum-of-free-enterprise/public-action-to-remedy-hunger-prof-amartya-sen.pdf

Stromberg, D. 2007. Natural Disasters, Economic Development, and Humanitarian Aid. *Journal of Economic Perspectives* 21(3): 199–222.

UNISDR (United Nations Office for Disaster Risk Reduction). 2015. Sendai Framework for Disaster Risk Reduction 2015–2030. Geneva: United Nations Office for Disaster Risk Reduction. https://www.unisdr.org/we/inform/publications/43291

Yang, D. 2008. Coping with Disaster: The Impact of Hurricanes on International Financial Flows, 1970–2002. *B.E. Journal of Economic Analysis and Policy Advances* 8(1) (Advances): Article 13. http://sites.lsa.umich.edu/deanyang/wp-content/uploads/sites/205/2014/12/yang_copedist.pdf (accessed 22 February 2017).

CHAPTER 4

Reexamining the Theory of Post-Disaster Restitution and Compensation through the Lens of the "Capability Theory"

Jyoti Shukla

4.1 Introduction

The United Nations Office for Disaster Risk Reduction (UNDRR) Strategic Framework 2022–2025 acknowledges that "we are trapped in a vicious and self-fulfilling cycle of disaster, respond, recover, and repeat. The people hit hardest are those who have done the least to cause these significant changes," meaning disasters (UNDRR 2022b: 6).

Underpinned by the traditional theories of distributive and corrective justice, the current post-disaster restitution and compensation approach is heavily marred with challenges (Hallegatte et al. 2017; Walsh and Hallegatte 2019). Although the current asset-based approach to post-disaster restitution and compensation focuses on economic losses of houses, infrastructure, jobs, etc., all of which are crucial to post-disaster recovery, it overlooks those aspects of well-being that are constituted by non-asset contributors such as mental, psychological, and sociological well-being (Murakami et al. 2020). Hallegatte et al. (2017) discuss that the asset-based approach inherits inequalities in pre-disaster society and concentrates investment in wealthier areas. Often, this dynamic results in continued vulnerability of disadvantaged members of society across different dimensions, such as physical vulnerability due to poor communities' tendency to be built on disaster-prone land parcels and have poor quality housing; social vulnerability due to continuing social ills; and fiscal vulnerability due to inadequate resources, including livelihood resources, before and after a disaster (Hallegatte et al. 2017).

Noticeable lacunas in an asset-based approach can be summarized as follows (Shukla, Yukutake, and Tiwari 2021): firstly, it narrowly focuses on only economic contributors to human well-being and overlooks others such as social capital and psychological health (Murakami et al. 2020); secondly, there is an obvious bias to shift more resources and investment toward more affluent households and geographies, thus excluding the poor (Walsh and Hallegatte 2019); and third and most importantly, it ignores systematic and institutional problems (Sen 1999) before the disaster and creates a vicious cycle of poverty and deprivation for the vulnerable segments of the society (Hallegatte et al. 2017). A growing body of literature emphasizes broader dimensions of human well-being and argues for the expansion of the assessment of disaster intensity and losses beyond asset-based models (Hallegatte et al. 2017; Walsh and Hallegatte 2019).

This chapter acknowledges the need for a more robust theoretical framework to inform the design of a comprehensive and resilient restitution and compensation mechanism post-disaster (defined later in section 4.3) to fill these gaps. To achieve this objective, the chapter undertakes a detailed literature review and assimilates discussions on the definition of disaster and compensation from a "capability" perspective. The chapter justifies the role of the government in providing environmental protection, including from disasters, as a public good. Challenges to the application of capability theory in designing a comprehensive restitution and compensation mechanism are also discussed.

4.2 Defining Disaster: Traditional versus Capability Approach

Defining disaster is a critical issue for social scientists concerned with its causes, conditions, and consequences (Perry 2018). Gaillard (2016) notices that each discipline concerned with disasters, such as sociology, geography, psychology, and anthropology, derives its own definition from reflecting disciplinary interests. Perry (2018) examines theory-based definitions of disaster devised by social scientists[1] and acknowledges that no single definition is possible. Based on the differences in conceptual perspectives and dimensions of disaster, Perry (2018) categorizes definitions of disaster in three paradigms: the classical approach (toward the end of World War II till 1961), the hazards-disaster tradition, and the socially focused approach.

4.2.1 Classical Approach

Perry (2018) notices two critical characteristics of disaster definitions in the classical era. Firstly, most definitions emphasize social disruptions or "failure of the social system to deliver reasonable conditions of life" (Perry 2018: 5). In 1961, Charles Fritz proposed a sociological notion of disaster as an event that prevents essential functions of society (Fritz 1961). Similar definitions emphasize the "interruption to routines in social life" (Stallings 1998: 136) and the "destabilization of the social system, indicated by a failure of normal functioning that requires an intervention to reinstate stability" (Porfiriev 1998: 56). Secondly, the classical era marks the beginning of the emergent norm thinking, which was later developed by social psychologists and researchers concerned with crowd behavior. As per Perry (2018), a modern adaption of emergent norm thinking is the consideration of "social change." For example, the research by Anderson (1969) follows the social change perspective of disaster. It examines the changes in the structure and function of 23 organizations in Anchorage because of the Alaskan earthquake.

In the classical approach, the perception of disaster as an event beyond human control that impacts social functioning differs from the modern view that most disasters arise from human agency and are therefore nested in the social system (Perry 2018).

4.2.2 Hazards Approach

From the natural hazard perspective, a disaster is an extreme event caused due to the intersection of a natural agent with the human systems (Burton, Kates, and White 1978). This definition of disaster engages with both natural science and social science perspectives on the disaster. For example, an earthquake is caused due to seismic activities, but it is considered a disaster only if it affects humans (Perry 2018).

This approach allowed the inclusion of those non-natural events that are human generated as the cause of the disaster. Mileti (1999) emphasizes the role of human agency in creating disasters through their encroachment on the natural environment. There was a shift in the focus of the definition of disaster from the event (natural and human-generated) to the level of vulnerability and resilience of the human society toward such events (Cutter 2005). Most definitions of disaster from the hazards approach converge with sociological researchers to focus on people and social relationships (Perry 2018).

[1] Perry (2018) distinguishes disasters from emergencies and catastrophes, as well as disasters arising out of conflict-based situations (as opposed to consensus situations).

4.2.3 Disaster as a Social Phenomenon

Modern research has moved away from an agent-based definition of disaster and the emphasis on physical damage to focus on social aspects (Drabek 2013). Put another way, the emphasis has shifted from natural to human agency of disasters or their social origin (Gilbert 1998). Quarantelli (2005) justifies this shift with the statement that the disruption and vulnerability are characteristics of the social system and not the agent of disaster. Perry (2018: 10) explains that "the vision of disasters as social phenomena has roots in classical era definitions, those of hazards researchers and those from scholars working with macroscopic perspectives such as human ecology, social change and anthropologists who place disasters within social and cultural parameters." However, each definition puts a different level of emphasis on the social phenomena, social construction of vulnerability to disaster, and the idea of social change because of disaster (Perry 2018). Perry summarizes these definitions to state that "disaster is social disruption that originates in the interruption of the social system and social relations" (Perry 2018: 11).

4.2.4 Understanding Disaster through the Capability Approach

The United Nations Office for Disaster Risk Reduction (UNISDR 2009: 9) gives a practical definition of disaster as "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources." The UNISDR's definition of the term "functioning" does not refer to Sen's theory and can benefit from this theory, as discussed next.

Sen discusses his theory of capability and functionings in many publications, and this chapter draws from Sen (1987, 1995). As per Sen (1979, 1987), capability is the freedom to choose to do or be what a person considers valuable to their well-being. The broader the set of functionings (or states of doing and being) that one can access, the greater the freedom of choice and capability.

In earlier work, Rao (2018a) explained the position of the capability theory in the paradigm of theories of justice. Kolm (1996: 33) explains that "a theory of justice is a set of considerations whose conclusion is the judgement of justice in a category of justice." The central application of the theories of justice is in the allocation of scarce resources or "economic justice" in general. Many theories of justice consider "equality" (in some form) as the critical criterion of "justice," and Sen (1979) questions the form of equality we aim to achieve (such as resources and income) and proposes equal "capability" as a solution. The problem with just allocation of resources (as opposed to capability) is that it assumes the equal ability of individuals (physical ability, cognitive ability, institutional environment) to convert personal resources into valuable achievements. An elaborate discussion of Sen's critical views on the theories of justice happens in Sen (2009).

Sen (1987) identifies human well-being with people's "capability" or the freedom to choose from a wide range of options of what they can be or what they can do—such as being well-nourished or fasting, for instance. Sen (1987) calls these states of beings and doings "functionings." A broader set of functionings means having greater freedom to choose (Sen 1987). The capability approach is comprehensive in considering people's access to resources and their ability to convert these resources into end achievements. For instance, having access to food (a resource) does not necessarily translate into being well-nourished unless the person's physical health allows the expected absorption of food into the body. Thus, the conversion of food into nutrition depends on access to food (i.e., resources) and an individual's ability to process food (i.e., personal characteristics).

Alongside personal characteristics, other conversion factors include the familial, social, political, institutional, natural, and built environment in which people operate. This discussion links back to the sociological definitions of disaster discussed earlier in section 4.2.3, which view disasters as rooted in the social systems. This chapter builds on this discussion and uses the capability theory to answer a critical question: What should a comprehensive and resilient restitution and compensation mechanism entail? This chapter's discussions are the first attempt to answer this question through the lens of the capability theory and call for further debate and empirical reinforcement through future research.

Through the capability theory, disaster can be understood as the deprivation of elementary functionings of a large group of people to the extent that societal support is needed to reinstate or improve the situation. What entails elementary functionings is a question open for discussion (refer to section 4.5.1 for further discussions). The definition emphasizes the loss of elementary functionings, while it is understandable that personal losses will extend beyond elementary functionings and vary across individuals. The definition acknowledges the need for societal support, given that disaster is a social phenomenon whose cost is to be distributed.

The capability theory explains the role of institutions (including social systems) in creating functionings, as discussed earlier in this section. Inefficient and unequal institutional arrangements can make some people more vulnerable to disasters due to reduced freedoms stemming from unequal access to resources and/or unequal treatment. For instance, poor people residing in temporary shelters in flood-prone areas are more vulnerable to flooding and disasters due to their reduced freedom of choice of location, a consequence of low income and lack of affordability of a decent house.

Sen (1999) argues that well-being is constituted by the freedom to choose functionings that add value to a person's life. While resources, income, and assets are necessary instruments to create functionings, their conversion into functioning achievements depends on the personal characteristics and institutional arrangements in which the person operates (Sen 1999). Unless all three contributors to well-being, i.e. resources, personal characteristics, and institutions, are reinstalled to pre-disaster levels or better, the well-being of the affected victims will only be partially reinstalled.

Table 4.1 presents a summary of the described approaches to defining disaster and the differences in agency and consequences of disaster under each.

Table 4.1: Four Approaches to Defining Disaster Based on the Agency and Consequences of Disaster

Approaches to Defining Disaster	Agency of Disaster	Consequences of Disaster
Classical approach	Disaster is a natural event beyond human control.	"Prevents essential functions of society" (Fritz 1961: 655). "Failure of the social system to deliver reasonable conditions of life" (Perry 2018: 5). "Interruption to routines in social life" (Stallings 1998: 136). "Destabilization of the social system, indicated by a failure of normal functioning that requires an intervention to reinstate stability" (Porfiriev 1998: 56).
Hazards approach	Disaster is an extreme event caused due to the intersection of a natural agent with the human systems (Burton, Kates, and White 1978). This approach allowed the inclusion of those non-natural events that are human generated as the cause of the disaster.	The focus of this approach shifted from the cause (natural and human-generated) to the level of vulnerability and resilience of the human society toward disasters (Cutter 2005). Most definitions of disaster from this approach converge with sociological researchers to focus on people and social relationships (Perry 2018).
Disaster as a social phenomenon	The emphasis of the definition of disaster shifts from natural to human agency or social origin (Gilbert 1998). "Disaster is social disruption that originates in the interruption of the social system and social relations" (Perry 2018: 11). Quarantelli (2005) justifies this shift with the statement that the disruption and vulnerability are characteristics of the social system and not the agent of disaster.	Disaster as a social phenomenon is concerned with disruption in the social system as the origin of disaster as opposed to the consequences.
Capability approach	Disaster is a social phenomenon, and therefore its cost should be distributed across all members of the society. Inefficient and unequal institutional arrangements can make some people more or less vulnerable to disasters. Being safe from disasters is a personal functioning that can be realized through a combined effort of the members of the society, such as by reducing vulnerabilities arising due to systemic inequalities in the society, improving environmental protection, and encouraging a sustainable way of life.	Disaster causes deprivation of elementary functionings of a large group of people to the extent that societal support is needed to reinstate or improve the situation.

4.3 Defining Compensation for Disaster: Traditional versus Capability Approach

4.3.1 Tort Law Approach

A growing body of literature from law and economics reviews the theory and practice of compensation for disaster-affected victims. Theoretical justifications for compensation, as presented in the contemporary literature, are rooted in the tort law theory, the welfare state theory, or the market theory of insurance (Faure 2013). Faure (2013) presents a critical review of these three theories as a rationale for compensation, their pros and cons, and challenges in their applicability in developing countries. A problem with these concepts of "compensation" is that they exclude those affected by disasters for which a tortfeasor can't be (easily) identified; low-frequency, high-impact disasters not covered by an

insurer; and victims who cannot afford insurance. The longstanding argument of "the loss lies where it falls" has been rejected by the victims who expect compensation (Faure 2013).

Culhane (2007) explains the theoretical difference between harms caused by social risks or those to be borne by the society (distributive justice) and those caused by a wrongful act of a private doer (corrective justice). The answer to the problem of "just distribution" of costs and benefits arising from social systems is guided by the theories of "distributive justice" while the latter is a problem of "corrective justice" (Culhane 2007). For example, when a private actor or doer causes the damage, the affected person can call upon the resources of the culpable party for compensation (corrective justice). On the contrary, social risks are shared by all the members of society. Therefore, the problem of "just compensation" for the affected people suffers the same challenge as theories of distributive justice, that is, to distribute resources so that social welfare can be maximized.

Faure (2013) and Posner (2003) justify post-disaster compensation as an economic problem of welfare maximization through minimization of the accident cost. Priest (1996) supports the strong normative belief that disaster relief is a primary role of the government. This belief is in sync with the concept of the welfare state theory endorsed by European Union Member States (Schwarze and Wagner 2004). The interest of elected government(s) in this matter is associated with large vote banks because of the large scale of the population affected by the disaster (Faure 2007). Faure (2007: 340) goes to the extent of saying that "... the individual's chances of special (financial) compensation by the government are greater where many victims are involved." Therefore, the idea of governments providing compensation to disaster-affected victims is problematic from a distributional perspective because some victims, such as those affected by a large-scale disaster, may receive preferential treatment over other victims affected by a personal accident or a small-scale disaster. Posner (2004) refers to this problem as a "negative distributional consequence."

Contrary to this problem of negative distributional consequences, Culhane (2007) highlights the preferential treatment to victims of the September 11 terrorist attack who received compensation as high as victims of tort cases. At the same time, Hurricane Katrina affected a large population that did not have a comparable claim on governmental compensation for losses. This section's discussion emphasizes the problem of governments treating disaster-affected victims differently depending on their vote incentives. Nevertheless, it is well established that the onus of compensation and restitution post-disaster lies with the government as an institution constituted for and by the members of the society who are jointly responsible for the damages caused by disasters.

4.3.2 A Capability Approach to a Comprehensive and Resilient Restitution and Compensation Mechanism

Taking inspiration from earlier works of Rao (2018a, 2019), this chapter defines a "comprehensive and resilient restitution and compensation mechanism" for disaster-affected people as the process through which: firstly, as per the principle of equivalence of compensation[2], the affected people are put back in the same state as before the disaster through a satisfactory reconstruction of all original functionings or their replacement with equally valuable or better functionings; secondly, as per the concept of building back better[3], the affected people overcome deprivation of pre-disaster functionings and harness functionings that improve their resilience toward disaster and their overall well-being.

[2] Rao (2018a: 7) writes that "compensation models are guided by the 'principle of equivalence,' as per which 'just and fair' compensation should put back the affected landowner in the same condition as she was before acquisition."

[3] The UNDRR (2022a) defines "build back better" as "the use of the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies and the environment."

Regarding building back better, the capability approach draws attention to improving people's skills and institutional arrangements, particularly social institutions (and social ills), in addition to physical reconstruction and improvements to the built environment. Also, people may be relatively more receptive to social and behavioral changes in a post-disaster scenario.

Put simply, a comprehensive and resilient mechanism would reconstruct, replace, and add to the original set of functionings of the affected people in a way that their well-being and resilience post-disaster is bettered. At a minimum, this would mean (i) improvement of people's access to resources such as food, shelter, income, and physical infrastructure; (ii) improvement in personal characteristics where possible, e.g., through academic training and professional skill training; and (iii) improvement in the institutional environment, including societal systems, such as reducing income-based spatial segmentation, which makes the poor more vulnerable to disasters due to their disadvantaged location on disaster-prone affordable sites.

The above definition of a comprehensive and resilient restitution and compensation mechanism encapsulates both the principle of equivalence and the build back better concept in the broader context of human capabilities and functionings.

4.4 Environmental Protection (Including Protection against Disaster) as a Public Good

Regarding climate change, unsustainability, and disaster, Crabtree (2018) raises the question of whether development as (individuals') freedom is sustainable and the impact of the doings and beings of an individual on the environment. Crabtree (2018) quotes Nussbaum (2003) to emphasize that Sen does not comment on the problem of conflict of individuals' freedom, where an increase in one person's freedom reduces the freedom of others. The problem of environmental protection raised by Crabtree (2018) is crucial and can be broken into three separate yet related issues of the limits of individual freedoms and conflict of freedoms; capabilities of the community (as opposed to a person); and provision of public goods, as discussed below.

As per Sen (1999), the conflict of an individual's "freedom" is comparable to "utility" as demonstrated by the Arrow-Debreu theorem of "Pareto optimality" (Sen 1999). Referring to the traditional economics definition of "economic efficiency" as "Pareto optimality," Sen (1999) explains it as a situation in which the welfare (or utility) of anyone cannot be improved without reducing someone else's welfare. The Arrow-Debreu theorem states that, under some conditions, "the result (or achievement) of the market mechanism is not improvable in ways that would enhance everyone's utility" (Sen 1999: 117). Sen (1999) demonstrates that Arrow-Debreu's efficiency results in "utility" can be translated to that of individual freedoms. This means that "a competitive market equilibrium guarantees that no one's freedom can be increased any further while maintaining the freedom of everyone else" (Sen 1999: 117).

"Marketability" is an essential assumption of these results as per which all commodities on which human welfare depends are assumed to be bought or sold in the market. Contrary to this, the most critical contributors to human welfare cannot be purchased or sold exclusively to an individual in the private market. Sen (1999) gives an example of public goods such as environmental protection, defense, policing, and epidemiological protection, which people consume together and which market mechanisms fail to provide.[4] Sen (2002) explains that some personal functionings depend on others for their realization. For example, being physically safe can be achieved by social harmony, policing, and

[4] Refer to Samuelson (1954, 1955) and Arrow's (1983) paper, The Organization of Economic Activity: Issues Pertinent to the Choice of Market versus Non-Market Allocation for a classic analysis of "market failure" in reference to public goods.

corrective legal actions. *Along similar lines, being safe from disasters is a personal functioning that can be realized through a combined effort of the members of the society, such as by reducing vulnerabilities arising due to systemic inequalities in the society, improving environmental protection, and encouraging a sustainable way of life*. Thus, as Sen (1999) argues, environmental protection is a public good.

It is essential to explain the idea of collective or community capabilities at this stage. At times, the concept of "collective" or "community" capabilities emerges about those capabilities that the community members jointly create. For instance, Stewart (2005) and Ibrahim (2017) use the term in the context of capabilities created by self-help groups (SHGs) in fighting poverty. Schlosberg and Carruthers (2010) examine the struggles of Indigenous peoples for ecological justice as a problem of "collective capabilities." Nonetheless, Sen (2002) clarifies the confusion and explains that individual capabilities may at times be socially dependent. Put another way, "capability" is a person-centred concept even though its actualization may depend on the joint actions of the community or the society (Robeyns 2017). Therefore, protection of the environment and consequential protection against disaster is an individual "capability" that can be realized through the joint actions of all the members of the society.

Returning to the discussion on environmental protection as a public good, the social provisioning of public goods is crucial to economic development and social change (Sen 1999). The most debated issues with social provisioning are the financial burden it imposes on public expenditure, distortion of incentives, and discouragement of individual efforts (Sen 1999). While acknowledging the challenge in overcoming the incentive distortion problem completely, Sen (1999) argues that capability deprivation is a better criterion compared to lowness of income as a criterion of disadvantage. The reasons for this are that, firstly, people care more about achieving their elementary functionings and the impact on their quality of life (as opposed to earning monetary subsidies); secondly, capability deprivation may be underpinned by deeper issues beyond an individual's control and thus is less likely to be distorted or misused to abuse the social support system; thirdly, people typically do not refuse education or cultivate undernourishment for tactical reasons; and fourthly, the focus of policymakers shifts to public provisioning of elementary facilities (Sen 1999). In summary, capability-based public provisioning, unlike income, makes identifying the target segment easier and less vulnerable to abuse.

The capability theory aligns with neoclassical economics, advocates social provisioning of public goods to overcome deprivation of functionings, and treats income as an instrument alongside other resources. Returning to the core discussion on disasters, it is without question that the onus of post-disaster reconstruction, restitution, and compensation lies with the government. The budgetary challenge to social provisioning of post-disaster relief is a question of distributive justice, similar to that of provisioning of public goods.

For a comprehensive and resilient mechanism of restitution and compensation of losses of disaster-affected victims and communities, all valuable functionings of affected people must be either reinstalled or replaced in a way that they can achieve at least the same capability as before the disaster and have access to additional functionings that can improve their resilience to disaster and overall well-being. Nevertheless, there are problems associated with the identification of elementary functionings as well as their observable indicators. Sen (1999) argues that some elementary functionings such as longevity, health status, and literacy are directly observable and provide a valuable base of anti-deprivation policies. Given the limited literature on identifying human functionings, elementary and non-elementary, it is challenging to identify losses of victims in the form of functionings and to measure capability.

4.5 Challenges to the Application of the Capability Approach

This section describes the logical steps to the application of the capability approach in the design of a comprehensive and resilient restitution and compensation process for disaster-affected victims. It also discusses the associated challenges with taking these steps in practice.

4.5.1 Identify the Functionings Lost by Disaster-Affected People

As mentioned earlier, an ideal resilient mechanism will successfully reinstall or replace all lost functionings for everyone affected by the disaster. Nevertheless, thus far, there has been little attempt to identify person-centric functionings primarily because it requires an inductive investigation at the individual level. Nussbaum's (2003) list of 10 central human capabilities is noteworthy and forms the basis for much empirical research on capabilities (e.g., Anand et al. 2009; Tiwari et al. 2022). Robeyns (2003) proposes a methodology for identifying relevant capabilities for analyzing gender inequality. Zimmermann (2006) explains the methodology to transport questions of freedom and social opportunities from social policy into the capability framework. Through a series of publications, Rao (2018b, 2019) and Rao, Tiwari, and Hutchison (2017) identify functionings derived from the ownership of land (as a resource) through an inductive approach of in-depth interviews of those who have lost land under the government's use of the power of compulsory acquisition.

4.5.2 Identify Relevant Indicators for Functionings

Designing indicators for functionings is a complex task and a fast-evolving research area. For instance, Anand et al. (2009) used an existing set of questions from the British Household Panel Survey alongside constructing specific questions as indicators for the 10 central human capabilities identified by Nussbaum (2003). For example, to understand respondents' capability to live a life of standard length, Anand et al. (2009: 132) asked, "Given your family history, dietary habits, lifestyle, and health status, until what age do you expect to live?" Along similar lines, Tiwari et al. (2022) used the Japan Household Panel Survey data to examine housing well-being.

Functioning indicators would help design actionable items from a policy perspective. The use of indicators may also facilitate a comprehensive assessment of development policies, particularly those concerning post-disaster restitution. With the help of these indicators, it would be possible to identify resources and conversion factors required to develop functioning. However, because functionings and capabilities are usually qualitative variables (Robeyns 2017), it is often challenging to identify their measurable indicators for empirical analysis.

4.5.3 Challenges to the Empirical Application of the Capability Theory

Given the open-ended character of the capability approach, its application described in this chapter in the context of disaster restitution allows for comprehensiveness and flexibility. Nevertheless, this makes the empirical application of the capability approach difficult (Robeyns 2017). The problem is best explained in the words of Robert Sugden (1993: 1953): "Given the rich array of functionings that Sen takes to be relevant, given the extent of disagreement among reasonable people about the nature of the good life, and given the unresolved problem of how to value sets, it is natural to ask how far Sen's framework is operational. Is it a realistic alternative to the methods on which economists typically rely—measurement of real income and the kind of practical cost-benefit analysis grounded in Marshallian consumer theory?"

Capabilitarian theorists argue in favor of the capability approach's adoption of a multidimensional approach to well-being and recommend using methods and techniques that allow for the complexity, vagueness, and fuzziness the approach entails (Chiappero-Martinetti 1994, 2000, 2006, 2008; Clark and Qizilbash 2005; Qizilbash and Clark 2005). Atkinson (1999) advocates several methods to operationalize the capability approach. A rich body of empirical literature has been developed through the application of the capability theory (e.g., Kuklys and Robeyns 2005; Robeyns 2006; Chiappero-Martinetti and Roche 2009; Lessmann 2012).

4.6 Conclusion

This chapter explains what constitutes a comprehensive and resilient post-disaster restitution and compensation mechanism using the "capability theory." It is independent of who executes it and which agency (or doer) is responsible for causing the disaster. While acknowledging the importance of each of these topics, this chapter focuses on the topic of what constitutes such a mechanism. It uses Sen's capability theory to explain the meaning of disaster and compensation through the lens of "capability."

The principle of equivalence advocates that a fair compensation and restitution mechanism should ensure that the affected people are put back in the same condition they were in before the disaster (Rao 2018a). Regarding functionings, this concept of equivalence would mean the reinstallation of the same set of functionings as before the disaster. While this is understandable on the grounds of fairness, putting a person back in the original state would also mean a continued state of deprivation of those functionings inaccessible to the person before the disaster. Additionally, this would also suggest putting the individual back at the same level of disaster vulnerability as before the disaster, thus defeating the objective of building resilient communities. Therefore, from a developmental perspective, a resilient restitution process should generate new functionings that can improve on people's original state of functioning deprivation and strengthen disaster resilience at the societal, familial, and individual levels. This would require betterment across all three capability factors—improved access to resources, uplifting personal characteristics, and improvement in the institutional environment, including social systems such as gender-based discrimination.

From a theoretical perspective, a comprehensive and resilient restitution and compensation mechanism would ensure that each affected person's valuable functionings are either completely reinstalled or replaced by an equal or better functioning. To build resilience at the societal, familial, and individual levels, the restitution mechanism should also ensure improved access to functionings that improve people's resilience and well-being. It is yet another critical question of distributive justice: what aspects of the lost functionings should be reinstalled at public expense and what losses should be internalized at the individual or household level? An in-depth investigation on the matter is warranted for future research.

In the absence of an overarching theoretical framework that can assimilate multi-disciplinary discussions on post-disaster restitution and compensation, this chapter is a valuable guide to the academia, research, policy, and practice concerned with post-disaster management. A critical review of these discussions and further expansion of our understanding of disaster through the capability theory is pending.

References

Anand, P., G. Hunter, I. Carter, K. Dowding, F. Guala, and M. Van Hees. 2009. The Development of Capability Indicators. *Journal of Human Development and Capabilities* 10(1): 125–152. https://doi .org/10.1080/14649880802675366.

Anderson, W. A. 1969. *Disaster and Organizational Change: A Study of the Long-Term Consequences in Anchorage of the 1964 Alaska Earthquake*. 1st Edition. Delaware: Disaster Research Center.

Arrow, K. J. 1983. *Collected Papers of Kenneth J. Arrow, Volume 2: General Equilibrium*. Cambridge: Harvard University Press.

Atkinson, A. B. 1999. The Contributions of Amartya Sen to Welfare Economics. *Scandinavian Journal of Economics* 101(2): 173–90. https://doi. org/10.1111/1467-9442.00151

Burton, I., R. Kates, and G. White. 1978. *The Environment as Hazard*. New York: Oxford University Press.

Chiappero-Martinetti, E. 1994. A New Approach to Evaluation of Wellbeing and Poverty by Fuzzy Set Theory. *Giornale Degli Economisti E Annali Di Economia* 7(9): 367–388.

____. 2000. A Multidimensional Assessment of Wellbeing Based on Sen's Functioning Approach. *Rivista Internazionale Di Scienze Sociali* 108(2): 207–239.

____. 2006. Capability Approach and Fuzzy Set Theory: Description, Aggregation and Inference Issues. In C. Lemmi and G. Betti, eds. *Fuzzy Set Approach to Multidimensional Poverty Measurement*. New York: Springer. https://doi.org/10.1007/978-0-387- 34251-1_6

____. 2008. Complexity and Vagueness in the Capability Approach: Strength or Weakness? In F. Comim, M. Qizilbash, and S. Alkire, eds. *The Capability Approach: Concepts, Measures, Applications*. Cambridge: Cambridge University Press.

Chiappero-Martinetti, E., and J. M. Roche. 2009. Operationalization of the Capability Approach, from Theory to Practice: A Review of Techniques and Empirical Applications. In E. Chiappero-Martinetti, ed. *Debating Global Society. Reach and Limit of the Capability Approach*. Milan: Feltrinelli.

Clark, D. A., and M. Qizilbash. 2005. *Working Paper: Core Poverty, Basic Capabilities and Vagueness: An Application to the South African Context*. Global Poverty Research Group Working Paper Series, 26. https://ora.ox.ac.uk/ objects/uuid:3d2942da-fdce-47a0-880c-80591fe85d8c

Crabtree, A. 2018. Capabilities, Ethics and Disasters. In D. P. O'Mathúna, V. Dranseika, and B. Gordijn, eds. *Disasters: Core Concepts and Ethical Theories*. https://doi.org/10.1007/978-3-319-92722-0

Culhane, J. G. 2007. What Does Justice Require for the Victims of Katrina and September 11? *DePaul Journal of Health Care Law* 10(2): 177–212.

Cutter, S. 2005. Are We Asking the Right Question? In R. W. Perry and E. L. Quarantelli, eds. *What Is a Disaster: New Answers to Old Questions*. Philadelphia: Xlibris Publishers.

Drabek, T. E. 2013. *The Human Side of Disaster*. 2nd Edition. Boca Raton, Florida: CRC Press.

Faure, M. G. 2007. Financial Compensation for Victims of Catastrophes: A Law and Economics Perspective. *Law and Policy* 29(3): 339–367.

____. 2013. Towards Effective Compensation for Victims of Natural Catastrophes in Developing Countries. In M. Faure and A. Wibisana, eds. *Regulating Disasters, Climate Change and Environmental Harm: Lessons from the Indonesian Experience*. Cheltenham, United Kingdom and Northampton, Massachusetts, United States: Edward Elgar Publishing.

Fritz, C. E. 1961. Disaster. In R. Merton and R. Nesbit, eds. *Contemporary Social Problems*. New York: Harcourt Publishers.

Gaillard, J. C. 2016. Natural Hazards and Disasters. In D. Richardson, N. Castree, M. Goodchild, A. Kobayashi, W. Liu, and R. Marston, eds. *The International Encyclopedia of Geography*. Chichester: Wiley-Blackwell.

Gilbert, C. 1998. Studying Disaster. In E. L. Quarantelli, ed. *What Is a Disaster: Perspectives on the Question*. London: Routledge.

Hallegatte, S., A. Vogt-Schilb, M. Bangalore, and J. Rozenberg. 2017. *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters.* Washington, DC: Climate Change and Development Series: World Bank.

Ibrahim, S. 2017. How to Build Collective Capabilities: The 3C-Model for Grassroots-Led Development. *Journal of Human Development and Capabilities* 18(2): 197–222. https://doi.org/10.1080/19452829.2016.1270918

Kolm, S.-C. 1996. *Modern Theories of Justice*. 1st Edition. Massachusetts: MIT Press.

Kuklys, W., and I. Robeyns. 2005. Sen's Capability Approach to Welfare Economics. In W. Kuklys, ed. *Amartya Sen's Capability Approach: Theoretical Insights and Empirical Applications*. Berlin: Springer.

Lessmann, O. 2012. Applying the Capability Approach Empirically: An Overview with Special Attention to Labor. *Management Revue* 23(2): 98–118.

Mileti, D. S. 1999. *Disasters by Design*. Washington, DC: John Henry Press.

Murakami, M., Y. Takebayashi, K. Ono, A. Kubota, and M. Tsubokura. 2020. The Decision to Return Home and Wellbeing after the Fukushima Disaster. *International Journal of Disaster Risk Reduction* 47: 1–12.

Nussbaum, M. 2003. Capabilities as Fundamental Entitlements: Sen and Social Justice. *Feminist Economics* 9(2–3): 33–59.

Perry, R. W. 2018. Defining Disaster: An Evolving Concept. In H. Rodríguez, W. Donner, and J. E. Trainor, eds. *Handbook of Disaster Research*. Cham: Springer International Publishing. http://doi.org/10.1007/978-3-319-63254-4

Porfiriev, B. N. 1998. Issues in the Definition and Delineation of Disasters and Disaster Areas. In E. L. Quarantelli, ed. *What is a Disaster: Perspectives on the Question*. London: Routledge.

Posner, R. A. 2003. *Economic Analysis of Law.* New York: Aspen.

____. 2004. *Catastrophe, Risk and Response*. Oxford: Oxford University Press .

Priest, G. 1996. The Government, the Market and the Problem of Catastrophic Loss. *Journal of Risk and Uncertainty* 12: 219–237.

Qizilbash, M., and D. A. Clark. 2005. The Capability Approach and Fuzzy Poverty Measures: An Application to the South African Context. *Social Indicators Research* 74(1): 103–39. https://doi.org/10.1007/s11205-005-6527-y

Quarantelli, E. L. 2005. A Social Science Research Agenda for the Disasters of the 21st Century. In R. W. Perry and E. L. Quarantelli, eds. *What Is a Disaster: New Answers to Old Questions*. Philadelphia: Xlibris Publishers.

Rao, J. 2018a. *Functionings of Land: Analysing Compulsory Acquisition Cases from Scotland*. Singapore: Palgrave Macmillan.

____. 2018b. Fundamental Functionings of Landowners: Understanding the Relationship between Land Ownership and Wellbeing through the Lens of "Capability." *Land Use Policy* 72: 74–84.

____. 2019. A "Capability Approach" to Understanding Loses Arising out of the Compulsory Acquisition of Land in India. *Land Use Policy* 82: 70–84.

Rao, J., P. Tiwari, and N. E. Hutchison. 2017. Capability Approach to Compulsory Purchase Compensation: Evidence of the Functionings of Land Identified by Affected Landowners in Scotland. *Journal of Property Research* 34(4): 305–324.

Robeyns, I. 2003. The Capability Approach: An Interdisciplinary Introduction. Pavia: Paper written for the Training Course preceding the 3rd International Conference on the Capability Approach.

____. 2006. The Capability Approach in Practice. *Journal of Political Philosophy* 14(3): 351–76. https://doi.org/10.1111/j.1467-9760.2006.00263.x

____. 2017. *Wellbeing, Freedom and Social Justice: The Capability Approach Re-Examined*. 1st Edition. Cambridge: OpenBook Publishers.

Samuelson, P. A. 1954. The Pure Theory of Public Expenditure. *Review of Economics and Statistics* 36(4): 387–389.

____. 1955. Diagrammatic Exposition of a Theory of Public Expenditure. *Review of Economics and Statistics* 37(4): 350–356.

Schlosberg, D., and D. Carruthers. 2010. Indigenous Struggles, Environmental Justice, and Community Capabilities. *Global Environmental Politics* 10(4): 12–35. https://doi.org/10.1162/glep_a_00029

Schwarze, R., and G. Wagner. 2004. In the Aftermath of Dresden. New Directions in German Flood Insurance. *Geneva Papers on Risk and Insurance* 29(2): 154–168.

Sen, A. 1979. *Equality of What? The Tanner Lecture on Human Values*. Stanford University.

____. 1987. *Commodities and Capabilities*. New Delhi: Oxford University Press.

____. 1995. *Inequality Reexamined*. 1st Edition. New Delhi: Oxford University Press.

____. 1999. *Development as Freedom*. Oxford: Oxford University Press.

____. 2002. Response to Commentaries. *Studies in Comparative International Development* 37(2): 78–86. https://doi.org/10.1007/bf02686264

____. 2009. *The Idea of Justice*. Cambridge: Belknap Press of Harvard University Press.

Shukla, J., N. Yukutake, and P. Tiwari. 2021. *On Well-Being of Households in Japan Post-Disaster Reinstatement*. Tokyo: ADBI Working Paper Series.

Stallings, R. A. 1998. Disaster and the Theory of Social Order. In R. W. Perry and E. L. Quarantelli, eds. *What Is a Disaster: New Answers to Old Questions*. Philadelphia: Xlibris Publishers.

Stewart, F. 2005. Groups and Capabilities. *Journal of Human Development* 6(2): 185–204. https://doi.org/10.1080/14649880500120517

Sugden, R. 1993. Review: Welfare, Resources, and Capabilities: A Review of Inequality Reexamined by Amartya Sen. *Journal of Economic Literature* 31(4): 1947–1962.

Tiwari, P., J. Shukla, N. Yukutake, and A. Purkayastha. 2022. *Measuring Housing Well-being for Disaster Victims in Japan and India: A Capability Approach*. Online: Land Economics Society.

UNDRR. 2022a. *UN Disaster Risk Reduction*. Accessed 1 May 2022. https://www.undrr.org/terminology

____. 2022b. *UNDRR Strategic Framework 2022–2025*. New York: UN Office for Disaster Risk Reduction.

UNISDR. 2009. *2009 UNISDR Terminology on Disaster Risk Reduction*. Geneva, Switzerland: United Nations International Strategy for Disaster Reduction. https://www.undrr.org/terminology

Walsh, B., and S. Hallegatte. 2019. *Measuring Natural Risks in the Philippines: Socioeconomic Resilience and Wellbeing Losses*. Philippines: World Bank Group: Climate Change Group and Social, Urban, Rural and Resilience Global Practice.

Zimmermann, B. 2006. Pragmatism and the Capability Approach: Challenges in Social Theory and Empirical Research. *European Journal of Social Theory* 9(4): 467–484. https://doi.org/10.1177/1368431006073014

PART II

Lessons from Country Experiences in Reconstruction and Recovery Processes

CHAPTER 5

Natural Disasters, Property Damages, and the Role of Aid: Implications for Policy

Jayash Paudel

5.1 Introduction

Nepal ranks 11th among the world's most earthquake-prone countries, 4th in terms of vulnerability from climate change, and 30th in relation to flood risk (Shakya, Basnet, and Paudel 2022). The entire Himalayan region is vulnerable to large earthquakes of high intensity. For example, the 2015 earthquake in Nepal with a magnitude of 7.8 degrees on the Richter scale affected approximately 8 million people and resulted in an economic loss of $10 billion, amounting to almost half of Nepal's gross domestic product (Paudel and Ryu 2018). Consumer theory concludes that if individuals are exposed to adverse local economic conditions or (dis)amenities, residential property values will incorporate these economic shocks. A comprehensive assessment on the economic cost of natural disasters involves a study of how economic agents belonging to different socioeconomic strata perceive risks of seismic shocks. This chapter examines the economic impact of Nepal's 2015 earthquake and further explores the role of aid in mitigating economic damages from seismic shocks in a developing country setting.

The economic impact of natural disasters has received tremendous attention in academic literature in recent years. The majority of these studies are based on revealed preferences methods and apply hedonic property value models to break down the market data on housing sales prices into different attributes, which include housing, neighborhood, and environmental characteristics (Tietenberg and Lewis 2018). Outside South Asia, Boes, Nüesch, and Wüthrich (2015) focus on the 2011 Fukushima accident as a quasi-experimental shock to show that apartments near nuclear power plants in Switzerland reported a 2.3% price decline, suggesting that rental prices reflect perceived risks of nuclear power plants to some extent. In the United States, Metz, Roach, and Williams (2017) investigate changes in home prices in seismically active regions before and after earthquakes in Oklahoma County and document that housing prices declined between 3.15% and 4.7% in areas with high seismicity. In the context of South Asia, the economic effects of natural disasters have largely focused on the incidence of forest fires and earthquakes (Paudel 2021a, 2023a, 2023c). A recent empirical study uses satellite data on real-time active fire locations in Nepal and concludes that an additional unit increase in the number of forest fire incidents over the last year results in a 4.48% decline in residential property values (Paudel 2022a). These findings are consistent with the theoretical notion that differences in home prices between high-risk areas prone to natural disasters and low-risk counterparts may be recovered using a hedonic price model (Rosen 1974; Metz, Roach, and Williams 2017).

Recent empirical studies have focused on the overall impact of natural disasters on education and health outcomes. Khanal (2022) reports that the 2015 earthquake in Nepal led to a 32.2% increase in diarrhea, a 35.5% increase in fevers, and a 25.7% increase in coughs among children in earthquake-affected districts. Inadequate clean drinking water and unavailability of health care facilities in areas exposed to large seismic shocks contribute to higher health risks among children in the aftermath of large earthquakes (Khanal 2022; Paudel 2023b). In the context of India, Nandi, Mazumdar, and Behrman (2018) document that the 2001 Gujarat earthquake caused a significant increase in childbirth rates and a decrease in birth spacing among uneducated, tribal, and Muslim women. Natural disasters are also associated with a significant decline in mental health outcomes (Baryshnikova and Pham 2019).

In a different study, Paudel and Ryu (2023) show that the direct effect of an earthquake among exposed infants can spill over to their younger siblings, who lost approximately 1.74 grades of schooling from seismic shocks associated with the 1988 earthquake in Nepal. This finding indicates that households exposed to large earthquakes may invest less in human capital, which may adversely affect younger siblings of a family. These studies contribute to a large segment of the literature exploring the direct effect of an economic shock on human capital of exposed infants (Almond, Edlund, and Palme 2009; Almond and Currie 2011; Caruso and Miller 2015; Paudel and Ryu 2018).

The focus of this chapter on Nepal, a small developing country in South Asia, is important for two reasons. First, it is well-documented that countries with lower levels of income and educational attainment, inadequate financial systems, and smaller degrees of openness experience larger economic losses in response to natural disasters (Toya and Skidmore 2007). To what extent changes in residential property values can be attributed to the incidence of a large natural disaster in Nepal remains an empirical question of interest among policymakers. Second, natural disasters may induce different mechanisms that, in turn, affect economic well-being of afflicted individuals. For example, Shakya, Basnet, and Paudel (2022) exploit the quasi-random spatial and temporal nature of ground tremors of the 2015 earthquake to show that the number of work permits issued to Nepalese individuals for international labor migration declined significantly in districts severely affected by the natural disaster. This chapter explores the role of a different mechanism, provision of aid, in partially mitigating lowered residential property values from the 2015 earthquake. This is important because long-term economic gains are associated with aid-financed efforts conducted in areas exposed to natural disasters (Heger and Neumayer 2019). The relationship between the incidence of a large earthquake, residential property values, and aid allocation contributes to a better understanding of programs designed for sustainable recovery from natural disasters.

5.2 Data and Methods

5.2.1 Sources of Data

The core analysis of the study is based on three data sources. The first data set, provided by the Central Bureau of Statistics in Nepal, includes detailed household-level data on residential property values from the Annual Household Survey (AHS) 2013–2014 and 2014–2015. There are two limitations associated with the AHS data. First, the survey questionnaires do not include information on geographic coordinates of locations where households live. This prevents researchers from computing the physical distance between the epicenter of the earthquake and household location. Second, the AHS data set includes self-assessed residential property values, which are based on a question asked to the homeowner. The question asks, "If you would like to buy a dwelling just like the one you own today, how much money would you have to pay?" Although the traditional hedonic model involves the use of housing prices from transactions in the competitive market (Rosen 1974), the degree of bias from using self-reported prices is inconsequential, ranging from 3% to 8% (Paudel 2022a). Furthermore, Kiel and Zabel (1999) argue that a houseowner's valuations can be used reliably in estimating housing prices and neighborhood attributes. The use of self-reported residential property values in this chapter is consistent with recent empirical studies in the context of Nepal (Paudel 2022a; Nepal et al. 2020). Among districts in the empirical sample, Kathmandu reports the highest average residential property value, followed by Lalitpur, Bhaktapur, Rupandehi, Kaski, Chitwan, Sunsari, Kanchanpur, Kapilvastu, Kailali, and Morang. Residential property values in these districts belong to the top 10th percentile of the overall distribution in the AHS data set. The empirical sample in this chapter includes 21,499 households interviewed between January 2014 and July 2015.

The second source of data, on the incidence of earthquakes in Nepal, is the United States Geological Survey. To quantify the intensity of seismic shocks from the earthquake, this chapter takes advantage of district-level variation in peak ground acceleration, which is the largest increase in velocity from shaking during the earthquake recorded by a particular station. This chapter follows Paudel (2022b) and classifies 34 districts with moderate seismic shocks as earthquake-affected ("treated") areas and 19 districts with light seismic shocks as "control" areas. Using variation in peak ground acceleration to quantify the intensity of the earthquake is important for two reasons. First, earthquake-related damage, death, or injury is potentially correlated with different unobservable characteristics of a region (Paudel and Ryu 2018). This implies that the exogeneity of earthquake-related physical damage across geographical regions is questionable, inducing estimated parameters in econometric models to be biased. Second, the use of peak ground acceleration in quantifying the treatment of earthquake incidence is similar in spirit to previous studies that apply variation in seismic intensity measured on the Modified Mercalli scale (Paudel and Ryu 2023).

The final source of data on aid is the Government of Nepal's Aid Information Management System, which tracks over $280 million in geocoded disbursements spread across 156 projects in 852 locations in the aftermath of the April 2015 earthquake (AidData 2016). The aid-financed projects involved earthquake relief; immediate food and emergency shelter assistance; water, sanitation, and hygiene-related programs; comprehensive emergency nutrition response; preservation of relics and safe debris management of heritage sites; restoring access to key public services; rehabilitation of community-based infrastructure and emergency employment for immediate life support; establishment of temporary shelters; and community mobilization to distribute shelter kits among disaster-afflicted populations. In the empirical sample, 22 districts received aid after the earthquake happened.

5.2.2 Empirical Approach

The empirical approach in this chapter is based on Paudel (2022b). Specifically, Paudel (2022b) applies a difference-in-differences research design to quantify the impact of the seismic shocks from the 2015 earthquake and estimates the following equation:

$$Y_{idt} = \beta(Post_t * Treated_d) + \alpha_1 Post_t + \alpha_2 Treated_d + \delta_t + \mu_j + \varepsilon_{idt} \quad (1)$$

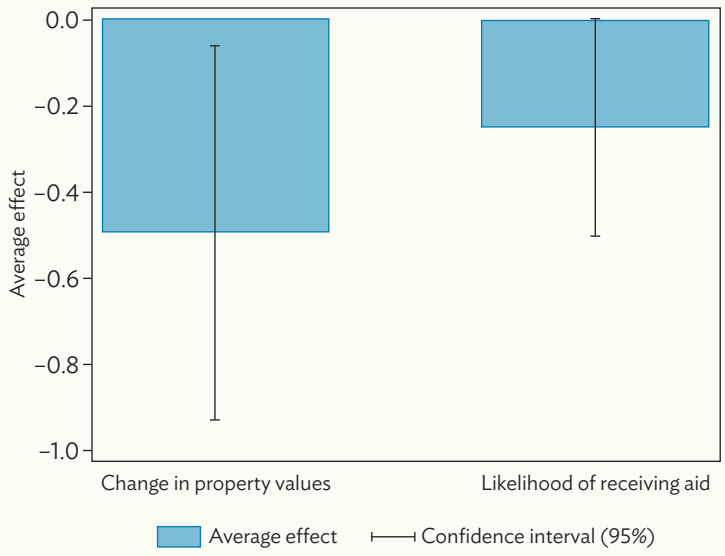
where $Treated_d$ is a binary indicator for districts affected by the 2015 earthquake, $Post_t$ is a binary indicator for the months after the earthquake, δ_t accounts for month-by-year fixed effects, and μ_j accounts for primary sampling unit fixed effects. Y_{idt} denotes five different outcome variables of interest: (i) self-assessed residential property value (in logs) for an individual i in district d in month t of a given year, (ii) likelihood of an individual receiving aid, (iii) total number of aid-financed projects, (iv) total amount of aid disbursed for projects in response to the earthquake, and (v) total amount of aid per capita. β is the parameter of interest that identifies the causal impact of the 2015 earthquake on residential property values and aid-related outcome variables. α_1 accounts for differences in outcome variables in "control" districts before and after the 2015 earthquake. Similarly, α_2 controls for differences in outcome variables between "treated" and "control" districts before the 2015 earthquake. Paudel (2022b) presents empirical results in more detail and conducts several robustness checks to check the identifying assumption of the difference-in-differences model in Equation (1). For example, Paudel (2022b) shows that outcome variables of interest in "treated" and "control" districts evolve in a parallel way before the incidence of the 2015 earthquake. This test provides statistical evidence on failure to reject the null hypothesis of parallel trends, implying that the estimates reported in this chapter are robust.

5.3 Main Findings

5.3.1 Effects on Property Values and Aid Provision

Figure 5.1 presents the main findings on the linkage between the 2015 earthquake in Nepal, residential property values, and provision of aid. Two specific results on the economic impact of seismic shocks from the 2015 earthquake in Nepal are worth highlighting. First, the regression estimate from (1) in relation to property values shows that the coefficient on the interaction term $Post_t * Treated_d$ is −0.4940, which is statistically significant at the 5% level. The estimated coefficient indicates that residential property values exhibit a significant 49.40% decrease in "treated" districts after the 2015 earthquake. The estimated impact has a 95% confidence interval, bounded between −92.93% and −5.86%. Second, the estimated parameter β from (1) in relation to provision of aid amounts to 0.2483, which is statistically significant at the 10% level. Figure 5.1 shows that households residing in earthquake-affected districts are 24.83% less likely to receive aid after the incidence of the earthquake, with the 95% confidence interval ranging between −49.98% and 0.03%. The empirical analysis, however, does not find any statistical significance in relation to the effect of the earthquake on other aid-related indicators: number of aid-financed projects, total aid disbursed for these projects, and total amount of aid per capita.

Figure 5.1: Regression Estimates on the Impact of the 2015 Earthquake on Residential Property Values and Likelihood of a Household Head Receiving Aid



Note: These estimates are based on a difference-in-differences empirical specification shown in Paudel (2022b).

Figure 5.1 shows that the economic cost of a large earthquake in Nepal is statistically significant in terms of both property damages and inadequate aid to help households recover from the natural disaster. To illustrate the economic significance of the estimated impact, I combine the first slope estimate in Figure 5.1 with average residential property values of 2.05 million Nepalese rupees (NRs) to compute economic damages per capita from the 2015 earthquake. This back-of-the-envelope calculation shows that a 49.40% decrease in residential property values corresponds to average household-level

economic damages of NRs1.17 million, with 95% confidence interval ranging between NRs2.2 million and NRs0.14 million. Despite large economic losses from seismic shocks, it is evident from Figure 5.1 that aid-financed efforts in the context of Nepal's 2015 earthquake appear to be inadequate in helping households recover from the natural disaster in the short run. Understanding the degree to which these short-run estimates capture the long-term economic effects of the earthquake is, unfortunately, beyond the scope of this chapter.

The magnitude of economic loss from the 2015 earthquake in Nepal is much larger than that associated with other environmental shocks (Paudel 2021b; Paudel 2022a). For example, Paudel (2022a) reports that forest fires in Nepal induced household-level economic damages of approximately NRs12,537. Paudel (2022a), however, cautions that this estimate does not account for additional adverse effects of forest fires such as poor air quality and unavailability of forest resources for livelihoods.

5.3.2 Gender and Household Size

To explore the heterogenous effect of the earthquake on property values and aid, this chapter also delves into two demographic variables: gender and household size. Prior literature suggests that earthquakes can widen gender disparities in economic outcomes. For example, Paudel and Ryu (2018) show that females exposed to the 1988 earthquake in Nepal during infancy lost significant human capital compared to male counterparts. This also indicates that natural disasters have the potential to exacerbate gender bias in a predominantly patriarchal society. In addition, birth order is associated with intra-household investments and children's education (Emerson and Souza 2008; Black, Devereux, and Salvanes 2005), which has direct consequences in the context of natural disasters. Relatedly, Paudel and Ryu (2023) provide empirical evidence on the differential impact of the earthquake on human capital among children with at most one sibling and their counterparts with at least two siblings. These studies bolster the need to explore the heterogenous economic impact of the 2015 earthquake across gender and household size.

The heterogenous treatment effect analysis in Table 5.1 indicates that the 2015 earthquake led to a more severe impact on residential property values among female-headed households compared to male-headed households. Columns (1) and (2) in Panel A show that residential property values exhibit a significant 45.73% decline among male-headed households and a 54.22% decrease among female-headed households in "treated" districts after the 2015 earthquake. Although females bear larger economic losses from property value declines, the likelihood of them receiving aid is relatively smaller compared to male counterparts. Column (4) in Panel A shows that female-headed households are 23.23% less likely to receive aid in response to the 2015 earthquake in Nepal.

Subsequent empirical analysis across households of different sizes in Panel B indicates that smaller households with at most six members experience a 49.11% decrease in their residential property values and are 24.48% less likely to receive aid in the aftermath of the earthquake. While the economic impact among larger households is negative, the statistical significance of parameters loses precision. Results from Table 5.1 imply that there may exist possible heterogeneity in the effect of the 2015 earthquake across other socioeconomic dimensions as well.

Table 5.1: Heterogenous Impact of the 2015 Earthquake on Residential Property Values and Aid Provision

	Dependent Variable			
	Log Residential Value (Rs.)		Likelihood of Receiving Aid	
	Males Only	Females Only	Males Only	Females Only
	(1)	(2)	(3)	(4)
	Panel A: Gender			
Treated*after	−0.4573**	−0.5422**	−0.2673**	−0.2323*
	(0.2184)	(0.2335)	(0.1285)	(0.1297)
Month-by-year fixed effects	Yes	Yes	Yes	Yes
Sampling unit fixed effects	Yes	Yes	Yes	Yes
Observations	10,996	10,503	10,996	10,503
R-Squared	0.6797	0.6682	0.8237	0.8265
	Dependent Variable			
	Log Residential Value (Rs.)		Likelihood of Receiving Aid	
	> 6 Members	At Most 6 Members	> 6 Members	At Most 6 Members
	(1)	(2)	(3)	(4)
	Panel B: Household Size			
Treated*after	−0.6339*	−0.4911**	−0.2189	−0.2448**
	(0.3189)	(0.2338)	(0.1336)	(0.1145)
Month-by-year fixed effects	Yes	Yes	Yes	Yes
Sampling unit fixed effects	Yes	Yes	Yes	Yes
Observations	7,745	13,719	7,745	13,719
R-Squared	0.7204	0.6908	0.8504	0.8388

Notes: This table reports estimates from Equation (1) based on Paudel (2022b) across four subsamples: males only, females only, households with more than six members, and those with at most six members. Standard errors, in parentheses, are clustered at the district level.
*** indicates significance at the 1% level.
** indicates significance at the 5% level.
* indicates significance at the 10% level.

5.4 Discussion

5.4.1 Lessons

Findings on the linkage between the 2015 earthquake in Nepal, residential property values, and aid provision offer two key lessons for policymakers. First, results from this chapter illustrate that the economic impact of a large earthquake in a developing country setting is much larger compared to other natural disasters such as forest fires. Forest fires occur more frequently throughout the year in Nepal, while large earthquakes tend to be unanticipated. For example, Paudel (2022a) uses real-time satellite data on active fire locations and concludes that forest fires induce a 4.48% decline in residential property values in Nepal. These fire-induced changes in property values in the short run are

approximately one tenth of the overall decline induced by seismic shocks. While wildfire risk awareness and fire prevention programs are necessary to mitigate the adverse impact of forest fires, policymakers grappling with limited resources in the developing world need to consider prioritizing earthquake-related interventions. This is important because one of the key lessons from the 2015 earthquake is that the economic cost of large seismic shocks in developing countries can be substantial.

Second, the heterogeneity in the overall economic impact of natural disasters across different socioeconomic groups deserves special attention. In the context of Nepal, the 2015 earthquake appears to have had a disproportionate impact on economically vulnerable groups, including female-headed households and families with more than six members. There exists well-documented evidence on how gender disparities in economic outcomes widen in response to large shocks, ranging from pandemics to environmental disasters such as earthquakes and forest fires (Paudel 2021c, 2021d; Paudel and Ryu 2018). Historical evidence indicates that both political transformation and access to management of natural resources can empower women and enhance their decision-making and economic livelihoods (Paudel and de Araujo 2017; Paudel 2018). Yet, it is of utmost importance that policymakers recognize that different socioeconomic groups are endowed with various levels of social capital that, in turn, determine their adaptive responses to natural disasters. For example, findings show that although all households exposed to the 2015 earthquake are less likely to receive aid, the unavailability of aid is more prominent among households with at most six members. Policymakers need to consider such inherent inequalities among different population subgroups when implementing interventions both prior to and after the incidence of natural disasters.

These lessons suggest that well-intentioned policy mechanisms may go awry during times of emergency because of ineffective implementation. Empirical findings from this chapter illustrate that negative effects on residential property values continue to persist even in earthquake-affected districts where aid was allocated for disbursement. To better understand mechanisms driving these changes, estimates from this chapter highlight the need for caution regarding potential leakage in distribution of aid across different areas with various layers of governance. In fact, Eichenauer et al. (2020) examine the design and implementation of the United Nations Flash Appeal following the 2015 earthquake and conclude that aid allocation did not consider socioeconomic vulnerabilities while supporting municipalities with a large proportion of high caste groups. This suggests that ethnic fractionalization in developing countries such as Nepal cannot be overlooked when designing programs to enhance economic well-being and alleviate poverty (Paudel 2021c). Future policymakers should implement risk-mitigating mechanisms effectively and equitably to account for economic losses among poor households in the aftermath of natural disasters. While aid is only one of those mechanisms, lessons involving leakage and inadequate governance apply to the implementation of policies aimed at promoting resilience as well.

From a policy perspective, it is critical to differentiate the economic impact of the 2015 earthquake in the short run from that in the long run. This chapter presents short-term changes in residential property values that last for 3 months after the 2015 earthquake. Due to unavailability of data over a longer time horizon, it is beyond the scope of this study to tease out the long-term repercussions of the earthquake on property values. In a different study, Paudel (2022b) implements an event study analysis to show that the decrease in residential property values lasted for 10 months after the 2015 earthquake. While long-run estimates are likely to be different, policymakers can still learn from these short-term changes in economic outcomes of households exposed to large seismic shocks. Unless policy mechanisms implemented in the short run succeed, it is likely that these immediate changes in residential property values will last for several months after an earthquake. For example, unavailability of aid among earthquake-affected households in the short run will prevent them from partially recovering from large economic damages associated with the 2015 earthquake.

5.4.2 Policy Implications

Nepal, a small developing country in the Himalayan range, is one of the most seismically active zones across the globe (Rajaure 2021). According to Stevens and Avouac (2016), earthquakes with moment magnitudes well above 9.0 in the Himalayan region are likely to occur again in the future. This implies that economic and policy implications from the 2015 earthquake are of significant interest to both Nepal and similar countries in Asia that are prone to large seismic shocks. In the context of Nepal, governmental efforts to mitigate the adverse effect of large earthquakes on economic outcomes appear to be minimal. For example, while Nepal's government allocates approximately $1 million annually to prevent forest fires (Paudel 2022a), it does not prioritize earthquake-related interventions in terms of annual budget and human resources. This is problematic because inadequate funding constrains successful implementation of preventative programs and awareness campaigns across different districts of Nepal (Sharma 2006).

While estimates presented in this chapter based on a quasi-experimental research design are arguably internally valid (Paudel 2022b), applying Nepal-based hedonic estimates to other countries outside of South Asia involves three specific caveats. First, Nepal's economic context is unique. For example, as mentioned previously, Nepal ranks 11th among the world's most earthquake-prone countries, 4th in terms of vulnerability from climate change, and 30th in relation to flood risk (Shakya, Basnet, and Paudel 2022). Second, while remittances contribute to over a quarter of Nepal's gross domestic product (Shakya, Basnet, and Paudel 2022), people in Nepal have inadequate access to risk-mitigating mechanisms such as housing insurance (Paudel 2022a). Finally, it is important to consider compositional changes in earthquake-affected districts in terms of both internal migration and foreign labor migration. For example, Shakya, Basnet, and Paudel (2022) provide quasi-experimental evidence on changes in labor market outcomes associated with the 2015 earthquake and conclude that the number of work permits issued to Nepalese males for international migration decreased significantly in districts severely affected by the earthquake. Future research may benefit from a rigorous examination of potential adaptive mechanisms undertaken by households in response to natural disasters across different settings.

5.5 Concluding Remarks

This chapter explores the relationship between seismic shocks from the 2015 earthquake in Nepal, residential property values, and disbursement of aid in response to the natural disaster. Specifically, it uses the empirical model in Paudel (2022b) to take advantage of plausibly exogenous variation in peak ground acceleration associated with seismic shocks from the earthquake. Regression estimates from a difference-in-differences specification illustrate that households exposed to large seismic shocks experienced a substantial drop in residential property values. This short-run economic impact is more prominent among economically vulnerable groups, including female-headed households and large families with more than six household members.

The chapter also finds that earthquake-affected households were less likely to receive aid in 2015, implying that aid-financed efforts did not partially mitigate large economic damages from the earthquake in the short run. The deterioration of economic well-being among households in the aftermath of the 2015 earthquake offers policy implications regarding leakage in aid distribution. Findings on lowered property values from seismic shocks indicate that policymakers need to implement well-intentioned aid-based mechanisms effectively and further help economically vulnerable households recover from natural disasters.

References

AidData. 2016. NepalEarthquake_GeocodedResearchRelease_Level1_v1.0 geocoded dataset. Williamsburg, VA and Washington, DC: AidData. http://aiddata.org/research-datasets

Almond, D., and J. Currie. 2011. Killing Me Softly: The Fetal Origins Hypothesis. *Journal of Economic Perspectives* 25(3): 153–72.

Almond, D., L. Edlund, and M. Palme. 2009. Chernobyl's Subclinical Legacy: Prenatal Exposure to Radioactive Fallout and School Outcomes in Sweden. *Quarterly Journal of Economics* 124(4): 1729–1772.

Baryshnikova, N. V., and N. T. A. Pham. 2019. Natural Disasters and Mental Health: A Quantile Approach. *Economics Letters* 180: 62–66.

Black, S. E., P. J. Devereux, and K. G. Salvanes. 2005. The More the Merrier? The Effect of Family Size and Birth Order on Children's Education. *Quarterly Journal of Economics* 120(2): 669–700.

Boes, S., S. Nüesch, and K. Wüthrich. 2015. Hedonic Valuation of the Perceived Risks of Nuclear Power Plants. *Economics Letters* 133: 109–111.

Caruso, G., and S. Miller. 2015. Long Run Effects and Intergenerational Transmission of Natural Disasters: A Case Study on the 1970 Ancash Earthquake. *Journal of Development Economics* 117: 134–150.

Eichenauer, V. Z., A. Fuchs, S. Kunze, and E. Strobl. 2020. Distortions in Aid Allocation of United Nations Flash Appeals: Evidence from the 2015 Nepal Earthquake. *World Development* 136: 105023.

Emerson, P. M., and A. P. Souza. 2008. Birth Order, Child Labor, and School Attendance in Brazil. *World Development* 36(9): 1647–1664.

Heger, M. P., and E. Neumayer. 2019. The Impact of the Indian Ocean Tsunami on Aceh's Long-Term Economic Growth. *Journal of Development Economics*.

Khanal, B. 2022. The Impacts of the 2015 Gorkha Earthquake on Children's Health in Nepal. *World Development* 153: 105826.

Kiel, K. A., and J. E. Zabel. 1999. The Accuracy of Owner-Provided House Values: The 1978–1991 American Housing Survey. *Real Estate Economics* 27(2): 263–98.

Metz, N. E., T. Roach, and J. A. Williams. 2017. The Costs of Induced Seismicity: A Hedonic Analysis. *Economics Letters* 160: 86–90.

Nandi, A., S. Mazumdar, and J. R. Behrman. 2018. The Effect of Natural Disaster on Fertility, Birth Spacing, and Child Sex Ratio: Evidence from a Major Earthquake in India. *Journal of Population Economics* 31(1): 267–293.

Nepal, M., R. K. Rai, M. S. Khadayat, and E. Somanathan. 2020. Value of Cleaner Neighborhoods: Application of Hedonic Price Model in Low Income Context. *World Development* 131: 104965.

Paudel, J. 2018. Community-Managed Forests, Household Fuelwood Use and Food Consumption. *Ecological Economics* 147: 62–73.

____. 2021a. Beyond the Blaze: The Impact of Forest Fires on Energy Poverty. *Energy Economics* 101: 105388.

____. 2021b. Short-Run Environmental Effects of COVID-19: Evidence from Forest Fires. *World Development* 137: 105120.

____. 2021c. Why Are People Energy Poor? Evidence from Ethnic Fractionalization. *Energy Economics* 102: 105519.

____. 2021d. Home Alone: Implications of COVID-19 for Mental Health. *Social Science and Medicine* 285: 114259.

____. 2022a. Environmental Disasters and Property Values: Evidence from Nepal's Forest Fires. *Land Economics* 98(2): 115–131.

____. 2022b. Resilience to Large Earthquakes: Lessons from Residential Property Values. *University of Oklahoma Department of Economics Working Paper Series*.

____. 2023a. Shaking Things Up: Do Seismic Shocks Affect Energy Choices? *Energy Policy* 172: 113297.

____. 2023b. Challenges in Water and Sanitation Services: Do Natural Disasters Make Matters Worse? *Review of Development Economics* 27(4): 1–18.

____. 2023c. Do Environmental Disasters Affect Human Capital? The Threat of Forest Fires. *Economics of Education Review* 97: 102463.

Paudel, J., and P. de Araujo. 2017. Demographic Responses to a Political Transformation: Evidence of Women's Empowerment from Nepal. *Journal of Comparative Economics* 45(2): 325–343.

Paudel, J., and H. Ryu. 2018. Natural Disasters and Human Capital: The Case of Nepal's Earthquake. *World Development* 111: 1–12.

____. 2023. Spillover Effects of Natural Disasters on Human Capital. In A. Bucciol, A. Tavoni, and M. Veronesi, eds. *Behavioral Economics and the Environment: A Research Companion*. Abingdon, Oxon, England and New York, NY: Routledge.

Rajaure, S. 2021. Seismic Hazard Assessment of the Kathmandu Valley and Its Adjoining Region Using a Segment of the Main Himalayan Thrust as a Source. *Progress in Disaster Science* 10: 100168.

Rosen, S. 1974. Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy* 82(1): 34–55.

Shakya, S., S. Basnet, and J. Paudel. 2022. Natural Disasters and Labor Migration: Evidence from Nepal's Earthquake. *World Development* 151: 105748.

Sharma, S. 2006. Participatory Forest Fire Management: An Approach. *International Forest Fire News* 34: 35–45.

Stevens, V. L., and J-P. Avouac. 2016. Millenary Mw > 9.0 Earthquakes Required by Geodetic Strain in the Himalaya. *Geophysical Research Letters* 43(3): 1118–1123.

Tietenberg, T., and L. Lewis. 2018. *Environmental and Natural Resource Economics*. 11th Edition. New York and London: Routledge.

Toya, H., and M. Skidmore. 2007. Economic Development and the Impacts of Natural Disasters. *Economics Letters* 94(1): 20–25.

CHAPTER 6

Post-Disaster Resettlement and Its Impact on Vulnerable Communities: Chennai, India

Vanessa Peter

6.1 Post-Disaster Resettlement in Chennai: An Overview

Chennai, the capital city of Tamil Nadu, is a south Indian coastal city vulnerable to disasters like floods and tsunami. The city, with its 19-kilometer stretch of coastline (ENVIS Centre n.d.), has faced the ravages of the Indian Ocean tsunami in 2004, the recent massive floods in 2005, 2008, and 2015, and several cyclonic storms, as shown in Table 6.1.

Table 6.1: Major Floods and Cyclones in Chennai

Floods	Cyclones
1976	2005 – Cyclone Fanoos
1996	2008 – Cyclone Nisha
1998	2010 – Cyclone Jal
2005	2011 – Cyclone Thane
2008	2012 – Cyclone Nilam
2015	2016 – Cyclone Vardhah
	2016 – Cyclone Nada
	2018 - Cyclone Gaja
	2020 – Cyclone Nivar

Source: Bandyopadhyay, Bindal, and Manna (2021).

These disasters were known not only for their scale of destruction but also for the magnitude of the post-disaster resettlement that has adversely impacted the vulnerable communities. The flood in 2015 in Chennai affected over 4 million people in and around the city, causing an economic loss of around $3 billion (Bandyopadhyay, Bindal, and Manna 2021). The most massive eviction and resettlement process in the city also commenced after 2015 floods that impacted the lives of the vulnerable communities who were already struggling to recover from the impacts of the disaster.

Massive resettlement in the city has always occurred after disasters. As part of the reconstruction projects following the 2004 tsunami, 7,432 families from Chennai and its neighboring areas were evicted and resettled in resettlement sites that were in the peripheral areas of the city (Peter and Alvino 2010). The resettlement of coastal communities, which had depended on coastal resources for their livelihoods, farther from the coast resulted in complete loss of those livelihoods. Shifting disaster-affected families to grossly inadequate temporary shelters located in low-lying areas where they were forced to face floods and fire accidents before accessing permanent housing after years of delay exacerbated the existing vulnerabilities, leaving families so desperate that some even resorted to selling their organs (People's Tribunal Report 2006).

The trend of post-tsunami resettlement was not confined to Chennai. It occurred across the state of Tamil Nadu, where 51% of the housing constructed as part of the tsunami recovery projects was at alternate locations. The proportion of resettlement housing programs to those in the original locations was significantly higher among the most urbanized coastal districts of Tamil Nadu. In Chennai, 81% of the total houses constructed under the tsunami rehabilitation program of the state, including the World Bank–financed Emergency Tsunami Reconstruction Project, were at alternate locations (Peter 2011).

The evictions that were carried out after the tsunami violated the rights of the affected persons. In Chennai, the affected families were transported in "garbage vehicles," and the housing provided at alternate sites was cramped (dwellings of nearly 200 square feet) and did not have indoor tap connections.

Since the tsunami, Chennai has witnessed additional rounds of massive evictions after the floods that severely affected the city in 2008. After the floods in 2008, the Public Works Department evicted several settlements located on the banks of water bodies in Ambattur, Tambaram, and Manali. The agenda of resettling slums as part of the river restoration projects has existed since the 1990s without yielding cleaner rivers (Coelho 2016).

After various civil society organizations intervened, exposing the gaps in the eviction and resettlement that took place after the tsunami and the 2008 floods, the Government of Tamil Nadu created a high-level committee on resettlement in 2011 (see Table 6.2).

Table 6.2: High-Level Committee on Resettlement, 2011

Scope of the committee	Resolve issues related to basic amenities and social infrastructure facilities in the resettlement schemes
Head of the committee	Chief Secretary, Government of Tamil Nadu, Chairperson
Members of the committee	Secretaries to Government of the following departments: • Finance Department • Home, Prohibition and Excise Department • Housing and Urban Development Department • Municipal Administration and Water Supply Department • Health and Family Welfare Department • Higher Education Department • School Education Department • Animal Husbandry, Dairying and Fisheries Department (renamed as Animal Husbandry, Dairying, Fisheries and Fisherman Welfare Department) • Co-operation, Food and Consumer Protection Department • Environment and Forest Department • Adi Dravidar and Tribal Welfare Department • Rural Development and Panchayat Raj Department • Social Welfare and Nutritious Meal Department (Renamed as Social Welfare and Women Empowerment Department) • Transport Department • Youth Welfare and Sport Development • District Administration • Commissioner of the Urban Local Body – Chennai

Source: Housing and Urban Development Department (2011).

The process of resettlement improved after the constitution of the high-level committee on resettlement. Several gaps in the resettlement process were identified and addressed. The designs of the resettlement sites have improved with larger units, better internal design, and arrangements for in-house piped water and electricity connections. The process of resettlement has also improved as provisions for a one-time shifting allowance and monthly subsistence allowance for a year were introduced. Protocols for arrangements of prompt transfer of documents, facilitation of admission in schools, and livelihood restoration programs were also introduced (Coelho, Peter, and Nundiyny 2018).

In 2015, the floods caused extensive damage to the lives and property of most of the residents in the city and its neighboring areas, those residing on the banks of the Cooum and Adyar rivers were among the worst impacted. The banks of the Cooum River housed 14,972 families in 65 settlements while the banks of the Adyar River accommodated 9,687 families living in 28 settlements.

The Government of Tamil Nadu carried out a series of evictions under the guise of post-flood rehabilitation, making use of the vulnerability of the flood-affected families. In 2016, the state shifted 3,464 of the 9,687 families residing on the banks of the Adyar River to the massive resettlement sites of Ezhil Nagar (Kannagi Nagar) and Perumbakkam, the largest resettlement sites in the state (Peter and Chaudhry 2017).

Since the floods, 12,951 families residing on the banks of the Cooum River were also resettled under the Integrated Cooum River Eco-Restoration Plan funded by the Chennai Rivers Restoration Trust and implemented by the Public Works Department, Greater Chennai Corporation, and Tamil Nadu Slum Clearance Board (now renamed as the Tamil Nadu Urban Habitat Development Board), the nodal government agency for providing housing for low-income groups and slums (Peter, Nundiyny, and Chaudhry 2021).

Despite the creation of the high-level committee in 2011 to address issues related to resettlement, challenges remain with giving affected communities prior legal notice and conducting a public consultation process. Since the 2015 floods in Chennai, the state has resettled 18,723 families from 69 settlements comprising 75,000 individuals without providing prior and adequate information about the eviction process and the resettlement packages. Of the 69 settlements evicted, 60 were resettled during the middle of the school year and only in 5 settlements were processes like social impact assessment and resettlement action plans conducted prior to resettlement. Of the 69 settlements, 64 did not receive public consultation processes prior to resettlement and 68 did not receive any legal notices (Peter and Muralidharan 2021).

The process of involving communities has not been addressed primarily because of the absence of adequate legal and policy safeguards that protect the rights of the disaster-affected communities and other vulnerable communities from arbitrary evictions both in Tamil Nadu and across the country (Peter 2020). With an absence of laws, policies, or guidelines on resettlement and rehabilitation in the state, there is no legal compulsion for the government to include and consult communities in the process of resettlement. The resettlement process is predetermined by the government departments, and the communities are forced to accept the limited options for resettlement proposed by the state.

Because the affected families are not engaged in the planning and implementation process, they are left to choose from the options provided by the government, which are often restricted to housing located in the peripheral areas of the city. The fear of losing the rehabilitation package if they reject the offer from the state forces them to accept even unviable options. The state is reluctant to include communities in codesigning the resettlement and rehabilitation because rehabilitation is not recognized as an entitlement or a right but as a "benevolent" gesture of the state. The absence of community

involvement in the designing of the program also renders the resettlement and rehabilitation process discriminatory.

After the 2015 Chennai floods, families shifted from the banks of the Adyar River in Chennai District were able to access free housing, a shifting allowance, and a subsistence allowance for 12 months. However, the families shifted from the banks of the Adyar River and its feeder canals in Kancheepuram District had to pay for their houses and did not receive any other assistance even though settlements located in both districts were affected by the floods and the families were shifted to the same resettlement site.

The issue of discrimination in resettlement and rehabilitation packages continues to exist as the rehabilitation package offered for the resettled families is either project based or department oriented. For example, families resettled under the World Bank–funded Tamil Nadu Sustainable Urban Development Project (TNSUDP) who were evicted after the 2015 floods received different resettlement packages when compared to those who were evicted from near the banks of water bodies. The project-affected families of the World Bank project and those evicted under the Chennai Rivers Restoration Trust project were shifted to the same resettlement site in the same blocks, yet they were accessing different packages. Such discriminatory practices could have been avoided if a robust state resettlement and rehabilitation policy had been in place. Lack of policy safeguard results in lack of state accountability regarding resettlement (Peter and Chaudhry 2017).

The evictions carried out from 2015 to 2020 without adhering to the due processes have violated the human right to adequate housing. This right is provided by Article 11.1 of the International Covenant on Economic, Social and Cultural Rights, including General Comment 4 (on the right to adequate housing) and General Comment 7 (on forced evictions breaching the right to adequate housing), as well as the United Nations Basic Principles and Guidelines on Development-Based Evictions and Displacement, which was presented by the Special Rapporteur on Adequate Housing and acknowledged by the United Nations Human Rights Council in 2007 (Peter and Chaudhry 2017).

Despite the existing narration on the adverse impact of post-disaster resettlement and the violation of the rights of the vulnerable communities, the floods in 2021 yet again triggered discussions around resettlement of "encroachers" residing near the water bodies. From March 2020 to June 2021, even during the coronavirus disease (COVID-19) pandemic situation, 2,045 families were evicted from the cities of Chennai, Coimbatore, and Madurai. Of these families, over 1,000 were living in houses along the banks of water bodies in Chennai. These evictions have increased their vulnerabilities, impoverishment, and indebtedness (Chaudhry et al. 2021).

Although the pitfalls of the existing resettlement practices are acknowledged by the Government and other civil society organizations, the Government of Tamil Nadu has continued to expand the existing sites and construct additional housing in lands classified as "hazardous." An additional 1,152 houses are nearing completion under the Prime Minister Awas Yojana's Global Housing Technology Challenge – India (a central government scheme for affordable housing) in the resettlement site of Perumbakkam, which already has over 20,000 houses. Despite the site flooding every year, the site was expanded. The government is also completing construction of 6,877 tenements near the Ennore Thermal Power Plant. In Chennai's Ennore neighborhood, 26.68 acres of land of the Tamil Nadu Housing Board that had been classified as a special and hazardous industrial use zone was reclassified in 2018 to a residential zone by the Chennai Metropolitan Development Authority. The development authority persisted with the reclassification even though the representative from the Tamil Nadu Pollution Control Board expressed his concern about possible pollution due to the nearby thermal station and its impact on the proposed residential development.

Such a resettlement process is planned and implemented because the primary focus is often on removing the communities from their place of habitation rather than on prioritizing an inclusive and resilient development model. These resettlement drives can be attributed to the existing model of urban infrastructure development, environmental conservation, and disaster mitigation plans. The existing model is anti-poor and anti-human rights. The absence of the views of the affected communities has further widened the gap between the communities, the public, and the state, resulting in mistrust on top of the existing stigma and criminalization these communities face. These trends highlight the emerging need for analyzing the existing policy and implementation gaps in post-disaster resettlement as a form of sociospatial segregation rather than a stand-alone process.

6.2 Post-Disaster Resettlement Contributes to Existing Sociospatial Discrimination

In the last 3 decades, Indian cities have been practicing "social apartheid" by which the working classes from the cities are moved to the fringes, where communities are forced to choose between access to decent housing and access to economic and educational opportunities. Most often, the resettlement areas are located on lands that are called "undesirable," "uninhabitable," "precarious," or "dangerous;" these are lands located in marshlands prone to flooding, hillsides prone to landslides, or along riverbanks, canal edges, burial grounds, and railway lines (Coelho 2014).

The existing resettlement practices have also resulted in a transition of the urban demography. From small clusters of settlements, the geography of urban poverty is now concentrated in the peripheral areas of the urban center where the new settlements are being established. This is yet another manifestation of the spatial discrimination practiced in the rural areas across India, where the hamlets and settlements of the marginalized communities are found to be in the fringes, away from the main villages, which are often inhabited only by the dominant communities. The marginalized communities are often the most affected during disasters because they are only "allowed" or "sanctioned" to reside on the available lands, like those near water bodies, that are neither in demand nor possessed by the affluent sections. Therefore, the trend of vulnerable communities residing in non-titled, government lands is directly linked to the process of historical marginalization. The nature of the land on which they reside also renders them vulnerable to disasters like floods (Peter, Nundiyny, and Chaudhry 2019).

The process of post-disaster resettlements reduces the scope of negotiation of the vulnerable communities as their existing vulnerabilities are exacerbated because of the impact of disaster. This process of resettlement undermining the contribution of communities to the local economy also ignoring the process of historical marginalization faced by these communities is an act of sociospatial discrimination (Peter, Nundiyny, and Chaudhry 2019).

The issue of resettlement is critical, as a greater number of families are being resettled every year. This evident from the fact that over the last 2 decades, 61,432 families (250 thousand individuals) from Chennai residing in settlements inside the city were forcibly evicted and resettled in eight resettlement sites located in the peripheral areas of the city, as mentioned in Table 6.3. Two of the massive eviction processes that the city witnessed, as described previously, were after the tsunami in 2004 and the flood in 2015.

Table 6.3: Resettlement Sites in and around Chennai

Site Number	District	Relocation Settlement Name	Total Number of Tenements Constructed by TNSCB
1	Chennai	Kannagi Nagar – Okkiyam Thoraipakkam	23,704
2	Chennai	Semmencherry	5,164
3	Chengalpattu	Perumbakkam	20,376
4	Kancheepuram	Navalur – Oragadam	2,048
5	Chennai	HLL Nagar – Tondiarpet	1,260
6	Chennai	All India Radio Land	5,856
7	Tiruvallur	Gudapakkam – Thirumazhisai	1,024
8	Tiruvallur	Athipattu – Ambathur	2,000
Total			61,432

TNSCB = Tamil Nadu Slum Clearance Board.

Source: Peter and Muralidharan (2021).

Since the Chennai floods in 2015, 96% of the evictions have been carried out for "conservation of water bodies" and providing "disaster-resilient housing for the vulnerable communities," distancing the most vulnerable families from the environmental discourse (Peter and Muralidharan 2021).

Removal of the vulnerable communities, branded as "encroachers," is perceived as the only approach to protect water bodies and prevent flooding. The absence of alternative views on inclusion of communities in the disaster mitigation measures and the restoration process has fueled misconceptions leading to a lack of public support for protection of the rights of the disaster-affected vulnerable communities. Further, this post-disaster resettlement has high social, economic, and cultural costs that delay the process of recovery for years (Peter and Chaudhry 2017).

Several discussions with families affected by post-disaster resettlement reveal that the process of resettlement has both short-term and long-term impacts on the resettled families. The short-term impacts include loss of education and livelihoods, limited access to social security schemes, and lack of safety for women and children in the resettlement housing projects. Many women who continued to work had to take three buses and travel for over 2 hours to reach their workplace, and this had an adverse impact on their health. For women in the resettlement sites, poor transport connectivity and lack of safety in the settlements have made them more dependent on the male family members or friends for mobility. The absence of adequate day care facilities for children of 0–6 years and absence of after-school programs for school-going children in the settlement has forced many mothers to remain unemployed and take care of their children (Coelho, Peter, and Nundiyny 2018).

The long-term impacts include increased indebtedness, increased unemployment among women (because the lack of safety, limited access to transportation services, and lack of childcare facilities in the resettlement results in increased dependency on the men in the families), violence against women and children, and stigma and discrimination attached to the resettlement sites affecting the social mobility of these families from the economically marginalized sections of the society.

Evictions and resettlement also affect the social fabric that existed in the neighborhoods prior to relocation. This has considerably affected the support structure that people had built over time.

Resettling families from the city to the remote, isolated, and massive resettlement sites also affects the aspirations of the communities; they were once residing in a mixed neighborhood with ample opportunities for social mobility, and they have been moved to a place to which they have no historical connection, unlike their previous places of habitation. In many cases, the transition from the previous place of habitation to the newly established resettlement sites becomes a difficult journey also because of conflicts with the host communities.

6.3 Impact of Post-Disaster Resettlement on Vulnerable Communities

The post-flood humanitarian actions of the state and the civil society did not ensure a sustainable recovery process because the resettlement process reduced the scope of resilience of communities by exacerbating their existing vulnerabilities, which were intensified because of the disaster (Peter and Chaudhry 2017).

To develop strategies for an inclusive disaster management plan and to prioritize in situ development or proximate resettlement, it is pertinent to understand the impact of post-disaster resettlement on the vulnerable communities. This impact has been documented and published by several civil society organizations and academicians. Some of the findings mentioned in this section are also based on focus group discussions conducted with the resettled families.

6.3.1 Loss of Livelihood

As the resettlement sites were located over 20 kilometers from the previous place of habitation, and with livelihoods being location-specific, most of the resettled people lost their employment immediately after resettlement. In the settlement of Perumbakkam, where most of the families were resettled since the 2015 floods, 51% of the families claimed to travel 21–30 kilometers to reach their places of work, spending 2–4 hours to reach their places of work. The people had to spend an average of 50–100 Indian rupees daily to commute to work (Peter and Chaudhry 2017). The impact of the resettlement was worse for the women, as many women opted out of work because they had no one to take care of their children (Coelho, Peter, and Nundiyny 2018).

While the communities had lost all their possessions after the disaster and were grappling with the impact of resettlement on their livelihoods, they continued to face the ravages of disasters such as floods because most of the resettlement sites are developed on marshlands that serve as a buffer for floodwaters (Coelho 2016). During the 2015 and 2021 floods, people in the resettlement sites of Semmencherry, Kannagi Nagar, and Perumbakkam faced the ravages of floods; people living in the first floors of multistoried tenements there lost their belongings. Most of the families were unable to resume their employment for more than a week during the flood situation.

With the COVID-19 pandemic, the livelihood situation worsened for those resettled to the Perumbakkam resettlement sites after the Chennai floods under the river restoration project. During this time, 45% of women-headed households and 40% of people with disabilities lost their livelihoods. The existing livelihood programs designed by the state are not effective, as they work via either microfinance through self-help groups or vocational training programs that are not linked to investments or markets. Therefore, many who benefit from the existing livelihood programs of the government are unable to generate income from the programs (Peter, Nundiyny, and Chaudhry 2021). The current model of resettlement further contributes to increasing vulnerabilities rather than building resilience.

6.3.2 Increased Family Expenditure

Apart from the increased travel costs, families resettled to sites located in remote and isolated areas like Navalur and Gudapakkam faced increased household expenditure because the working members and school-going and college-going children continued to reside in rental accommodations near the previous place of habitation while the women or elders in the family lived alone in the resettlement sites. In addition, the families had to pay a maintenance fee of 250–750 Indian rupees per month to the Tamil Nadu Urban Habitat Development Board, adding to the inflated family expenditure of the resettled families. Lack of income to meet the increased family expenditure have resulted in indebtedness among the resettled families (Coelho, Peter, and Nundiyny 2018).

The COVID-19 pandemic has further increased the vulnerabilities of the resettled families because the temporary loss of income has led to indebtedness. In the resettlement site of Perumbakkam, 63% of the employed individuals had lost employment for less than 3 months, and 35% of the employed individuals had lost month for a period of 3 to 6 months (Peter, Nundiyny, and Chaudhry 2021).

The situation became difficult for many families as no formal announcement was made by the Government of Tamil Nadu regarding the extension of payment for maintenance fees for houses for the months of unemployment. Whereas the state government made a formal announcement regarding the extension of dates for payment of rent and loans for the houses constructed only by the Tamil Nadu Housing Board servicing the low, middle, and high income groups, the Tamil Nadu Urban Habitat Development Board was not included in the announcement. As there was no formal announcement regarding the extension of dates for payment of maintenance cost for the tenements, people in the resettlement sites were worried about payment, especially in the absence of any income. The COVID-19 pandemic has further worsened their situation, making it difficult for the communities to recover from the impacts of the 2015 floods.

6.3.3 Limited Access to Education

Access to childcare, education, and nutrition facilities is still a challenge for families with children in the resettlement sites. Only 34% of the school-going children access education from schools inside the resettlement sites, while 66% of the children travel over 5 kilometers to access education. There are children studying in 21 different locations in different parts of the city, traveling from the resettlement sites of Navalur, Gudapakkam, and Perumbakkam daily; 40% of the children travel over 20 kilometers to access education. In all the resettlements, inadequate higher secondary education has increased the dropouts from the ages of 15 to 18 years. The cost of education has also increased because of transportation charges; 58% of the children are using public transportation (bus services) to commute to school (Peter and Nundiyny 2018).

Though the children studying in government schools have access to free bus passes, inadequate transportation facilities and connectivity from the site to the school force children to use private transportation like auto rickshaws. Especially in sites like Gudapakkam and Navalur, which are in interior areas, children spend 50–100 Indian rupees to commute to school. Inadequate bus services during mornings and evenings force children to travel in crowded buses, competing with the adults who also use the buses to reach their places of work (Coelho, Peter, and Nundiyny 2018).

6.3.4 Lack of Basic Facilities in the Resettlement Sites

The living conditions of the flood-affected relocated families continues to be grossly inadequate because the sites lack adequate basic amenities including health care (primary health centers), access to subsidized foods (fair price shops), water supplies, burial and cremation grounds, road facilities, and access to government schemes. The problems have been persisting for more than 5 years in some cases. The lack of a grievance redress mechanism and the failure to ensure convergence of various social security schemes by coordinating with the multiple departments continue to be challenges that result in inadequate services in these settlements (Peter and Chaudhry 2017).

6.4 Way Forward

6.4.1 Introducing Legal and Policy Safeguards Protecting Vulnerable Communities

In India generally and Tamil Nadu specifically, the existing legislation and policies do not protect communities from arbitrary evictions. Though nine states in India have legislation on slums/informal settlements with specific provisions on evictions, they are primarily related to processes carried out prior to evictions and not protection from forced or arbitrary evictions (Peter 2020). There are no adequate provisions on resettlement and rehabilitation in the existing legal framework in the country.

There is a need for developing a community-led human rights–based, gender-sensitive, and child-friendly legal framework in order to ensure a comprehensive and planned approach that respects the human rights of affected persons and adheres to national and international laws, policies, guidelines, and standards. The human rights standards elaborated in the Basic Principles and Guidelines on Development-Based Evictions and Displacement (2007) should also be incorporated (see Table 6.4).

Table 6.4: Some of the Provisions of the Basic Principles and Guidelines on Development-Based Evictions and Displacement, 2007

Phase	Principles
Basic principles	• Any eviction must be authorized by law, carried out in accordance to human rights laws and in accordance to the present guidelines (Paragraph 21) • States must adopt legislative and policy measures prohibiting the execution of evictions that are not in conformity with their international human rights obligations (Paragraph 22)
Before eviction	• The state should explore fully all possible alternatives to evictions. Prior to any decision to initiate eviction, authorities must demonstrate that the eviction is unavoidable and consistent with international human rights commitments (Paragraph 38 and 40) • Effective dissemination of the information by the authorities in advance, including land records and comprehensive resettlement plans (Paragraph 37) • Opportunities and efforts to facilitate the provision of legal, technical, and other advice to the affected people to articulate their demand and development priorities (Paragraph 37) • Special efforts to ensure equal participation of women in all planning processes (Paragraph 39) • An eviction notice should include full justification of the decision, including details of the proposed alternatives (Paragraph 41) • An inventory to assess the values of the property, investments, and other material goods that may be damaged needs to be maintained (Paragraph 42)

continued on next page

Table 6.4 *continued*

Phase	Principles
During eviction	• Mandatory presence of government officials or their representatives on site during evictions. The officials must identify themselves to the persons being evicted and present formal authorization for the eviction (Paragraph 45) • Neutral observers, including regional and international observers, should be allowed access upon request (Paragraph 46) • Evictions must not take place in inclement weather, at night, during festivals or religious holidays, prior to elections, or during or just prior to examinations (Paragraph 49) • Communities shall be given at least 90 days' notice prior to the date of resettlement (Paragraph 56(j))
After eviction	• Competent authorities shall ensure that evicted persons or groups have safe and secure access to: (i) Essential food, potable water, and sanitation (ii) Basic shelter and housing (iii) Essential medical services (iv) Livelihood sources (v) Education for children (Paragraph 52) • The time and financial cost required for travel to and from the place of work or to access essential services should not place excessive demands upon the budgets of low-income households (Paragraph 56(f))
Remedies for forced eviction	• When eviction is unavoidable for the promotion of general welfare, the state must provide fair and just compensation for any losses of personal, real, or other property of goods. Compensation should be provided for any economically assessable damage. Compensation should be provided for loss of life or limb; physical or mental harm; lost opportunities including employment, education, and social benefits; loss of earning and earning opportunities; moral damage; and costs required for legal or expert assistance, medicine and medical services, and psychological and social services (Paragraph 60)

Source: United Nations (2007).

The other components that need to be consciously included in the legal and policy framework are:

Prioritizing in situ development. There is an emerging need to spell out in the existing laws and policies that resettlement should be the last option after exploring all possible alternatives. There is also a need to substantiate the claims that all possible alternatives have been explored before proposing resettlement. Housing for the vulnerable sections should be viewed as a tool for catalyzing social mobility and not as infrastructure development. Therefore, housing solutions should adopt an integrated approach where linkages to basic entitlements, employment opportunities, quality education, and access to basic facilities like water, electricity, and sewerage are ensured. To recreate the entire social fabric in a new settlement with a different socioeconomic context is not a viable solution.

There is also a need for further strengthening and implementing the Resilient Urban Design Framework of the Tamil Nadu Urban Habitat Development Board to ensure that disaster-resilient in situ houses are constructed, thereby reducing adverse social, economic, and cultural impacts of resettlement. The Resilient Urban Design Framework adopted by the Tamil Nadu Slum Clearance Board under the World Bank–funded First Tamil Nadu Housing Sector Strengthening Program should be applicable to all the projects irrespective of the project donor or the funding available. The goals of this framework are summarized in Box 6.1.

Box 6.1: Goals of the Resilient Urban Design Framework

Toward reaching the vision tenants of enriching the lived experience and building resilient communities, the following multifaceted and multidisciplinary goals are developed:

- Embrace environmentally sensitive design
- Enhance economic opportunities
- Facilitate social development
- Engender improved health and lifestyle
- Design for safety
- Ensure inclusion and universal accessibility
- Promote cultural relevance
- Introduce innovate housing design
- Adopt integrated site planning
- Utilize smart and low-cost technology

The Government of Tamil Nadu should allocate the required funds to the Tamil Nadu Urban Habitat Development to implement the components of the framework. The stakeholder engagement detailed in this framework should also be adopted. This engagement includes developing a repository of community feedback and input mechanisms.

During the period where the in situ housing process is conducted, alternate arrangements should be made available for the families in consultation with them. There is also a need to develop clear minimum guidelines for providing alternate accommodation till the housing project is completed. As most of the communities will not be able to afford rent till the completion of construction of houses, alternate transit accommodation should be provided or a rental assistance program should be developed.

Minimizing resettlement by adopting mixed models and nature-based solutions to increase resilience. In the Integrated Cooum River Eco-Restoration Project of the Chennai Rivers Restoration Trust, which was implemented after the 2015 floods, 12,951 families were evicted and resettled in the sites located in the margins of the city. There was a scope for reducing resettlement substantially. The final report of the restoration plan had three options with a scope for partial resettlement, in situ development, and in situ redevelopment. However, the government only opted for resettlement, as there was housing available in the existing resettlement sites (Peter and Muralidharan 2021). Though there was a scope to minimize resettlement by adopting an area-based solution, the available alternatives were not explored. Different models of housing like rental housing programs can also be explored to include the most vulnerable groups, like migrant workers and families experiencing homelessness.

As one of the initiatives under the Water as Leverage for Resilient Cities in Asia program (an initiative of the Dutch Government's Special Envoy for International Water Affairs and the Netherlands Enterprise Agency), the City of 1,000 Tanks water alliance, led by Ooze Architects of the Netherlands, has developed a comprehensive set of in situ nature-based design and process solutions to address the issue of flooding and drought in a settlement located on the banks of the Adyar River though a community engagement process without resettling people. Box 6.2 summarizes these solutions.

Box 6.2: Nature-Based Solutions for Promoting Resilient In Situ Housing Programs

Design solutions for resilient habitat development:
- Understand flood paths and drain system to prevent flooding
- Design habitats with a system for water collection, recycling, and recharge
- Create decentralized sewage treatment and sanitation plans
- Pursue biodiversity-rich greening efforts
- Install climate proofing with ventilation addressing extreme heat situations
- Provide safe and well-lit community spaces with locally produced green electricity
- Establish disaster preparedness and emergency planning

Process solutions:
- Establish multidisciplinary advisory board
- Assess local resources (technical, human material, knowledge, flora)
- Develop localized disaster preparedness and emergency plans

Community engagement solutions:
- Form community task groups
- Promote local knowledge and participation
- Build a culture of codesign and cocreation (participatory planning)
- Involve the most marginalized group in the community to ensure a barrier-free environment

Because of the lack of funds and the absence of political will to implement the project, the plan is still in the design phase. Such innovative projects can be implemented through a community engagement process. Therefore, there is a need to innovate by adopting mixed models and nature-based solutions to minimize post-disaster resettlement.

Introducing spatial planning exercises for proximate resettlement. The government must recognize the link between housing and livelihood; proximate relocation should be the last option. Tamil Nadu should also replicate the provision of the Delhi Slum and JJ Rehabilitation and Relocation Policy of 2015 that mentions providing alternative accommodation to those living in informal settlements either on the same land or in the vicinity within a radius of 5 kilometers (Peter 2020).

One of the reasons the government has cited for not providing resettlement in the proximate area is the nonavailability of vacant or unused government lands for providing houses. If lands were available, the respective land owning department should agree to the land alienation process to hand over the land to the Tamil Nadu Urban Habitat Development Board for construction of houses for the vulnerable sections.

To identify and ensure availability of lands for proximate resettlement, it is critical to engage in planning exercises like the master plan process to earmark locations for affordable housing along with mitigation strategies to integrate public transport catering to the specific needs of the population resettled (Roychowdhury, Sareen, and Singh 2021). Governments can use strategies like a joint land identification exercise with the different land-owning departments. This process could be mandated under the policy to ensure that the issue related to availability of lands can be addressed.

Dedicated regulatory structure for quality control and monitoring. For the purpose of ensuring adequate housing with access to basic social infrastructure facilities, there is a need for an instructional mechanism and a regulatory structure to monitor the implementation of the program. This structure could also be an agency for coordination between different government departments/agencies and for convergence of services and schemes. In Hong Kong, China, the Housing Authority is the nodal authority for public housing provision, coordinating the activities of the housing department, resettlement department, and urban services department (Roychowdhury, Sareen, and Singh 2021).

The official website of the Housing Authority of Hong Kong, China mentions that the Housing Authority has 4 official members and 26 nonofficial members. There are also 6 standing committees, including the Building Committee and Audit Subcommittee. Likewise, the Housing Department of Hong Kong, China also has a separate committee to oversee the environment, health, and safety.

The Housing Authority of Hong Kong, China also has a specific process for community and stakeholder engagement. The authority has also recognized the roles of multiple stakeholders like nongovernmental organizations, media, educational and professional institutions, legislative and district councilors, residents, communities, business partners including supplies and contractors, and government colleagues and staff (Hong Kong Housing Authority n.d.).

While we are unable to access primary sources on the effectiveness of such mechanisms, adopting a multi-stakeholder approach will improve the scope of transparency and accountability. However, the risk of flooding of lobby and interest groups in the nonofficial members is a concern that should be offset by measures to increase the participation of communities, as they are the key stakeholders who will be enriching the process and who stand to benefit from the voices of communities being included in the decision-making process and improved quality of the housing programs.

Similar structures could be developed and strengthened in Tamil Nadu to address the issues related to evictions and resettlement and improve the overall quality of the housing program of the state. The role of the existing State and District Level Habitat Development Committees constituted by the Tamil Nadu Urban Habitat Development Board can be further strengthened by increasing representation from the Resident Welfare Association, women's groups at the community level, academicians, and civil society organizations. This will enhance participation of the vulnerable communities in the planning, implementation and evaluation of the housing programs. Likewise, the revival of the existing but defunct mechanisms like the Shelter Committee of the Chennai Metropolitan Development Authority and the High-Level Committee on Resettlement and Rehabilitation can further address the issue of post-disaster resettlement programs by strengthening the design and approval process and the quality of social and civic infrastructure facilities in the site.

Recognition of other relevant government departments as stakeholders can help in enhancing coordination between the agency providing housing services, the revenue department, the land-owning departments, planning agencies, urban local bodies, district administration, and social welfare agencies. Stronger connections between government stakeholders, civil society, and community based groups can also these groups to address many issues.

Community-centric monitoring processes like social audits can also be strengthened to enhance the participation of communities. The Tamil Nadu Urban Habitat Development Board has now commissioned educational institutions to facilitate social audits, and this process can be further strengthened by ensuring enhanced community participation by involving the Resident Welfare

Association and women's groups in the monitoring process. The social audits have to be institutionalized and implemented for all housing projects for the vulnerable groups irrespective of the project or fund.

Strengthen grievance redress mechanisms. It is important to set up independent grievance redress mechanisms for the disaster-affected families. In every district, an ombudsperson can be appointed by the government to ensure redressal of complaints in an unbiased and transparent manner. The existing social sustainability and grievance management framework the World Bank–funded First Tamil Nadu Housing Sector Strengthening Program should be applicable to all the projects irrespective of the project donor or the funding available. Box 6.3 provides the main requirements of this framework.

Box 6.3: Social Sustainability and Grievance Management Framework

- Strengthen the voice and participation of people
- Strengthen participation and consensus-building process
- Enhance transparency in the project execution
- Ensure that the voices of the most vulnerable—like women-headed households, elders, people with disabilities, and children—are heard
- Create a stakeholder consultative platform to ensure engagement during preparation, implementation, and operation and maintenance of projects
- Create grievance redressal mechanisms by forming a grievance redressal committee, creating an online grievance redressal system, and setting up a toll-free number to ensure timely addressal of grievances
- Ensure information disclosure through consultation meetings, workshops, and other communication materials
- Strengthen institutions by engaging in regular capacity enhancement programs

Capacity enhancement. To ensure that the post-disaster resettlement is minimized and the vulnerable communities are included in the recovery and rehabilitation process, including housing, it is important to enhance the capacity of the different stakeholders. Capacity enhancement of the officials from the housing and relevant line departments should be enhanced to introduce new typologies of affordable housing. This capacity enhancement should consider the specific housing demand and cultural context, identification of location, and preparation of an action plan (Roychowdhury, Sareen, and Singh 2021).

6.4.2 Integrating Housing in Disaster Management Plans and Mainstreaming Disaster Management Plans Policies Concerning Housing and Resettlement

Currently, the localized disaster management plans prepared by the Urban Local Bodies and the District Administration face the following challenges:

(i) The plans are prepared in a one-time ritualistic manner carried out in a top-down approach with no scope for review or development.
(ii) Vulnerability mapping exercises are not carried out as part of the disaster management plans.
(iii) The existing plans are not participatory; without involvement of vulnerable communities in developing the disaster management plan, there are no specific strategies or plans to reduce the risks faced by these communities.

To address these issues, participatory processes for preparation of disaster management plans must be developed. These plans should also be incorporated in planning exercises like master plans. These plans should be developed from the community level and feed into the plans at the city and state levels.

The Government of Tamil Nadu released a draft of a resettlement and rehabilitation policy in October 2021, but the policy is yet to be finalized. One of the key gaps in the draft is that the post-disaster resettlement and evictions based on court orders are not included. The draft has also not included a social and economic framework for addressing the long-term impacts of resettlement.

There is an emerging need for including disaster management and mitigation plans in the other laws and policies concerning housing and resettlement. A specific standard operating procedure should also be made available for post-disaster housing programs.

6.4.3 Institutionalizing Community-Led Planning, Implementation, and Evaluation Processes

Attygalle (2020) has described the process of community-led planning as community-owned, community-driven, community-shaped, and community-informed approaches. Adopting the principles of mutual respect, trust, and relationship in a nonjudgmental manner is the key step for ensuring a community-led initiative. Enabling collaboration between communities and other stakeholders and mechanisms can considerably reduce the delay in the recovery process and ensure inclusion of communities.

Institutionalizing community-led processes requires:

- Facilitating formation of community-based organizations from the settlement to the state level
- Constituting technical advisory committees involving representation from community-based organizations along with other experts to enhance participation of communities in planning, implementation, and evaluation
- Prioritizing intersectional issues by enhancing participation in the process by women, LGBTQ+ people, people with disabilities, elders, and children
- Formulating community consultation guidelines in the departments implementing housing programs
- Developing systems to facilitate social audit and transparency meetings to ensure accountability

A strong community-led approach will ensure that vulnerabilities decrease and resilience increases. The state should ensure that policy decisions like mass resettlement to sites located in environmentally sensitive, hazardous, interior, and remote locations are not carried out under the pretext of making cities resilient, disaster-resistant, and sustainable.

The human rights of the disaster-affected families are being violated with every resettlement. Therefore, there is a need for developing comprehensive legislation with a special focus on addressing vulnerabilities, emphasizing guidelines and minimum standards for relief and rehabilitation in accordance with international standards. All disaster management plans of the state should include provisions of, and comply with, the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Inter-Agency Standing Committee's Operational Guidelines on the Protection of Persons in Situations of Natural Disasters.

6.5 Conclusion

Post-disaster resettlements carried out under the pretext of making cities resilient, disaster-resistant, and sustainable are violating the human rights of the most vulnerable communities. Rather than improving their living conditions, it is pushing these communities into more vulnerable situations and hindering their opportunities for social mobility. For the success of any development programs for the vulnerable sections of society, enhanced participation can only lead toward success. Therefore, adopting a strong community-led approach will ensure reduction of vulnerabilities and increased resilience.

There is also a need for adopting a multipronged approach by introducing legal and policy safeguards to uphold the rights of the vulnerable communities by institutionalizing community-led mechanisms. Without a policy mandate, there will be no compulsion to include and consult communities in the process of resettlement. The resettlement process will continue to remain predetermined by the government departments, stifling the voices of the affected communities.

References

Attygalle, L. 2020. Understanding Community Led Approaches to Community Change. Canada: Tamarack Institute.

Bandyopadhyay, C., M. K. Bindal, and M. Manna. 2021. Chennai Flood 2015. New Delhi: National Institute of Disaster Management (NIDM), Ministry of Home Affairs, Government of India. https://nidm.gov.in/PDF/pubs/ChennailFlood_NIDM2021.pdf

Chaudhry, S., D. Kumar, A. Jaipal, A. Ayushman, D. Pal, and S. Devi. 2021. Forced Evictions in India in 2020: A Grave Human Rights Crisis During the Pandemic. New Delhi: Housing and Land Rights Network.

Coelho, K. 2014. Resettlement Projects as Poverty Traps. Pune: Infochange Agenda, Centre for Communication and Development Studies.

____. 2016. Placing the Poor in the Flood Path: Post-Disaster Slum Resettlement in Chennai. *The Caravan*. 3 January. Accessed 28 February 2022. https://caravanmagazine.in/vantage/placing-the-poor-in-the-flood-pathpost-disaster-slum-resettlement-in-chennai

Coelho, K., V. Peter, and A. D. Nundiyny. 2018. A Baseline Study on the Impacts of Resettlement in Gudapakkam, and Perumbakkam. Chennai: Tamil Nadu Slum Clearance Board (TNSCB) and Indian Council of Social Science Research (ICSSR).

ENVIS Centre. n.d. Coastal Profile in Tamil Nadu. ENVIS Centre, Government of Tamil Nadu. http://tnenvis.nic.in/Database/TN-ENVIS_900.aspx

Hong Kong Housing Authority. n.d. Stakeholder Engagement. https://www.housingauthority.gov.hk/hdw/en/aboutus/publication/sr0809/stakeholder-engagement.htm

Housing and Urban Development Department. 2011. Government Order Number 117. Housing and Urban Development Department (HUDD), Government of Tamil Nadu, India.

People's Tribunal Report. 2006. Voiceless No More. People's Tribunal Report on Housing Rights. Bangalore: Books for Change.

Peter, V. 2011. Status of Tsunami Housing in Tamil Nadu. Chennai: Information and Resource Centre for the Deprived Urban Communities (IRCDUC).

____. 2020. Analysis of the Existing Legal Framework on Right to Land and Housing for the Deprived Urban Communities in India. New Delhi: Information and Resource Centre for the Deprived Urban Communities and Indo-Global Social Service Society.

Peter, V., and R. M. Alvino. 2010. The World Bank and Disaster Relief. In M. Kelley and D. D'souza, eds. *The World Bank in India: Undermining Sovereignty, Distorting Development*. Chennai: Orient Blackswan Private Limited.

Peter, V., and S. Chaudhry. 2017. From Deluge to Displacement: The Impact of Post-Flood Evictions and Resettlement in Chennai. New Delhi: Information and Resource Centre for the Deprived Urban Communities (IRCDUC) and Housing and Land Rights Network (HLRN).

Peter, V., and R. Muralidharan. 2021. Policy Perspectives on the Existing Development Programmes and Its Implication on the Vulnerable Sections. Chennai: Tamil Nadu, Information and Resource Centre for the Deprived Urban Communities (IRCDUC).

Peter, V., and A. D. Nundiyny. 2018. Access to Childcare, Education, and Nutrition Services in the Relocation Settlements of Perumbakkam, and Navalur in Kancheepuram District, and Gudapakkam in Tiruvallur District. New Delhi: Information and Resource Centre for the Deprived Urban Communities (IRCDUC).

Peter, V., A. D. Nundiyny, and S. Chaudhry. 2019 Deprivation by Design: An Assessment of the Long-Term Impacts of Forced Relocation from Porur Lake, Chennai. New Delhi: Information and Resource Centre for the Deprived Urban Communities (IRCDUC) and Housing and Land Rights Network (HLRN).

____. 2021. Assessing the Impacts of Resettlement on Livelihoods of Families in Perumbakkam, Chennai: Integrated Cooum River Eco-Restoration Project. New Delhi: Information and Resource Centre for the Deprived Urban Communities (IRCDUC) and Housing and Land Rights Network (HLRN).

Roychowdhury, A., R. Sareen, and M. Singh. 2021. Mass Housing and Liveability: Mapping of Ground Reality. New Delhi: Centre for Science and Environment.

United Nations. 2007. Basic Principles and Guidelines on Development-Based Evictions and Displacement. https://www.ohchr.org/sites/default/files/Documents/Issues/Housing/Guidelines_en.pdf

CHAPTER 7

Identifying Victims' Losses from the Black Saturday Bushfires in Australia

Jyoti Shukla and Piyush Tiwari1

7.1 Introduction

The impact of bushfires on human well-being extends beyond the loss of assets. The asset-based compensation approach that the governments adopt for reconstruction of losses is marred with challenges in identification of eligible claimants, compensable losses, and value of losses. This research identifies non-asset losses faced by affected persons during the Black Saturday bushfires in 2009 in Victoria, Australia under a theoretical framework underpinned by Sen's theory of justice or the "capability approach." The chapter argues for widening the scope of post-disaster reconstruction to include all "functionings" (or states of well-being).

The impact of disasters on affected people lasts beyond the immediate destruction of their possessions, disruption to livelihood, and loss of life. Disasters can influence long-term social and economic development, with the well-being of the poor affected most severely. In post-disaster contexts, the widely adopted "build back better" approach promotes sustainable development by integrating a wide range of vulnerability reduction measures into restitution efforts (McCaughey et al. 2018). However, many of these efforts have resulted in unintended consequences. In Aceh, Indonesia, the post-tsunami reconstruction that focused on rebuilding in place to reduce social disruptions due to mass relocations did not have the desired effect, as people preferred to live away from coastal areas (McCaughey et al. 2018). In fact, this reconstruction approach resulted in social segregation; house prices in coastal locations fell, and those houses were then occupied by the poor, compounding the risk and vulnerabilities of those who live in disaster-prone areas. In the case of areas affected by Hurricane Katrina in the United States, the effect on poor people was severe as they faced significant barriers to return (Fussell 2015). Analyzing the satisfaction among post-disaster resettled communities in Sri Lanka, Dias, Keraminiyage, and DeSilva (2016) find that a sustainable resettlement program is not merely reconstruction of a set of houses; it should reestablish the socioeconomic and cultural life of people. In this context Sina, Chang-Richards, and Wilkinson (2019) argue that building livelihood resilience to natural disasters is important to sustain income and economic development in disaster-affected areas. This requires early recovery income support, physical and mental health, ability to transfer to other jobs/skills, and availability and timeliness of livelihood support, together with its cultural sensitivity and governance structure (Sina, Chang-Richards, and Wilkinson 2019). In the People's Republic of China, after the 2008 Sichuan earthquake, Yang et al. (2018) find that livelihood changes that resulted from the earthquake led to a significant reduction in "human well-being."

Bushfires are major disasters causing destruction and displacement of Australians every year. According to an estimate by du Parc and Yasukawa (2020), between July 2019 and February 2020, 65,000 new displacements were triggered by bushfires. These bushfires caused destruction to 3,100 homes (du Parc and Yasukawa 2020). Given the history of occurrences of bushfires, Australia has designed policies to respond to them. A major policy that guided response to bushfires has been prepare, stay, and defend or

[1] The authors would like to thank Siobhan Hutchings for excellent research assistantship and Museums Victoria for granting access to the interviews. The discussions with Liza Dale-Hallett during the initial phase of research were insightful. The authors are responsible for any error in interpretation of data.

leave early (PSDLE). As per the policy, Australian fire services had advised residents to either prepare to stay and defend their properties against bushfires, or to prepare and leave before a fire arrived in their area. PSDLE guided the immediate response to the bushfires in 2009 as well. However, because of the scale of destruction and loss of life that followed the 2009 bushfires, the policy came under scrutiny. In their study, Whittaker et al. (2013) report that persons affected by the bushfires in 2009 expressed that life is more important than property. They viewed leaving as a better option than staying and defending their properties. The risks from staying were too high.

Leaving is a complex decision with space and temporal dimensions, as it is not always clear where to go and how long it will take to return. Displacement is associated with social, economic, and personal costs over the short and long run that are usually not considered in formal post-disaster reconstruction processes. In 2018, Australia developed a disaster risk reduction framework. The Australia Disaster Risk Reduction Framework addresses all phases of disaster prevention, mitigation, and preparedness, emergency response, and recovery and rehabilitation, and it specifies the roles of governments and other stakeholders. It is still inadequate in its articulation of non-asset-based well-being losses of disaster-affected persons.

The current formal mechanisms through which the losses to affected persons are rebuilt after disasters are through the private insurance that people hold for their house and other assets. Nonetheless, as Alston, Hargreaves, and Hazeleger (2018) note, the haste to rebuild homes and the anxiety of making insurance claims and their procedural requirements have led some people to make decisions that are not prudent in long run. Immediately after disaster, people's decision-making ability is weak (Alston, Hargreaves, and Hazeleger 2018). After the 2009 bushfires, the bureaucratic response to rebuilding alienated the affected people, which increased the sense of loss of autonomy (Alston, Hargreaves, and Hazeleger 2018). Another challenge with post-disaster reconstruction immediately after the disaster is the focus on tangible losses associated with assets and infrastructure and restoration of services. Place as a total concept gets ignored, resulting in a piecemeal approach to reconstruction (Alston, Hargreaves, and Hazeleger 2018). Rebuilding and assisting people who survive the disaster involves much more than rebuilding infrastructure and takes time (Alston, Hargreaves, and Hazeleger 2018).

This chapter, with a focus on the restitution of well-being losses of affected individuals, provides the empirical data needed to inform a shift from the asset-based recovery and rehabilitation approaches of government and nongovernment agencies in Australia to practices that also emphasize reinstating the capabilities of individuals after bushfires.

7.2 Black Saturday Bushfires of 2009

The risk of bushfires in Australia is one of the highest in the world, and the state of Victoria is the most prone to bushfires. In spite of its small land mass compared to any other state in Australia, Victoria has endured almost half of the economic damage from bushfires (Buxton et al. 2011). The bushfires that occurred on 7 February 2009, which came to be called the Black Saturday bushfires, claimed 173 lives and engulfed 2,000 houses (Whittaker et al. 2013). The weather conditions on 7 February were conducive to fires, and the day witnessed more than 400 fires across Victoria (Whittaker et al. 2013).

These fires dealt a heavy financial, social, and personal blow to communities living in rural locations and on urban fringes (Caruana 2010). The drought that had preceded the bushfires had already weakened the economic position of these communities. The destruction caused by the Black Saturday fires was evident in the damaged landscapes, disrupted livelihoods, displacement of families, fully or partially burnt homes, destroyed infrastructure, and disruption to services including education

(Alston, Hargreaves, and Hazeleger 2018). The government responded by setting up three temporary villages in communities that had been badly affected, but this meant people were displaced from their homes for an uncertain period of time (Alston, Hargreaves, and Hazeleger 2018). Facilities such as a community dining hall were set up, which was supported by a nongovernment organization and was run by local women. The community hall was also used to provide services such as counselling and for providing information concerning various services (Alston, Hargreaves, and Hazeleger 2018). Many of these activities were meant to provide temporary services and meet the needs in the short run. By nature, they did not involve any activities that could address the long-run effects of the disaster on affected persons.

7.3 A Framework for Identifying Losses

A growing body of literature has been arguing for the expansion of assessment of disaster losses beyond asset-based models to include broader dimensions of human well-being (Hallegatte et al. 2017; Walsh and Hallegatte 2019; Tiwari and Shukla 2022, 2023). Although the traditional measurement of economic losses in terms of the loss of buildings, infrastructure, equipment, and agricultural production is useful in guiding post-disaster recovery strategies, it excludes non-asset well-being losses, reconstruction of which has a significant impact on the recovery of affected persons. Empirical research by Walsh and Hallegatte (2019) in the context of Typhoon Haiyan in the Philippines suggests that well-being losses have far exceeded asset losses.

The focus of reconstruction on tangible losses (assets) is logical, as these can be observed and assessed. Intangible losses such as the loss of life, mental and physical health, culture, identity, place, autonomy, impact, opportunities, physical security, affiliation, self-worth, social unity, and dignity are far less evident and are difficult to quantify (Alston, Hargreaves, and Hazeleger 2018). Often, these are excluded in the assessment of losses and are not included in insurance claims (Alston, Hargreaves, and Hazeleger 2018).

In estimation of the impact of disasters, economic impacts are easier to measure because the assets and flows they refer to are transacted in markets and hence are the focus of estimation (Stephenson 2010). Literature, however, suggests that asset-based approaches have two noticeable lacunas: firstly, they overlook many aspects of human well-being such as psychological health and social capital (Murakami et al. 2020); and secondly, they induce an implicit bias toward richer households and geographies so that recovery investments go to them and exclude the poor (Walsh and Hallegatte 2019). Asset-based approaches to post-disaster recovery use traditional income-based measures of welfare, inviting the criticism that they ignore many other dimensions of human welfare and societal progress (Stiglitz, Fitoussi, and Durand 2018; Michalos 2011; Binder 2013). This chapter attempts to fill the gap by identifying the non-asset losses of affected persons, which may require mechanisms from social work to address them.

Amartya Sen's capability approach has emerged as the most promising framework for examining human welfare (Sen 1979). To explain the difference between traditional welfare economics and the capability approach, traditional welfare economics equates well-being to utility, which is measured in terms of income and resources. In contrast, the capability approach identifies well-being with "capability" and "functionings" (Sen 1987). Here "functioning" means the state of "being or doing" such as being well-nourished and being well-sheltered. Hence, functioning is the act of using a resource or the state of wellness achieved through its use and should be distinguished from both (i) the resource, which is in use, and (ii) the happiness resulting from the act of using the resource (Sen 1987). "Capability," on the other hand, is the set of valuable functionings that a person has effective access to.

The capability approach emphasizes that it is important for people to have choices to enhance their well-being, "abilities" to facilitate realization of well-being, and "opportunities" to allow access to and use of abilities and choices (Acharya 2018). The application of the capability approach in analyzing disaster risks is increasing (Murphy and Gardoni 2008, 2010; Tiwari and Shukla 2022). Sen (1987) explains how capability and "functionings" are created by individuals through combining resources with their personal, familial, social, economic, and political characteristics. When seen through the lens of the capability approach, for a satisfactory recovery after a disaster, it would be crucial to reinstall at least the central "capabilities" and "functionings" necessary for a decent quality of life, through the combination of both monetary and nonmonetary resilience mechanisms (Murphy and Gardoni 2008). Nussbaum (2007) builds on Sen's discussion and identifies 10 central capabilities necessary for well-being (Table 7.1).

Table 7.1: Central Human Function Capabilities Necessary for Human Well-Being as Identified by Nussbaum

Capability	Description
Life	Being able to live to the end of a human life of normal length; not dying prematurely, or before one's life is so diminished as to be not worth living
Bodily health	Living with good health, and not in a state where ill health seriously affects the quality of life Having access to medical help as needed Being able to have good food and to exercise in ways that sustain health
Bodily integrity	Being able to move freely from place to place; to be secure against violent assault, including sexual assault and domestic violence Having opportunities for sexual satisfaction and for choice in matters of reproduction
Senses, imagination, and thought	Being able to use the senses, to imagine, think, and reason and to do these things in a truly human way, a way informed and cultivated by an adequate education, including, but by no means limited to, literacy and basic mathematical and scientific training Being able to use imagination and thought in connection with experiencing and producing works and events of one's own choice, religious, literary, musical, and so forth Being able to use one's mind in ways protected by guarantees of freedom of expression with respect to political and artistic speech and freedom of religious exercise Being able to have pleasurable experiences and to avoid unnecessary pain
Emotions	Being able to have attachments to things and people outside ourselves; to love those who love and care for us, to grieve at their absence; in general, to love, to grieve, to experience longing, gratitude, and justified anger Not having one's emotional development blighted by fear and anxiety (Supporting this capability means supporting forms of human association that can be shown to be crucial in people's development.)
Practical reason	Being able to form a conception of the good and to engage in critical reflection about the planning of one's life (which entails protection for the liberty of conscience)

continued on next page

Table 7.1 *continued*

Capability	Description
Affiliation	A. Being able to live with and toward others, to recognize and show concern for other human beings, to engage in various forms of social interaction; to be able to imagine the situation of another and to have compassion for that situation; to have the capability for both justice and friendship (Protecting this capability means protecting institutions that constitute and nourish such forms of affiliation, and also protecting the freedom of assembly and political speech.) B. Having the social bases of self-respect and non-humiliation; being able to be treated as a dignified being whose worth is equal to that of others (This entails protections against discrimination on the basis of race, sex, sexual orientation, religion, caste, ethnicity, or national origin.)
Other species	Being able to live with concern for and in relation to animals, plants, and the world of nature
Play	Being able to laugh, to play, to enjoy recreational activities
Control over one's environment	A. Political. Being able to participate effectively in political choices that govern one's life; having the right of political participation, protections of free speech and association B. Material. Being able to hold property (both land and movable goods); having the right to seek employment on an equal basis with others; having freedom from unwarranted search and seizure In work, being able to work as a human being, exercising practical reason and entering into meaningful relationships of mutual recognition with other workers

Source: Adapted from Nussbaum (2007).

Examining losses through Nussbaum's core capabilities could overcome the challenges identified in the literature. The capabilities approach could provide a framework for identifying losses that affected persons face after a disaster. A prudent effort to reconstruct losses should aim to restore these capabilities.

7.4 Data and Methodology

This chapter uses the data from a survey conducted during May through September 2010 by Museums Victoria using semi-structured interviews of persons and social workers affected by the 2009 Black Saturday bushfires. Two interviews were conducted later—one in 2011 and the other in 2012. Eighteen in-depth interviews were conducted, each lasting about 60–90 minutes. The profile of interviewees is presented in Appendix 7.1. For confidentiality of respondents, the identity of respondents has been anonymized. In discussion, interviewees have been referred to as P1, P2, ..., P18.

Conceptual content analysis was used to analyze the interviews and examine how individuals' well-being was affected by the bushfires. Firstly, codes were assigned to the relevant text inductively. The text was considered relevant if it referenced an interviewee's well-being, a change in well-being, or factors that influenced their well-being. Since the focus of this chapter is on non-asset losses, factors that purely influence individuals' financial well-being (for example, destruction of property) were not considered in the analysis.

Next, the codes were sorted into 11 categories based on the codes' relevance to Nussbaum's (2007) capabilities for well-being. The categories were life, bodily health, bodily integrity, senses, imagination and thought, emotions, affiliation (A), affiliation (B), other species, play, control over one's environment (A), and control over one's environment (B). Coding was conducted individually by researchers.

To further reduce the data, a chart was created for each interviewee. This chart contained the codes referenced by the interviewee and illustrative quotations that conveyed the interviewee's original meaning. A final summary was constructed documenting "key" codes. The "key" codes were mentioned by several participants and/or by interviewees with unique insight into specific sectors' well-being (for example, a teacher's comment on how children's learning development was affected).

7.5 Results and Discussion

7.5.1 Life

Being able to live life to the full length of a normal life and without it being reduced to a life not worth living is an important capability that Nussbaum (2007) identifies. However, the deaths that resulted from the bushfires of 2009 affected survivors' confidence to live normal lives. Table 7.2 reports that the negative impact of loss of lives due to bushfire was mentioned by 9 interviewees. P7 expressed their feeling of despair and helplessness as "I could handle people losing a house and possessions, which is hard, but there really was a death toll that made me break down, lots of times." Others reported similar feelings.

7.5.2 Bodily Health

To be able to lead a good life, being healthy is important. The impact of trauma due to the bushfires has short- and long-term impacts on the physical and mental well-being of affected persons. Davidson and McFarlane (2006) found that disasters that have a high occurrence of physical injury, threat to or actual loss of life, destruction of property, financial problems, and lack of human care result in psychological harm. The immediate effect, recounted by 5 interviewees, on physical health was evident. P13 stated that "by the end of the month I was bleeding from the throat and had to go to a specialist," and in words of P13, "Persons with asthma or ... breathing problems ... were suffering from the smoke."

The long-term impacts persist, affecting mental health. P18, who had also faced the Ash Wednesday bushfire in 1983 in South Australia, recounted the negative psychological effects that were persistent even 25 years after the disaster. In their words, the "psychological trauma that we've encountered over our life, and you see it, and that was born out of Ash Wednesday fires."

The quality of living conditions deteriorated after the bushfires, and as P2 stated, "we were just living like ... in the 1920s." Exhaustion and fatigue were some other symptoms caused by lack of sleep, as P7 recounted that "I can just remember that was the first time in 4 weeks that I actually slept and I got more than a 2-hour block of sleep."

7.5.3 Bodily Integrity

Bodily integrity refers to the capability of being able to change location freely (Nussbaum 2007). However, during the period after the bushfires, people in the affected areas faced heightened concerns related to safety and security. P18 shared that "the kids couldn't go to school because the road was closed." The feeling of insecurity was prevalent, as P5 stated that "You didn't know here you were

safe, anywhere." What is usually assumed and taken for granted about safety could not be expected. Children were worst affected as "everything that was a given and a safety barrier and a safety net for these kids was destroyed, temporarily" (P17).

Manifestation of the effects of disasters on children are immediate and long-term. In the aftermath of the bushfires in 2009, children reported depression, separation anxiety, and reexperiencing of the event via nightmares (Alston, Hargreaves, and Hazeleger 2018). Adolescents reported anxiety and depression, substance abuse, change in attitude to take risk, aggressive behavior, and incoherent thinking (Fullerton and Ursano 2005). These symptoms persist for a longer period; McFarlane (1987b) reported that after the Ash Wednesday bushfire, children still showed symptoms of depression after 26 months.

7.5.4 Senses, Imagination, and Thought

The ability to use one's senses to imagine, think, and reason in a truly "human way" is an important capability that contributes to well-being (Nussbaum 2007). The negative impact of the bushfires on people extended to their normal functioning, as expressed by P17: "It [the shock that followed the bushfires] just consumed your ability to function. And to do the normal stuff that you take for granted." The loss of history affected the ability to have pleasurable experiences and caused pain. The pain was evident in the words of P10: "There is no history left. It all went up in the fire. All of those generations from the hall, the school, every house that our ancestors lived in, all the records, everything was destroyed." The experience of disaster also fueled creative art expression, as P15 stated, "I think [of] creative ways of expression after periods of trauma." The learning abilities of children also suffered as their comprehension ability was affected due to the fear and trauma caused by the bushfires. P17 highlighted this concern during the interview and stated that "Children appear to be learning and functioning well … but when you scratch below the surface, there are all these gaps of things that haven't stuck."

7.5.5 Emotions

The ability to have attachment and express love, grief, or anger is a capability that contributes to well-being (Nussbaum 2007). Positive emotions contribute positively while negative emotions do precisely the opposite.

Emotional exhaustion and a sense of hopelessness was evident among those who were affected by the Black Saturday bushfires. Dealing with post-disaster chores required people to handle multiple non-routine tasks. P5 expressed their angst: "I was sick. I got really sick, I was burning the candles at both ends, more or less. Trying to keep my business afloat, trying to deal with police who wanted statements …" The feeling was pervasive among many. P15 expressed similar sentiments when they said that they "found it very hard to get a normal heartbeat [during period after the bushfires and in dealing with post-disaster recovery], found it difficult to breathe normally, and I knew I wasn't coping."

Fear of losing someone was a major emotional burden that people carried, as they were often unsure of the well-being of those they cared for. P6 recalls that after the bushfires "it sort of went round that we'd perished. … It was a bit emotional when we [interviewees and their "mate"] met in the middle." Since there were deaths due to the bushfires and the community was small and well connected, the atmosphere of grief that followed was emotionally unsettling for a prolonged period. P15 expressed that it was "very hard driving the roads and knowing who'd passed away."

Alston, Hargreaves, and Hazeleger (2018) note that the physical environment has emotional importance for those who live there. When a place is damaged, not only does the physical destruction affect people, but it also erodes the sense of "self" as the connection to "place" erodes. Memories are built over time, and people associate value with memorabilia that they accumulate over time. Loss of these items due to disaster wipes out memories created over time. P16 mentioned the impact of such loss when they said, "My mum had come to live here with us, and she brought with her the things she brought from England ... that was the things that we did lose. It was her memories." Memories that were created over time were lost, leaving feelings of helplessness and despair. P6 lost their farm and were unable to come to terms. Their feelings were evident when they said that "the thing that really gets you—we've been here for 40–50 years, working our hearts out, getting into a nice little farm, a nice little farm, and all of a sudden, it's all gone." The durability of the aftereffect of a disaster continues to affect people emotionally. The psychological distress that it caused was expressed by interviewees. P5 expressed hopelessness in their words: "The damages [caused by the bushfires] do take on a victim mentality and from thereon, it's very difficult to move forward ..."

Disasters impact the self-esteem of affected persons, and this could occur in many ways. The need to accept help sometimes creates a feeling of shame and embarrassment, which adds to psychological distress. P12 mentioned that the feeling of being "embarrassingly grateful for the small amount of help" was affecting their self-esteem. Vigil and Geary (2008) find that the greater the reliance of a family on external support, the more the psychological well-being of adolescents in the family is reduced. This was much more evident among young people who reported lower self-esteem and psychological distress and who displayed signs of depression relative to other families who were not in need of help (Vigil and Geary 2008). Though relief services are essential after disasters, it is important to balance these to avoid affecting the role and function of a family (Caruana 2010).

Literature that examines hope argues that hope is a defense against negative emotions (Lazarus 1991). Lazarus (1991: 282) argues that hope is "yearning for amelioration of a dreaded outcome." Despair is the opposite emotion that creeps in, resulting in abandonment of hope (TenHouten 2022). Personal characteristics of affected persons and the social environment play an important role in affecting these emotions. Some interviewees expressed hope. P11 expressed, "You take what happens on your shoulders and keep moving. And forget about the what-if. Let's make this into something better." There was a desire to move forward and use hope as an emotion to enable that. P11 expressed that "I think if you class yourself as a victim, then you're all inside yourself. You're feeling sorry for yourself." P13 also echoed, "I hate that word [victim]. And I refuse to use it. They're [affected persons] survivors. [Considering oneself as a victim doesn't allow 'victims'] the opportunity to move on from there." Women were far more resilient and hopeful about future; as P17 expressed, "a lot of men have not yet sought any additional help. It's a bit of a no-go zone for men." Adding nuance to the picture of women's coping with the disaster, Alston, Hargreaves, and Hazeleger (2018) find that after the bushfires of 2009, women also noted their own anxiety issues and some suffered regular panic attacks.

7.5.6 Affiliation (A)

Affiliation is the ability to live with others and show concern toward them (Nussbaum 2007). The research of Caruana (2010) finds that experiencing three or more stressful life events within a short period of time can unsettle the functioning of family life. These could result in positive or negative outcomes. In a study involving families affected by the 1983 Ash Wednesday fires in southern Australia, McFarlane (1987a) found that 26 months after the event, families were much closer to each other and demonstrated that they had shared goals. However, this was not the case in the early months following the disaster. Over time, already existing strong external social links that the family had became stronger, while weak social links weakened further (Bolin 1976). Anecdotal evidence also suggested that in the

post-disaster period, incidences of intimate partner violence, child abuse, and sexual violence increased (Caruana 2010).

Support in the form of comfort, safety, or material aid from family members or extended kin help affected persons in rebounding from the disaster psychologically (Bolin 1976). In a study on families affected by the bushfires, McFarlane (1987a) finds that families who did not share their immediate reactions to the disaster with each other found the long-term adjustment challenging. Single parent families who lacked resources in the first place were more at risk of impairment and felt the loss of social supports more severely (Solomon and Smith 1994).

The data from the interviewees who experienced the bushfires of 2009 indicates that the affected persons wanted to be with others who were also affected by the bushfires. This desire was strong, as they felt affiliated with those who were in a similar situation. In the expression of P7, when they said that "there was a renewed sense of wanting to be here and wanting to be with these other people ... we needed to be with people who understood where we were at, who'd been through it," the trust and bonding that was formed between affected persons was evident. Affected persons were able "to trust others in the same boat as you and [they believed] that we [they] could together get through it [the trauma and loss after the bushfires]" (P15). Concern and care demonstrated by social workers and others who are involved in post-disaster reconstruction work is also important for recovery. P4 recalls that a forensic police officer "was really lovely to talk to. She was very caring, and certainly not [taking a] strict and formal police type approach to things."

The bonding within the community and the gesture of care that its members show toward each other has a positive impact on well-being. The development of deeper relationships, compassion, resilience, and spirituality, as well as an enhanced appreciation of life, can be some of the positive outcomes flowing from the experience of an adverse event. Caruana (2010), in their study, report stronger friendships, marriages, and community ties being forged in hard times. The positive effect of care from members of community was recalled by P7 in their interview: "People would walk up to us in the main street and give her [their daughter] a bag of toys." These actions of community members contributed to strengthening bonding and the recovery process. People felt affiliated with the community. P11 expressed that feeling "I've never seen ... so close to tears. He couldn't believe that somebody had been so generous."

Lack of affiliation, particularly from government officials, builds a sense of being unheard or ignored. Despite the best intentions, rebuilding efforts of government are despised. P18 recounted such incidents: "Every politician wanted to come up here for a photo opportunity. They'd listen to your story but you'd see their eyes start to glaze over, and they actually had no understanding of what you'd been through."

7.5.7 Affiliation (B)

Nussbaum (2007) attributes the ability to have self-respect and not to be humiliated by others as an important capability necessary for well-being. During the reconstruction work that followed the bushfires, while social workers who were involved "were all very ... respectful" (P16) toward affected persons, the approach of media was far from it. As P17 recounted her experience, "They (media) wanted me to read it [an account of the impact of the bushfires on family] out, giving the true impact of the story. ... It was an awful position to be in." They felt that many had "lost dignity." Alston, Hargreaves, and Hazeleger (2018) noted similar reaction particularly among women who thought that the interventions of groups including government who sought community views during consultations were artificial. Later in the implementation of programs or in the design of relief, the views of communities were ignored, which increased the feeling of distrust (Alston, Hargreaves, and Hazeleger 2018).

7.5.8 Other Species

The ability to live with other animals, plants, and the natural world is a crucial capability for well-being (Nussbaum 2007). Households who live near the bush live there because they value their proximity highly. Animal lives lost and the burnt pastures affected the capability to live with other species. The impact on well-being was immense. One of the respondents described the impact of the bushfires on animal lives, and from the respondent's expression, it was clear that it had a negative impact on their well-being.

P11 described the state of animal life and the landscape that had been burnt: "There were so many that died [animals]. We rescued a heap of koalas, but a heap of those koalas got put down ... and [kanga]roos or wallabies ... they got put down." Further, they stated that "If you look at the way the pastures were before the fires, where everything was brown, every single thing every shade of brown. It's, yeah, it's very devastating ... isn't it?"

7.5.9 Play

The ability to play, laugh, and enjoy recreational activities was severely curtailed, partly out of lost interest and partly due to being drawn into meetings related to reconstruction work. P13 stated that there was neither interest nor time: "We hardly saw a news program, hardly saw a newspaper, didn't have time to read the newspaper even if we saw one."

For children, the loss of their childhood and associated activities was profound. P2 articulated that "She [daughter] is one that really did lose 12 months of her life ... she had her sister's things, she had a cubby house [in the garden] and that she was utilizing to the maximum, and all of a sudden she's got nothing [as it was burnt down by the fire]. And 12 months later, you find yourself thinking, so you rebuild it? Well, no, she's got 6 months really before she goes to school. ... It's not worth building another cubby house."

The resentment among affected persons took the form of dark humor, which was not conducive for well-being.

7.5.10 Control Over One's Environment (A)

The ability to have a political voice is a capability that Nussbaum (2007) argues is necessary for well-being. In the aftermath of the bushfires, the lack of consultation with affected persons distanced them from the reconstruction process and caused dissatisfaction. Even when an opinion was expressed, it did not make a visible difference that would result in buy-in from affected persons. P5 expressed their disappointment: "I voiced my opinion, it was just to thin air, it feels like [that] because there has been no response from anyone." During reconstruction, affected persons were required to provide various documents to prove their identity or access their claim. During the bushfires, many documents were lost, and this made it difficult for affected persons to prove their identity. P17 described "the reality that people didn't have their insurance paperwork, they didn't have licenses, not access to money."

Gender-focused research and reports from across the world provide strong evidence that women and men are affected in different ways. Issues such as the increase of violence against women during and after disasters signal the need for a gendered response. The haste to rebuild tangible things without careful analysis can result in the reinstitution of social and gender inequalities and a reconfiguration of new problems (Alston, Hargreaves, and Hazeleger 2018).

7.5.11 Control Over One's Environment (B)

The ability to own property or seek employment is a capability that allows a person to take control of their life. In the immediate period that follows a disaster, affected persons face homelessness, vulnerability to lawlessness, and the threat of epidemics. Living in temporary accommodation that takes them away from social networks negatively affects recovery (Caruana 2010). During the bushfires, many lost their productive assets, which made it difficult for them to establish control over their environment. P6's exasperation on their loss of control was evident in their expression: "We don't have 50 years to start again [on the farm], we're in our 60s ... it's a hard picture."

Disasters cause not only the loss of productive assets, but also the loss of many other capabilities. As Caruana (2010: 84) explains, "When drought threatens the viability of a family farm, it threatens more than a livelihood and a workplace, but also a home, a lifestyle, a family tradition, an asset to pass on to future generations and hence, for many, a sense of self." The negative consequences extend to mental and psychological well-being, and even unwilling change to the livelihood. In the context of drought, Sartore et al. (2008) found that women were seeking employment off the farm, resulting in them becoming less accessible to their children. Children were expected to contribute to farmwork as the financial situation of their families worsened (Alston 2007). Other unintended consequences included delayed retirement among farmers, which led in some cases to conflict over farm succession. The devastation also affects the cultural and spiritual control, particularly for the Indigenous peoples. The Rena oil spill in New Zealand in 2011 increased the vulnerability of Maoris (Alston, Hargreaves, and Hazeleger 2018).

Table 7.2: Core Capabilities, Their Interpretation, and Frequency of Reference in Interviews

Themes	Subtheme	Count
Life	Loss of life	9
Bodily Health	Fire had long-term effects on mental health	5
	Fires inflicted short-term physical injuries	5
	Fires reduced quality of interviewee's living conditions in the long term	3
	Exhaustion during fire and repairs	4
Bodily Integrity	Roadblocks prevented travel unnecessarily	8
	During fire, interviewee didn't feel safe anywhere	3
	Lost childhood innocence, became aware of safety threats	1
Senses, imagination, and thought	Around/during the fire, people found it difficult to think clearly and perform simple tasks themselves	6
	Disaster experience has fueled artistic expression	4
	Lost history, as town landmarks were destroyed that won't be recovered	2
	Disruption to children's learning development (Swiss cheese effect)	1

continued on next page

Table 7.2 *continued*

Themes	Subtheme	Count
Emotions	Short-term emotional distress during fires and repairs	6
	Fear for loved ones' safety during fires	7
	Grief experienced from losing loved ones in fire	3
	Lost possessions with sentimental value	5
	Lost property with sentimental value	5
	Long lasting emotional trauma from fires	6
	Psychological distress (feeling hopeless) from "victim" mentality	2
	Psychological distress (shame/embarrassment) from being a victim/needing help to recover	4
	Interviewee held on to a sense of hope and optimism in response to fire	4
	Disliked being labeled a victim, believes it creates a harmful mentality	3
	Men in community not seeking emotional support	3
Affiliation (A)	Fires and the process of rebuilding brought community closer together	11
	Emotional support provided by connecting with others experiencing similar losses	5
	Authorities/volunteers were compassionate toward victims	3
	Emotional/nonemotional support provided by community	8
	Lack of empathy from politicians	1
Affiliation (B)	Treated with respect by recovery staff/volunteers	1
	Media lack of integrity for survivors' situation (not empathizing or misreporting stories)	2
	Interviewee believed support funding wasn't fairly distributed	1
Other Species	Death of native/domestic animals	5
	Loss of natural environment	10
Play	Lost recreational time during fires	3
	Children lost possessions that make up important memories in their childhoods and couldn't reasonably be replaced after the fire	1
	Sense of humor retained despite disaster	4
Control over one's environment (A)	Community's opinion on roadblocks was not considered	2
	Cynical that government/commission will make effective change in response to the fires	6
	Identification lost in fires meant interviewee faced difficulty proving identity	3
Control over one's environment (B)	Red tape prevented people from receiving support needed	3
	Investments lost that people do not have the time/resources to ever recoup	4

7.5.12 Connection with Place of Residence

Households who lived in communities around the bush valued their place of residence and the bonds that were formed among the members of community. These contributed to capabilities that are important for well-being. Analysis of interviews allows identification of these capabilities. In the post-disaster reconstruction process, it is necessary that the residence and location is restored as early as possible to develop lost capabilities. Table 7.3 presents the count of references that affected persons made to residence and location in ways that they had reasons to value.

Emotions. People who lived near the bush were aware of the dangers associated with fire. The value that they associated with living near the bush outweighed the dangers. They also prepared themselves, should there be a fire outbreak. P7, who had faced Ash Wednesday in 1983, mentioned that "we were aware of bushfires. I remember Ash Wednesday, so I was aware that living in that community can be dangerous and we also went to lots of CFA meetings." They were willing to take risks and prepare themselves to defend against fire for the emotional benefit that they received by living near the bush.

Affiliation (A). The community was closely connected. Members of the community cared for each other. This was very different than living in suburbs in cities. P8 expressed the value of community as an important factor in their move to live near the bush. According to them, "it was very community minded. It is only one of the first validations of our move. It was the antithesis of life in Doncaster, which was very close, proscribed, very little community." Households who live in bush communities are involved in community life, as P11 articulated that they are "very much involved in the community and it pays off, you know. You get back two for every one you give." Social facilities like schools play the role of meeting place where residents interact with other members of society and also support each other. Even after the bushfires, schools continued to play the role of meeting space for community, as P17 explained: "School has always been the safe place. It's always been the place you come to when you just need a bit of advice or have a bit of a sounding board on things. And that was still the case [after the bushfires]."

Other species. Living near the bush contributes to the capability of being able to live with concern for other species. P1 expressed their association with the koala that they had rescued during the bushfires: "We had a deep affinity for ... koala and its baby that we rescued." The association with other species is deep and emotional, as expressed by P7: "People who live out here, who live in the bush, live in the bush because they love trees and we don't want to get rid of our trees."

Play. The place is also valued because it offers residents opportunities to play and pursue recreational activities. Various interviewees expressed the contribution of place: "Out here it's free and open. Beautiful. Lovely. That's what we like about it" (P6). "Just living a simple life, which, to me, had always provided a balance from my ... work" (P8).

The bushfires caused disruption to these opportunities. P12 stated that "the thing that I missed was the life on the land—the animals, the seasons, the farm work."

Table 7.3: Connection to Place and Associated Core Capabilities

Theme	Subtheme	Count
Emotions	Fire risk did not trump desire to live in location	2
Affiliation (A)	Interviewee felt a strong sense of community	8
	Interviewee was actively involved in community groups/activity	13
	School community was of particular importance to interviewee	4
Other Species	Interviewee felt a connection with the native animals	2
	Interviewee felt a connection with the natural environment	11
Play	Interviewee valued freeness and space of rural life	1
	Interviewee valued simplicity of rural lifestyle	1
	Interviewee valued farming lifestyle	1

7.6 Conclusion

Post-disaster restitution of losses of affected persons after bushfires is a complex task involving various stakeholders and activities. Consequently, the focus of restitution becomes the identifiable tangible losses of assets. In the immediate period after bushfires, various agencies such as fire services and disaster relief agencies are engaged, but their scope remains limited to rescue and relief efforts. The reconstruction of assets becomes the domain of insurance companies, who fund the reconstruction to the extent that the insurance policies of affected persons permit and various building companies can build. Social work scholars have argued that the losses that the disasters cause are much more than the losses that are the focus of current reconstruction programs or covered by insurance policies. Loss of place affects health and well-being, and the consequences of these losses are felt in complex ways. The loss of place is not merely the loss of a house or infrastructure; it affects various factors that shape human lives. The ability of people to adapt depends on these factors. It is therefore important to address the scale of losses that survivors of disasters have experienced. The lack of a framework for identifying these losses has limited the scope of reconstruction work. This gap also results in differences between the expectations of bushfire survivors and those of service providers.

This chapter uses Sen's capability approach to identify the nature of losses that affected persons faced after the Black Saturday bushfires in 2009. In the capability approach, well-being is associated with "capability" and "functionings." "Functioning" means the state of "being or doing," while "capability" is the set of valuable functionings that a person has effective access to. Nussbaum identifies 10 core capabilities that are necessary for human well-being. Loss of some or all of the core capabilities affects well-being. The chapter argues that the capabilities of affected persons need to be satisfactorily reconstituted. This requires asset-based and non-asset-based approaches to reconstruction.

The content analysis of the transcripts of interviews of affected persons and social workers facilitates identification of capabilities that were affected by the Black Saturday bushfires. The results suggest that the bushfires affected all the core capabilities. The losses that were reconstructed through insurance compensation or reconstruction works or by disaster relief agencies were grossly inadequate, as they left intangible losses uncompensated. The focus of reconstruction was on getting the physical infrastructure rebuilt as quickly as possible. While rebuilding was necessary, this focus left intangible losses associated with place, which are important for life, unaddressed for a long time.

The research identified that many of the certainties that households took for granted were destroyed, affecting their well-being. Loss of identity, dignity, livelihood, and control over one's environment are aspects of losses that are not measurable by common metrics used in post-disaster reconstruction.

Identifying losses that people suffer, which include much more than the physical infrastructure, is critical to enhancing the scope of post-disaster reconstruction work. While the focus of this chapter is on identifying losses associated with bushfires, the type of the disaster is less important than adopting an approach for reconstruction that focuses on the losses of capabilities and the resources that can be converted in restoring these capabilities. Personal, cultural, social, economic, and political factors can convert resources into capabilities.

References

Acharya, P. 2018. Building Regulations through the Capability Lens: A Safer and Inclusive Built Environment? In F. Comim, S. Fennell, and P. B. Anand, eds. *New Frontiers of the Capability Approach*. Cambridge: Cambridge University Press.

Alston, M. 2007. "It's Really Not Easy to Get Help": Services to Drought-Affected Families. *Australian Social Work* 60(4): 421–435.

Alston, M., D. Hargreaves, and T. Hazeleger. 2018. Postdisaster Social Work: Reflections on the Nature of Place and Loss. *Australian Social Work* 71:4: 405–416.

Binder, M. 2013. Subjective Well-Being Capabilities: Bridging the Gap Between the Capability Approach and Subjective Well-Being Research. *Journal of Happiness Studies* 15: 1197–1217.

Bolin, R. 1976. Family Recovery from Natural Disaster: A Preliminary Model. *Mass Emergencies* 1: 267–277.

Buxton, M., R. Haynes, D. Mercer, and A. Butt. 2011. Vulnerability to Bushfire Risk at Melbourne's Urban Fringe: The Failure of Regulatory Land Use Planning *Geographical Research* 49(1): 1–12.

Caruana, C. 2010. Picking Up the Pieces: Family Functioning in the Aftermath of Natural Disaster. *Family Matters* 84: 79–88.

Davidson, J. R., and A. C. McFarlane. 2006. The Extent and Impact of Mental Health Problems after Disaster. *Journal of Clinical Psychiatry* 67(Suppl 2): 9–14.

Dias, N., K. Keraminiyage, and K. DeSilva. 2016. Long-Term Satisfaction of Post Disaster Resettled Communities: The Case of Post Tsunami – Sri Lanka. *Disaster Prevention and Management* 25(5): 581–594.

Fullerton, C., and R. Ursano. 2005. Psychological and Psychopathological Consequences of Disasters. In J. J. López-Ibor, G. Christodoulou, M. Maj, N. Sartorious, and A. Okasha, eds. *Disasters and Mental Health*. West Sussex: Wiley.

Fussell, E. 2015. The Long-Term Recovery of New Orleans' Population after Hurricane Katrina. *American Behavioral Scientist* 59(10): 1231–1245.

Hallegatte, S., A. Vogt-Schilb, M. Bangalore, and J. Rozenberg. 2017. *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters*. Climate Change and Development Series. Washington, DC: World Bank.

Lazarus, R. S. 1991. *Emotion and Adaptation*. Oxford University Press.

McCaughey, J., et al. 2018. Socio-Economic Consequences of Post-Disaster Reconstruction in Hazard-Exposed Areas. *Nature Sustainability* 1(1): 38–43.

McFarlane, A. 1987a. Family Functioning and Overprotection Following a Natural Disaster: The Longitudinal Effects of Post-Traumatic Morbidity. *Australian and New Zealand Journal of Psychiatry* 21: 210–218.

____. 1987b. Post-Traumatic Phenomena in a Longitudinal Study of Children Following a Natural Disaster. *Journal of the American Academy of Child and Adolescent Psychiatry* 26(5): 764–769.

Michalos, A. C. 2011. What Did Stiglitz, Sen and Fitoussi Get Right and What Did They Get Wrong? *Social Indicators Research* 102(1): 117–129.

Murakami, M., et al. 2020. The Decision to Return Home and Well-Being after the Fukushima Disaster. *International Journal of Disaster Risk Reduction* 47: 1–12.

Murphy, C., and P. Gardoni. 2008. Recovery From Natural and Man-Made Disasters As Capabilities Restoration and Enhancement. *International Journal of Sustainable Development and Planning* 3(4): 1–17.

____. 2010. Gauging the Societal Impacts of Natural Disasters Using a Capability Approach. *Disasters* 34(3): 619–636.

Nussbaum, M. C. 2007. Human Rights and Human Capabilities. *Harvard Human Rights Journal* 20: 21–24.

du Parc, E., and L. Yasukawa. 2020. The 2019–2022 Australian Bushfires: From Temporary Evacuation to Longer-Term Displacement. Internal Displacement Monitoring Centre, September.

Sartore, G., B. Kelly, H. J. Stain, G. Albrect, and N. Higginbotham. 2008. Control, Uncertainty, and Expectations for the Future: A Qualitative Study of the Impact of Drought on a Rural Australian Community. *Rural and Remote Health Journal* 8(3).

Sen, A. 1979. Equality of What? The Tanner Lecture on Human Values. Stanford University.

____. 1987. *Commodities and Capabilities*. New Delhi: Oxford University Press.

Sina, D., A. Chang-Richards, and S. P. R. Wilkinson. 2019. What Does the Future Hold for Relocated Communities Post-Disaster? Factors Affecting Livelihood Resilience. *International Journal of Disaster Risk Reduction* 34: 173–183.

Solomon, S., and E. Smith. 1994. Social Support and Perceived Control as Moderators of Responses to Dioxin and Flood Exposure. In R. Ursano, B. McCaughey, and C. Fullerton, eds. *Individual and Community Responses to Trauma and Disaster*. Cambridge: Cambridge University Press.

Stephenson, C. 2010. The Impacts, Losses and Benefits Sustained from Five Severe Bushfires in South-Eastern Australia. Bushfire Cooperative Research Centre, State Government of Victoria, Report 88.

Stiglitz, J., J. Fitoussi, and M. Durand. 2018. *Beyond GDP: Measuring What Counts for Economic and Social Performance*. Paris: OECD Publishing.

TenHouten, W. 2022. The Emotions of Hope: From Optimism to Sanguinity, from Pessimism to Despair. *American Sociologist*.

Tiwari, P. and J. Shukla 2022. Post-Disaster Reconstruction, Well-Being and Sustainable Development Goals: A Conceptual Framework. *Environment and Urbanization Asia* 13(2): 323–332.

____. 2023. Measuring Housing Well-Being of Disaster Affected Persons in Chennai (India). *Housing Studies*. doi.org/10.1080/02673037.2023.2211950

Vigil, M., and D. Geary. 2008. A Preliminary Investigation of Family Coping Styles and Psychological Well-Being among Adolescent Survivors of Hurricane Katrina. *Journal of Family Psychology* 22(1): 176–180.

Walsh, B., and S. Hallegatte. 2019. Measuring Natural Risks in the Philippines: Socioeconomic Resilience and Well-Being Losses. Policy Research working paper no. WPS 8723. Washington, DC: World Bank Group.

Whittaker, J., K. Haynes, J. Handmer, and J. Mclennan. 2013. Community Safety during the 2009 Australian "Black Saturday" Bushfires: An Analysis of Household Preparedness and Response. *Journal of the International Association of Wildland Fire* 22(6): 841–849.

Yang, H., et al. 2018. Changes in Human Well-Being and Rural Livelihoods under Natural Disasters. *Ecological Economics* 151: 184–194.

Appendix 7.1: Profile of Interviewees

Respondent	Profile
P1	Rescue worker
P2	Affected person who lost their home
P3	Affected person whose family lost home
P4	Affected person who lost home and family members (interview in February 2011)
P5	Affected person who lost home and family members
P6	Affected person whose farm was destroyed
P7	Affected person whose home was destroyed
P8	Affected person whose home was destroyed
P9	Affected person whose home was destroyed
P10	Affected person
P11	Affected person who lost their home
P12	Charitable worker
P13	Social worker
P14	Government official
P15	Affected person and involved in rescue work
P16	Affected person who lost their home
P17	Affected person whose place of work was destroyed
P18	Charitable worker

CHAPTER 8

Housing Displacement and Replacement in Coastal Flood-Prone Areas: Evidence from a Land and Building Tax-Based Study in Indonesia

S. Sariffuddin, D. Ary A Samsura, Erwin van der Krabben, Budi Setiyono, and Wisnu Pradoto

8.1 Introduction

Growing pressure is being placed on policymakers to involve property markets in flood risk management by providing more room for water. Regarding coastal flood risk, rapid urbanization in at-hazard areas is causing a housing market boom, and the incidence of coastal hazards, such as uncontrolled land use change, is increasing. Therefore, many experts think that the property market should adapt to coastal flooding in response to the exponential growth of coastal vulnerability. Voluntary action of the property market, often called autonomous adaptation, is needed for adapting to coastal flooding (Filatova 2014). For example, Wolff et al. (2020) argue that land-use change would be a new exposure for coastal cities, supporting the argument that coastal flooding is not only a hydrometeorological disaster but also an anthropogenic issue (Daniel, Florax, and Rietveld 2009). Given that potential loss and damage are strongly associated with land use, autonomous adaptation should complement planned adaptation for flood risk management (Filatova 2014). This concept is in line with the recent debate about how risk management should focus more on managing vulnerability receptors (including the property market) than using engineering defenses for flood protection (Sayers 2017).

International experience shows that the shift from flood protection to flood risk management is receiving attention in many countries for being more suitable and offering complementary engineering measures. Flood risk management can be interpreted from two perspectives: hydrological and planning policy (Schanze 2006). The hydrological perspective emphasizes using engineering measures to regulate water flow for flood protection, especially keeping water away from land and defending against floods (Löschner and Nordbeck 2020). In contrast, the planning policy perspective serves as a complementary measure by considering risk analyses for decisions and actions to mitigate the residual risk of flood protection (Sayers 2017). However, it is also important to acknowledge that spatial adaptation plays a vital role in flood risk management (Filatova 2014) through the active adaptation of individual households before and after purchasing their houses in flood-prone areas. It is possible that individuals' voluntary displacement to avoid flood-prone areas could be considered as the property market's active role in supporting spatial adaptation. People move from dangerous locations to safer areas to reduce risk and achieve individual equilibrium by adjusting their household expenditures (Brasington 2021; Hunter, Luna, and Norton 2015).

From an economic perspective, adaptation is an extra cost that directly influences the balance of family expenses. Hence, Mendelsohn (2000) proposes the cost–benefit model that housing displacement is only one attempt of households to find their new individual equilibrium in housing consumption. In this model, housing displacement can be interpreted as decisions that individuals make as economic agents to reduce extra housing consumption costs, which is, at a minimum, a balance between marginal benefits (MB), marginal costs (MC), and marginal externalities (ME). When individuals face spending inequality due to adaptation, they make rational decisions based on economic conditions (Filatova 2014; Fujita and Thisse 2013). This concept also serves as the framework for effective adaptation to climate change (Mendelsohn 2000) and a market-based instrument for flood risk management (Filatova 2014) that informs flood risk through price signals. Instead of being a command-and-control system, this

alternative approach is a response to the lack of flood risk perception for most coastal flood risks due to dissonant perception (Filatova, Mulder, and van der Veen 2011).

Many studies have demonstrated the valuable contribution of housing adaptation through residential mobility and immobility. Marfai et al. (2008) thoroughly investigate residential immobility adaptation in the form of house and floor elevations and mini-dam construction. They find that local community capacity, including economic viability, plays an essential role in household adaptation. Survey-based evidence also shows that coastal flood risk influences housing displacement. For example, using questionnaires to investigate residential mobility adaptation, Buchori et al. (2018) find that vulnerable people move to safer areas to mitigate risks. However, based on interview survey data, Quinn et al. (2018) conclude that the main reason individuals move is to improve quality of life by increasing their income. Unfortunately, most of this previous research does not account for whether these individuals' relocations are permanent. What remains unclear is whether their original locations become abandoned areas with no property sale transactions. Additionally, no clear information exists regarding whether housing succession occurs in at-risk areas. This lack of information is understandable because the previous investigations employed aggregated statistics with survey-based evidence (questionnaires and interviews). Therefore, according to land and building tax data, housing-based relocation can be generalized as permanent house-based relocation, and disaggregated data could address these knowledge gaps.

Research has also associated housing displacement decisions with relocation destinations. This tendency is not surprising because most studies pay more attention to where people move rather than their origins or where they move from. For example, Loughran and Elliott (2019) examine people's relocating destination after they accepted residential buyouts in Houston, Texas, without investigating the condition of abandoned areas. Regarding residential mobility literature, Brasington (2021) summarizes three factors that need to be considered in the study of property displacement, namely whether to move, where to move, and what to move into. Given that facts about housing immobility indicate that abandoned areas are still habitable for particular people, it is essential to investigate abandoned areas, especially because some researchers have identified the replacement phenomenon in Palangkaraya, Indonesia (Permana and Miyata 2008) and Dhaka, Bangladesh (Braun and Aßheuer 2011). However, limited evidence exists of a correlation between relocation and coastal flood risk in abandoned areas.

To address this gap, our population-based research study aimed to examine the correlation between coastal flood risk and housing displacement and replacement. We used the innovative method of examining land and building tax history, and we hypothesized that property displacement would correlate with coastal flood risk.

8.2 Private Adaptation: Housing Displacement and Replacement

Housing displacement is only one adaptation strategy of households as economic agents (Black et al. 2011) to adjust their housing consumption (Hanushek and Quigley 1978; Wang et al. 2019). This idea has been widely discussed and is associated with climate change (Call and Gray 2020; Walelign and Lujala 2022), the labor market (Chan, O'Regan, and You 2021), residential satisfaction, stress (Wang et al. 2019), and crop failure (Gray and Mueller 2012). For example, Cattaneo et al. (2019) demonstrate that income loss caused by crop failure led people to look for new land for agricultural purposes. Another example is that residential buyout programs for households in flood-prone areas in the United States stimulate voluntary relocation (Loughran and Elliott 2019). However, numerous studies also note that many people stay in flood-prone areas because of economic constraints (Blondin 2021; Cundill et al.

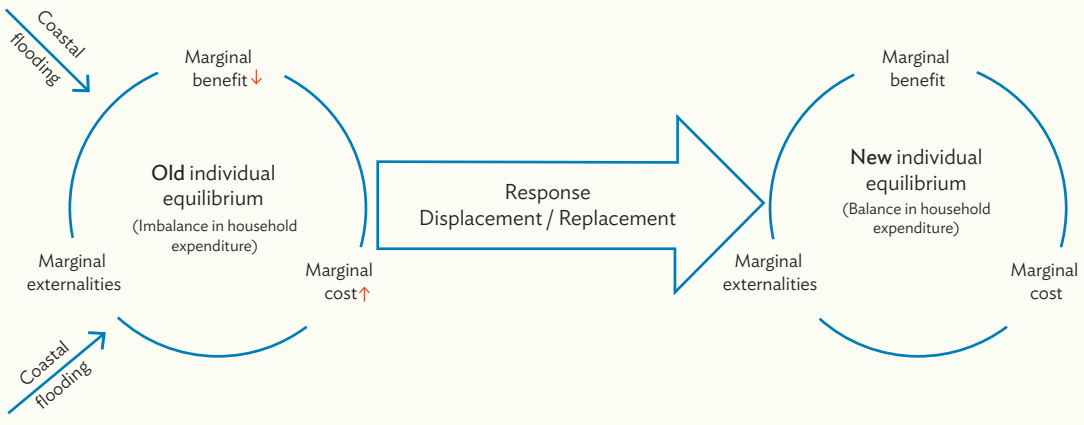
2021; Piggott-McKellar and McMichael 2021). Therefore, the private adaptation model could serve as a framework to explain relocation as an adaptation strategy.

In the field of urban economics, Winstanley, Thorns, and Perkins (2002) divide the literature on residential mobility into three approaches: the life-cycle model, cost–benefit model, and neighborhood change model. Given the financial consequences for all models, Brasington (2021) argues that researchers can reduce those three models into a cost–benefit model if the losses and benefits can be defined appropriately. In the cost–benefit model, housing displacement could be explained by expenditure adjustments for housing consumption determined by rental value, including the purchases for residential use (Ahlfeldt 2011; Alonso 1964). If a household experiences a property value adjustment, relocation to an urban area, and transportation costs, it will adjust its expenditure to balance income and expenses, moving to a safer area to do so. It also explains the paradoxical housing displacement of individuals from safe regions to risky areas in Palangkaraya (Permana and Miyata 2008). As a result, displacement is a coping mechanism of private adaptation (Black et al. 2011) for achieving individual equilibrium.

Mendelsohn (2000) argues that efficient adaptation can only be achieved if the cost is less than the resulting benefit. Since adaptation requires additional costs, people try to adjust their expenses accordingly. From the perspective of private adaptation, individual equilibrium is an attempt to make the marginal benefit (MB) greater than the marginal cost (MC) and marginal externalities (ME) or to balance the MB and MC + ME. This model also underlies the market-based instrument for flood risk management before an individual household decides to buy a house (Filatova 2014). When homebuyers have to pay extra for adaptation by purchasing insurance (for example) before the transaction, it is expected that they will decide rationally. This assumption is based on the postulated rational behavior of price-takers (Fujita and Thisse 2013). Behavioral changes for private adaptation occur quickly due to expenditure adjustments for achieving individual equilibrium.

With these points in mind, displacement can be understood as the individual household behavior in deciding whether to relocate. Therefore, housing displacement for adaptation could be considered to be voluntary private adaptation. A form of location-based adaptation occurs when people leave or avoid flood risk areas to lower risks to improve individual equilibrium. Filatova (2014) emphasizes that flood risk management can be achieved through land-use adaptation, as the property market plays an essential role in spatial patterns. Inspired by Black et al. (2011), we propose a conceptual framework of housing displacement for individual equilibrium (see Figure 8.1).

Figure 8.1: The Conceptual Framework of Property Displacement for Individual Equilibrium



8.3 Methods

8.3.1 Data and Variables

We obtained the housing displacement and replacement data by screening the land and building tax history to obtain the property ownership changes (n = 493,065) from 2015 to 2020. Researchers generally agree that a tax payment for a property indicates that the property owner is a permanent resident (Firman 2004). Fussell, Curtis, and DeWaard (2014) employ a similar method in using data from the Internal Revenue Service and Statistics of Income Division. Our search process was based on the identity number of the land tax (Bahasa: *nomor objek pajak*; NOP) and the tax payment history. To reduce the large data set, we screened the changes of property ownership using the available taxpayer information, either name, single identity number (Bahasa: *nomor induk kependudukan*; NIK), or tax identification number (Bahasa: *nomor pokok wajib pajak*; NPWP). By doing so, we were able to illustrate the housing displacement and replacement in geographic and statistical visualizations. In addition, we collected data on household experiences from the tax payment records. We used electricity subscription as a proxy for household income data, as energy consumption is an excellent source of information on the welfare of people in Indonesia (Deutsch et al. 2020; Sambodo and Novandra 2019). Using previous research results, we classified flood-prone areas according to the physical coastal characteristics strongly associated with risk, including slope (Bao, Gayes, and Pietrafesa 2018; Martínez-Graña et al. 2016), land subsidence (Catalao, Raju, and Nico 2020; Miller and Ravens 2022), and proximity to the shoreline (Bosker et al. 2019; Zhang, Hwang, and Lindell 2010).

We gathered data for all the variables with the understanding that household displacement is an adaptation measure (Black et al. 2011; Hunter, Luna, and Norton 2015) carried out by individual households as economic agents (Brasington 2021) to achieve personal equilibrium for household consumption (Hanushek and Quigley 1978). Since displacement is motivated by socioeconomic factors (Brasington 2021), we also considered adaptation ability, determined by finances, experience, and education (Adger and Vincent 2005) as control variables. Rogers et al. (2020) and Pathak (2021) examine the impact of economic viability on possible adaptation solutions, and some researchers have confirmed that flood experience influences adaptation mechanisms (Budhathoki, Paton, Lassa, and Zander 2020; Budhathoki, Paton, Lassa, Bhatta, and Zander 2020; Ullah et al. 2020). Because this study was based on property-level adaptation and data regarding education were unavailable, we agreed that economic and income factors would be more appropriate (Hudson, Bubeck, and Thieken 2021) than education.

We gathered data from the authorities of Pekalongan City (Indonesia) and through remote sensing. The local government provided tax-due notification letters (Bahasa: surat pemberitahuan pajak terhutang; SPPT) from 2015 to 2020, which we call the land and building tax history. We investigated previous research that used similar data to study the optimization of original income in Aceh (Sufyan, Kadir, and Fitriyeni 2020) and to estimate the tax value of buildings and land in Jambi (Delis and Hodijah 2015). As proxy data for household income, we collected data from the municipality on electric power subscriptions from the building construction permits (Bahasa: ijin mendirikan bangunan; IMB). We used simple remote sensing to extract slope and land subsidence data, and we used the Sentinel-1 data captured on 17 February 2017 and 4 December 2019, provided by the European Space Agency, to model the land subsidence using the Sentinel Application Platform (SNAP 8.1). We renewed the land subsidence model previously carried out by Andreas et al. (2017), and we used the same method to extract slope data from the digital elevation model provided by DEMNAS Indonesia (national digital elevation model) using QGIS (Quantum Geographic Information System) 3.20.2. We also used the research by Syam, Wengi, and Gandapurnama (2021) on climate risk and impact assessment of Pekalongan, Indonesia. They mapped flooded areas using a combination of sea-level rises, surface topography models, land subsidence, and land use.

8.3.2 Statistical Analyses

We used rStatistics (version 4.1.2) to perform statistical analysis. The dependent variable (y_{ij}) includes categorical data for housing displacement: risk-to-risk, risk-to-safe, and safe-to-risk displacement. The independent variables (x) include numerical data for land subsidence (x_i [meters]), proximity to the shoreline (u_{ij} [meters]), and slope (e_{ij} [meters]). The control variables are household electricity (w_{ij} [kilowatt-hours]) and experience (p_{ij} [years]). We performed a multinomial logistic regression to estimate the odds ratio (OR) of housing displacement with 95% confidence intervals (95%CI). This study determined significance of the statistical model at $p < 0.05$. In previous research by Jarvis (2018), Gabriel and Painter (2008), and Jiang et al. (2009), the authors carried out similar methods. According to Nagayasu (2021), we can interpret housing displacement as choosing the location randomly, assuming the location decision for displacement is unordered. Retrieved from Nagayasu (2021), the fundamental equation of multinomial logistic regression for grouping (i) households into j categories is

$$y_{ij} = a + bx_{ij} + u_{ij} + ej + w_{ij} + p_{ij}, \quad (1)$$

where

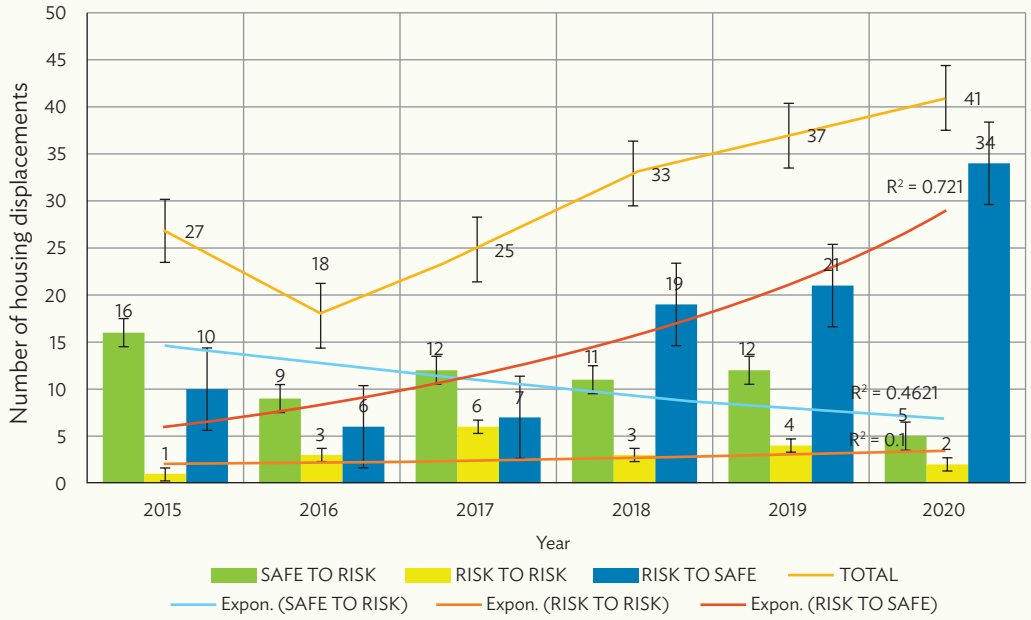
y_{ij} : housing displacement (categorical data)
a : constant
bx_{ij} : land subsidence (meters)
u_{ij} : proximity to shoreline (meters)
e_{ij} : slope (meters)
w_{ij} : electricity (as proxy data for income)
p_{ij} : experience (years)

8.4 Results

A total of 181 houses were displaced from 2015 to 2020 (n = 493,065), and a sharp increase occurred from 2017 to 2020 (38%). In contrast, risk-to-risk and safe-to-risk displacements tended to decrease, even though risk-to-risk displacements increased in 2017 (6 houses). After 2017, both risk-to-risk and safe-to-risk displacements tended to fall. Figure 8.2 shows the number of housing displacements from 2015 to 2020 divided into displacement patterns. Essential differences existed between risk-to-safe and safe-to-risk displacements, and 38% of average housing was displaced from safe-to-risk locations. However, housing displacements in risk-to-risk areas were mostly constant, even though the number increased (24%) in 2017. This result might have been a response to the embankment building that was constructed in 2016. The safe locations as displacement destinations included Pekalongan Barat (45%), Pekalongan Selatan (32%), and Pekalongan Timur (23%). Pekalongan Barat has become a favorable displacement location possibly because of its urban facilities, which is one consideration in housing consumption (Hanushek and Quigley 1978). In contrast, safe-to-risk displacements also originated from Pekalongan Barat (22%), Pekalongan Selatan (37%), and Pekalongan Timur (41%).

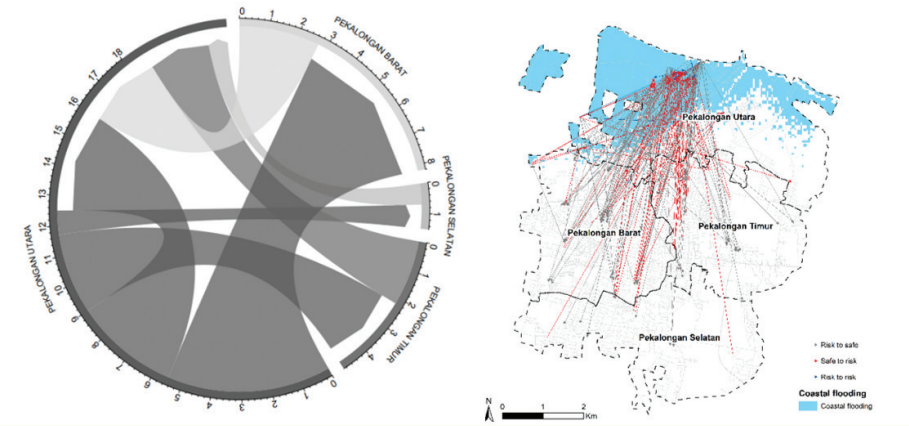
Comparing the three displacement patterns revealed risk-to-safe relocation in the form of group movement, while the other two patterns were individual displacements. Households that moved from risk-to-safe came from adjacent neighborhood groups indicated by the same zone according to identity numbers of land tax (Bahasa: nomor objek pajak; NOP), whereas the households that moved from both risk-to-risk and safe-to-risk came from scattered individual households. Both risk-to-risk and safe-to-risk relocations tended to replace abandoned areas, and they displaced an average of 3–5 kilometers from their original location. This pattern might have occurred because of less destructive slow-onset flooding and perceptions of low risk among the community (Syam, Wengi, and Gandapurnama 2021). Figure 8.3 shows the relocation visualization and geographical relocation of house displacement within the city of Pekalongan.

Figure 8.2: Housing Displacements in Response to Coastal Flood Risk (2015–2020)



Expon = exponential functions.

Figure 8.3: Internal Housing Displacement



km = kilometer.

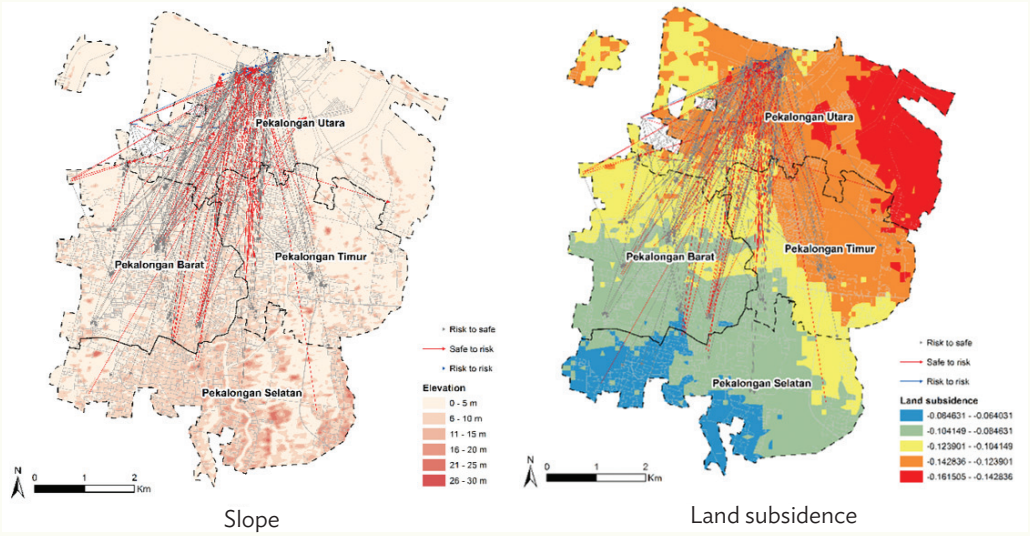
This section describes the housing displacements and replacements. As mentioned in the methods section, this study used property tax history to screen property ownership using the unique numbers of property tax identities (Bahasa: nomor objek pajak; NOP), which are also embedded on each house parcel. Property tax history provided two critical pieces of information for this study: (i) tax payments and (ii) property ownership records. The tax-due notification letters indicate housing displacements and

replacements according to the property ownership succession on each house parcel. Using geospatial data of housing parcels, we illustrated the residential mobility and recognize that new property buyers occupied the sold houses. In short, there is no doubt that housing replacement occurred in coastal flood risk areas.

In this section, we draw together displacement decisions and coastal flood risk variables. We begin with flood zone, slope, and land subsidence. Figure 8.3 (left) shows the internal housing displacement within Pekalongan City. The majority of displacement originates from Pekalongan Utara subdistrict, which is experiencing coastal flooding and land subsidence. The shaded areas and arrows indicate the number of displaced households and their destinations. Figure 8.3 (right) shows risk-to-safe displacements (black lines), safe-to-risk displacements (red lines), and risk-to-risk displacements (blue lines). These migration lines also illustrate housing replacement, indicated by the arrows. The origins of the black lines are similar areas that experienced coastal flooding, and the destinations of the red lines are abandoned areas (the origin areas of the black lines).

Further analysis showed that the risk-to-safe housing displacements tended to avoid 0–5 meters (m) of slope and move to elevations of 16–25 m in Pekalongan Barat, Pekalongan Selatan, and Pekalongan Timur. The highest slope destination was 30 m, in Pekalongan Selatan, while the lowest slope destination was 20 m, in Pekalongan Barat. Both the risk-to-risk and safe-to-risk displacements tended to occupy 0–5 m of slope in a similar area of Pekalongan Utara. A similar situation occurred regarding land subsidence. In the destination area for risk-to-safe displacement, land subsidence was about −5 centimeters (cm) in Pekalongan Selatan, Pekalongan Barat, and Pekalongan Timur. In Pekalongan Utara, the land subsidence for risk-to-risk and safe-to-risk displacements was about −2 cm. Although most of our findings support Andreas et al. (2017), this study also revealed a 40–60 cm subsidence in certain areas (see Figure 8.4). After displacement, most household origins experienced a land subsidence of 40–60 cm. They moved to West Pekalongan and East Pekalongan, which had a lower land subsidence of 10–20 cm and 20–30 cm, respectively.

Figure 8.4: Coastal Flood Risk and Property Displacements



Slope Land subsidence

km = kilometer, m = meter.

Further analysis revealed that income and experience strongly influenced risk-to-safe displacements but not risk-to-risk and safe-to-risk displacements. Most individual households displaced from risk-to-safe areas subscribed to 900–1,300 kilowatt-hours, which we defined as medium-income inhabitants. Displaced houses from risk-to-risk and safe-to-risk subscribed to 450 kilowatt-hours, which we defined as low-income inhabitants. This finding indicates that middle-income people tended to move from risk-to-safe areas, and the low-income people replaced them. Experience is another essential aspect of socioeconomic factors. Experienced people (those living in flood risk areas more than 10 years) tended to relocate to safe areas. The longer middle-income people had resided in flood risk areas, the more likely they were to migrate to safer areas, and the less experienced low-income communities tended to replace them.

A multinomial logistic regression was used to explain the relationship between the decision to displace and coastal flood risk variables. Table 8.1 shows the results for three forms of housing displacements. The risk-to-risk displacement was the reference for the statistical model. The r-squared is 0.897, so it can be considered a robust statistical model. The p-value of most of the coastal flood risk variables is <0.001. Thus, we interpret the variables to be statistically significant, influencing the dependent variable. In this model, the variable of proximity to the shoreline has a p-value of 0.170 (>0.05), which is not statistically significant. In safe-to-risk displacements, all variables of coastal flood risk have a p-value greater than 0.05. Therefore, we interpret them to be not statistically significant in explaining the dependent variable. Based on the p-value (statistically significant, <0.005), coastal flood risk influenced only the property displacement from risk-to-safe areas. The property owners had higher odds (OR[95%CI] = 0.32094) of relocating to higher slopes than those relocating from risk-to-risk areas. Those with higher incomes had higher odds (OR[95%CI] = 0.35051) of relocating to higher regions than those from risk-to-risk displacements. The variable of land subsidence (OR[95%CI] = 2.25e-08) and experience (OR[95%CI] = 0.00030) also influenced the decision of risk-to-safe displacement and was higher than those relocating from risk-to-risk areas.

Table 8.1: Multinomial Logistic Regression

	Reference: Risk-to-Risk Displacement			
	Risk-to-Safe Displacement		Safe-to-Risk Displacement	
Predictors	Odds Ratios	P	Odds Ratios	P
(Intercept)	0.00	<0.001	0.20	0.343
Land subsidence	0.00	<0.001	1.32	0.263
Proximity to shoreline	1.19	0.170	1.00	0.234
Slope	0.32	<0.001	1.87	0.191
Experience	0.00	<0.001	1.31	0.187
Electricity (welfare)	0.35	<0.001	1.31	0.532
Observations	154			
R^2 Nagelkerke	0.897			

In this chapter, we argue that residential mobility is only one adaptation process of households as economic agents. To explore this idea, this study also employed two controlled adaptation variables: experience and income. As can be seen in Table 8.1, the two variables are significant contributory factors to the decision to displace from at-risk to safe areas. Furthermore, this result shows that experience in middle-income people positively correlates with coastal flood risk variables (land subsidence and

slope). In summary, we interpret the results to mean that middle-income inhabitants considered coastal flood risk and avoided moving to high-risk areas. The two controlled variables did not significantly contribute to safe-to-risk displacements.

8.5 Discussion

This study indicates that housing replacement underlies displacement through the succession of house ownership and that three kinds of coastal flood risk affect housing mobility: risk-to-risk, risk-to-safe, and safe-to-risk displacement. The critical finding, demonstrated by house ownership successions recorded in tax history, is that individuals in risk-to-safe displacements were replaced by inhabitants in safe-to-risk displacements. Middle-income people in at-risk areas sold their houses, which were then occupied by lower-income inhabitants. This evidence of risk-to-safe displacement supports the previous research of Buchori et al. (2018), who investigated migration patterns in Semarang, on the north coast of Java, Indonesia. The replacement finding also supports the work of Permana and Miyata (2008) from a different point of view. They investigated the replacement phenomenon in illegal housing, whereas we conducted this research on legal housing, as indicated by tax payment history. In summary, this study adds to the previous knowledge that replacement is an important part of housing displacement.

Moreover, housing replacement occurred because of the succession of house ownership in at-risk areas. This study also confirms the emergence of a used-property market in at-risk regions, which is potentially favorable for low-income people because of its lower prices. Thus, the house displacement in our study (risk-to-risk and safe-to-risk) contrasts with that of Brasington (2021), who argues that adaptation is an extra cost that influences the individual equilibrium. The individual equilibrium model suggests that people displace from situations that impose higher costs for adaptation (and added marginal costs) to situations with lower or no costs, and the need for shelter, the most basic dwelling requirement, could explain this situation. Van Ham (2012) argues that even though housing customers have many choices, the actual market choices are limited, and house buyers' choices depend on opportunities and constraints in the housing market, including their financial housing consumption abilities.

Another significant result is that the middle-income inhabitants responded more to coastal flood risks than low-income inhabitants did. Risk-to-safe displacement provides deeper insight into the rational behavior of housing adaptation (Filatova 2014; Fujita and Thisse 2013), and we interpret the results to mean that middle-income people might consider risk in their decision in an economically rational manner, while lower-income people might not. This situation indicates that the property market still exists in flood-prone areas, especially for transitioning used houses of middle-income people to low-income inhabitants. A strong possibility exists that the situation will increase coastal vulnerability because of low-income people deciding to live in flood-prone areas. Indeed, this finding supports Wolff et al. (2020) in that the land-use issue is the next exposure in coastal studies. Also, Daniel, Florax, and Rietveld (2009) support the idea that coastal flood risk is not only a hydrometeorological disaster but also an anthropogenic issue.

Another important finding is that group relocation occurs because of coastal flooding. People relocate from similar zones of residential areas, albeit at different times. It is possible that the areas become uninhabitable due to sinking, which is influenced by land subsidence and sea-level rise. Therefore, this study supports Black et al. (2011) in highlighting the environmental influence of uninhabitable areas as a driver of migration. Of course, group relocation also indicates that the problem occurs in a particular area and impacts most inhabitants.

This chapter also confirms that income influences the rational decisions of individual households as economic agents in response to coastal flood risk. It has been demonstrated that risk influences housing behavior, although it occurs mostly in the middle-income groups of society (Fujita and Thisse 2013), and low-income inhabitants might replace the middle-class inhabitants for a similar purpose: individual equilibrium (Permana and Miyata 2008). Concerning our statistical results, we also found that the influence of coastal flood risk on property displacement decisions is low, even though the variable is significant (p-value < 0.001). It might be that other factors determine the decision to relocate instead of considerations based on the cost–benefit model. There might be phenomena of replacement rather than displacement because our research areas were in zones of slow-onset flooding. Our study shows that the property market is not absent in abandoned regions, as these locations are often occupied by low-income people who ignore flood risks.

8.6 Conclusion

This chapter examined the role of flood risk variables on housing displacement decisions. The statistical results indicate that our hypothesis was supported for middle-income but not lower-income inhabitants. Housing displacement and replacement, which is housing behavior in response to slow-onset flooding, should be considered in property-based flood risk management. The contrasting findings regarding low-income communities responding to coastal flood risk suggest that these communities face limited viable options in the property market. An implication of this finding is that environmental deterioration might be influenced not only by coastal hazards but also by the inability of inhabitants to maintain their neighborhoods. An advantage of this research is that we conducted a property-based displacement study, which revealed individual behavior in response to coastal flood risk. The active role of middle-income residents and the passive role of lower-income residents shows that economic viability still influences adaptation.

However, we would also like to identify limitations of our study, particularly the lack of demographic data (such as income, education, and gender) to classify the community as economic agents more precisely. We also did not identify property prices at the origins and destinations, and these limitations warrant further research that includes these aspects. In addition, several questions remain, such as whether displacement influences the environmental condition. For example, it is unknown what socioeconomic characteristics displaced communities present. Therefore, a second broad recommendation is that the property market be considered as an alternative approach to flood risk management. Due to the spatial property market response, coastal flood risk may support spatially based flood risk management and complement the government's planned adaptation.

References

Adger, W. N., and K. Vincent. 2005. Uncertainty in Adaptive Capacity. Comptes Rendus Geoscience 337(4): 399–410. https://doi.org/10.1016/j.crte.2004.11.004

Ahlfeldt, G. 2011. If Alonso Was Right: Modeling Accessibility and Explaining the Residential Land Gradient. Journal of Regional Science 51(2): 318–338. https://doi.org/10.1111/j.1467-9787.2010.00694.x.

Alonso, W. 1964. Location and Land Use: Toward a General Theory of Land Rent. Harvard University Press. https://doi.org/10.4159/harvard.9780674730854

Andreas, H., Usriyah, H. Zainal Abidin, and D. Anggreni Sarsito. 2017. Tidal Inundation ("Rob") Investigation Using Time Series of High Resolution Satellite Image Data and from Institu Measurements along Northern Coast of Java (Pantura). IOP Conference Series: Earth and Environmental Science 71. https://doi.org/10.1088/1755-1315/71/1/012005

Bao, S. W., P. Gayes, and L. Pietrafesa. 2018. The Need and Rationale for a Coastal Flood Risk Index. OCEANS 2018 MTS/IEEE Charleston. https://doi.org/10.1109/oceans.2018.8604927

Black, R., S. R. G. Bennett, S. M. Thomas, and J. R. Beddington. 2011. Migration as Adaptation. Nature 478(7370): 447–449. https://doi.org/10.1038/478477a

Blondin, S. 2021. Staying Despite Disaster Risks: Place Attachment, Voluntary Immobility and Adaptation in Tajikistan's Pamir Mountains. Geoforum 126: 290–301. https://doi.org/10.1016/j.geoforum.2021.08.009

Bosker, M., H. Garretsen, G. Marlet, and C. van Woerkens. 2019. Nether Lands: Evidence on the Price and Perception of Rare Natural Disasters. Journal of the European Economic Association 17(2): 413–453. https://doi.org/10.1093/jeea/jvy002

Brasington, D. M. 2021. Housing Choice, Residential Mobility, and Hedonic Approaches. In M. M. Fischer and P. Nijkamp, eds. Handbook of Regional Science. https://doi.org/10.1007/978-3-662-60723-7_4

Braun, B., and T. Aßheuer. 2011. Floods in Megacity Environments: Vulnerability and Coping Strategies of Slum Dwellers in Dhaka/Bangladesh. Natural Hazards 58(2): 771–787. https://doi.org/10.1007/s11069-011-9752-5

Buchori, I., A. Pramitasari, A. Sugiri, M. Maryono, Y. Basuki, and A. W. Sejati. 2018. Adaptation to Coastal Flooding and Inundation: Mitigations and Migration Pattern in Semarang City, Indonesia. Ocean and Coastal Management 163: 445–455. https://doi.org/10.1016/j.ocecoaman.2018.07.017

Budhathoki, N. K., D. Paton, J. A. Lassa, and K. K. Zander. 2020. Assessing Farmers' Preparedness to Cope with the Impacts of Multiple Climate Change-Related Hazards in the Terai Lowlands of Nepal. International Journal of Disaster Risk Reduction 49: 101656. https://doi.org/10.1016/j.ijdrr.2020.101656

Budhathoki, N. K., D. Paton, J. A. Lassa, G. D. Bhatta, and K. K. Zander. 2020. Heat, Cold, and Floods: Exploring Farmers' Motivations to Adapt to Extreme Weather Events in the Terai Region of Nepal. Natural Hazards 103(3): 3213–3237. https://doi.org/10.1007/s11069-020-04127-0

Call, M., and C. Gray. 2020. Climate Anomalies, Land Degradation, and Rural Out-Migration in Uganda. Population and Environment 41: 507–528. https://doi.org/10.1007/s11111-020-00349-3

Catalao, J., D. Raju, and G. Nico. 2020. Insar Maps of Land Subsidence and Sea Level Scenarios to Quantify the Flood Inundation Risk in Coastal Cities: The Case of Singapore. Remote Sensing: 12(2): 296. https://doi.org/10.3390/rs12020296

Cattaneo, C., M. Beine, C. J. Fröhlich, D. Kniveton, I. Martinez-Zarzoso, M. Mastrorillo, K. Millock, E. Piguet, and B. Schraven. 2019. Human Migration in the Era of Climate Change. Review of Environmental Economics and Policy 13(2): 189–206. https://doi.org/10.1093/reep/rez008

Chan, S., K. O'Regan, and W. You. 2021. Migration Choices of the Boomerang Generation: Does Returning Home Dampen Labor Market Adjustment? Journal of Housing Economics 53: 101760. https://doi.org/10.1016/j.jhe.2021.101760

Cundill, G., C. Singh, W. N. Adger, R. Safra de Campos, K. Vincent, M. Tebboth, and A. Maharjan. 2021. Toward a Climate Mobilities Research Agenda: Intersectionality, Immobility, and Policy Responses. Global Environmental Change 69: 102315. https://doi.org/10.1016/j.gloenvcha.2021.102315

Daniel, V. E., R. J. G. M. Florax, and P. Rietveld. 2009. Flooding Risk and Housing Values: An Economic Assessment of Environmental Hazard. Ecological Economics 69(2): 355–365. https://doi.org/10.1016/j.ecolecon.2009.08.018

Delis, A., and S. Hodijah. 2015. Estimasi Nilai Basis Pajak Bumi dan Bangunan di Kota Jambi: Pendekatan Hedonic Price Function. Jurnal Perspektif Pembiayaan dan Pembangunan Daerah 2(3): 147–160. https://doi.org/10.22437/ppd.v2i3.2271

Deutsch, J., J. Silber, G. Wan, and M. Zhao. 2020. Asset Indexes and the Measurement of Poverty, Inequality and Welfare in Southeast Asia. Journal of Asian Economics 70: 101220. https://doi.org/10.1016/j.asieco.2020.101220

Filatova, T. 2014. Market-Based Instruments for Flood Risk Management: A Review of Theory, Practice and Perspectives for Climate Adaptation Policy. Environmental Science and Policy 37: 227–242. https://doi.org/10.1016/j.envsci.2013.09.005

Filatova, T., J. P. M. Mulder, and A. van der Veen. 2011. Coastal Risk Management: How to Motivate Individual Economic Decisions to Lower Flood Risk? Ocean and Coastal Management 54(2): 164–172. https://doi.org/10.1016/j.ocecoaman.2010.10.028

Firman, T. 2004. Major Issues in Indonesia's Urban Land Development. Land Use Policy 21(4): 347–355. https://doi.org/10.1016/j.landusepol.2003.04.002

Fujita, M., and J.-F. Thisse. 2013. Economics of Agglomeration Cities, Industrial Location, and Globalization. Cambridge University Press. https://doi.org/10.1017/cbo9781139051552

Fussell, E., K. J. Curtis, and J. DeWaard. 2014. Recovery Migration to the City of New Orleans after Hurricane Katrina: A Migration Systems Approach. Population and Environment 35(3): 305–322. https://doi.org/10.1007/s11111-014-0204-5

Gabriel, S. A., and G. Painter. 2008. Mobility, Residential Location and the American Dream: The Intrametropolitan Geography of Minority Homeownership. Real Estate Economics 36(3): 499–531. https://doi.org/10.1111/j.1540-6229.2008.00220.x

Gray, C. L., and V. Mueller. 2012. Natural Disasters and Population Mobility in Bangladesh. Proceedings of the National Academy of Sciences 109(16): 6000–6005. https://doi.org/10.1073/pnas.1115944109

Hanushek, E. A., and J. M. Quigley. 1978. An Explicit Model of Intra-Metropolitan Mobility. Land Economics 54(4). https://doi.org/10.2307/3146168

Hudson, P., P. Bubeck, and A. H. Thieken. 2021. A Comparison of Flood-Protective Decision-Making between German Households and Businesses. Mitigation and Adaptation Strategies for Global Change 27(1): 5. https://doi.org/10.1007/s11027-021-09982-1

Hunter, L. M., J. K. Luna, and R. M. Norton. 2015. Environmental Dimensions of Migration. Annual Review of Sociology 41(1): 377–397. https://doi.org/10.1146/annurev-soc-073014-112223

Jarvis, B. F. 2018. Estimating Multinomial Logit Models with Samples of Alternatives. Sociological Methodology 49(1): 341–348. https://doi.org/10.1177/0081175018793460

Jiang, W., L. Deng, L. Chen, J. Wu, and J. Li. 2009. Risk Assessment and Validation of Flood Disaster Based on Fuzzy Mathematics. Progress in Natural Science 19(10): 1419–1425. https://doi.org/10.1016/j.pnsc.2008.12.010

Löschner, L., and R. Nordbeck. 2020. Switzerland's Transition from Flood Defence to Flood-Adapted Land Use: A Policy Coordination Perspective. Land Use Policy 95. https://doi.org/10.1016/j.landusepol.2019.02.032

Loughran, K., and J. R. Elliott. 2019. Residential Buyouts as Environmental Mobility: Examining Where Homeowners Move to Illuminate Social Inequities in Climate Adaptation. Population and Environment 41(1): 52–70. https://doi.org/10.1007/s11111-019-00324-7

Marfai, M. A., L. King, J. Sartohadi, S. Sudrajat, S. R. Budiani, and F. Yulianto. 2008. The Impact of Tidal Flooding on a Coastal Community in Semarang, Indonesia. The Environmentalist 28(3): 237–248. https://doi.org/10.1007/s10669-007-9134-4

Martínez-Graña, A. M., T. Boski, J. L. Goy, C. Zazo, and C. J. Dabrio. 2016. Coastal-Flood Risk Management in Central Algarve: Vulnerability and Flood Risk Indices (South Portugal). Ecological Indicators 71: 302–316. https://doi.org/10.1016/j.ecolind.2016.07.021

Mendelsohn, R. 2000. Efficient Adaptation to Climate Change. Climatic Change 45(3): 583–600. https://doi.org/10.1023/A:1005507810350

Miller, A. C., and T. M. Ravens. 2022. Assessing Coastal Road Flood Risk in Arctic Alaska, a Case Study from Hooper Bay. Journal of Marine Science and Engineering 10(3): 406. https://doi.org/10.3390/jmse10030406

Nagayasu, J. 2021. Life Cycles and Gender in Residential Mobility Decisions. Journal of Real Estate Finance and Economics 62(3): 370–401. https://doi.org/10.1007/s11146-019-09743-7

Pathak, S. 2021. Determinants of Flood Adaptation: Parametric and Semiparametric Assessment. Journal of Flood Risk Management 14(2): e12699. https://doi.org/10.1111/jfr3.12699

Permana, I., and Y. Miyata. 2008. An Urban Economic Model of Illegal Settlements In Flood Prone Areas In Palangkaraya City, Indonesia: A Partial Equilibrium Analysis. Regional Science Inquiry Journal IV(1): 29–38.

Piggott-McKellar, A. E., and C. McMichael. 2021. The Immobility-Relocation Continuum: Diverse Responses to Coastal Change in a Small Island State. Environmental Science and Policy 125: 105–115. https://doi.org/10.1016/j.envsci.2021.08.019

Quinn, T., F. Bousquet, C. Guerbois, E. Sougrati, and M. Tabutaud. 2018. The Dynamic Relationship between Sense of Place and Risk Perception in Landscapes of Mobility. Ecology and Society 23(2). https://doi.org/10.5751/es-10004-230239.

Rogers, B. C., N. Bertram, B. Gersonius, A. Gunn, R. Löwe, C. Murphy, R. Pasman, M. Radhakrishnan, G. Urich, T. H. F. Wong, and K. Arnbjerg-Nielsen. 2020. An Interdisciplinary and Catchment Approach to Enhancing Urban Flood Resilience: A Melbourne Case. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 378(2168): 20190201. https://doi.org/doi:10.1098/rsta.2019.0201

Sambodo, M. T., and R. Novandra. 2019. The State of Energy Poverty in Indonesia and Its Impact on Welfare. Energy Policy 132: 113–121. https://doi.org/10.1016/j.enpol.2019.05.029

Sayers, P. 2017. Evolution of Strategic Flood Risk Management in Support of Social Justice, Ecosystem Health, and Resilience. In Oxford Research Encyclopedia of Natural Hazard Science. https://doi.org/10.1093/acrefore/9780199389407.013.85

Schanze, J. 2006. Flood Risk Management: A Basic Framework. In J. Schanze, E. Zeman, and J. Marsalek, eds. Flood Risk Management: Hazards, Vulnerability and Mitigation Measures. NATO Science Series 67: 1–20. Springer Netherlands. https://doi.org/10.1007/978-1-4020-4598-1_1

Sufyan, S. B., M. Y. A. Kadir, and C. E. Fitriyeni. 2020. Customs Policy for Land and Building Rights in Optimization of Original Income in Aceh Besar District, Indonesia. Proceedings of the International Conference on Law, Governance and Islamic Society (ICOLGIS 2019). https://doi.org/10.2991/assehr.k.200306.225

Syam, D. A., K. R. L. Wengi, and A. Gandapurnama. 2021. Climate Risk And Impact Assessment Pekalongan. Mercy Corps Indonesia.

Ullah, F., S. E. Saqib, M. M. Ahmad, and M. A. Fadlallah. 2020. Flood Risk Perception and Its Determinants among Rural Households in Two Communities in Khyber Pakhtunkhwa, Pakistan. Natural Hazards 104(1): 225–247. https://doi.org/10.1007/s11069-020-04166-7

Van Ham, M. 2012. Housing Behavior. In The SAGE Handbook of Housing Studies. SAGE Publications Ltd. https://doi.org/10.4135/9781446247570

Walelign, S. Z., and P. Lujala. 2022. A Place-Based Framework for Assessing Resettlement Capacity in the Context of Displacement Induced by Climate Change. World Development 151: 105777. https://doi.org/10.1016/j.worlddev.2021.105777

Wang, D., S. He, C. Webster, and X. Zhang. 2019. Unravelling Residential Satisfaction and Relocation Intention in Three Urban Neighborhood Types in Guangzhou, China. Habitat International 85: 53–62. https://doi.org/10.1016/j.habitatint.2019.01.004

Winstanley, A. N. N., D. C. Thorns, and H. C. Perkins. 2002. Moving House, Creating Home: Exploring Residential Mobility. Housing Studies 17(6): 813–832. https://doi.org/10.1080/02673030216000

Wolff, C., T. Nikoletopoulos, J. Hinkel, and A. T. Vafeidis. 2020. Future Urban Development Exacerbates Coastal Exposure in the Mediterranean. Scientific Reports 10(1): 14420. https://doi.org/10.1038/s41598-020-70928-9

Zhang, Y., S. N. Hwang, and M. K. Lindell. 2010. Hazard Proximity or Risk Perception? Evaluating Effects of Natural and Technological Hazards on Housing Values. Environment and Behavior 42(5): 597–624. https://doi.org/10.1177/0013916509334564

CHAPTER 9

Post-Disaster Recovery in Kerala, India: At a Crossroads

Jyothi Krishnan and Abey George

9.1 Introduction

This chapter examines post-disaster recovery processes in a few disaster-affected pockets in the southern state of Kerala in India. The chapter argues that while recovery processes are implemented by the state, they are embedded in unequal social and economic power relations. Post-disaster situations can therefore mimic pre-disaster vulnerabilities and inequalities. If attempts to restore normalcy are not accompanied by efforts to unmask unequal social and economic power relations, post-disaster recovery can result in the re-institutionalization of marginality and social vulnerability.

Post-disaster recovery therefore needs to be viewed as a social process that is to be informed by discourses around social inequalities. It also needs to take a critical view of the concept of "normalcy." First, the chapter briefly examines the changing view of disasters and critiques about the term "natural disasters." It also touches upon debates that inform our understanding of disaster vulnerability and post-disaster recovery. Next, the chapter looks at post-disaster recovery processes under way in certain disaster-affected pockets of the state of Kerala. It looks at how most recovery processes have been focused on housing, neglecting the availability of other basic services, livelihood recovery, and the revival of ruptured community bonds, all of which are critical to recovery. It also looks into the gaps in delivery of the housing component, which have aggravated vulnerabilities. Notable in all cases is the near-total absence of the affected population in decisions that affect their lives after the disaster.

9.1.1 Situating Disasters

Classical disaster research has treated disasters as events that originate as physical events in the earth and atmospheric systems, which then create an impact on the environment and social systems.[1] Disasters therefore are viewed as events with a sudden onset and are identified by the scale of the casualties, damage, and disruption that they cause (Tierney 2019). Such a view also subscribes to a linear view of disasters as events that have a "beginning (the period of onset), a middle (the emergency period), and ultimately an end (when social life returns more or less to normal and when recovery takes place)" (Curato and Ong 2015: 7). Such a view makes disasters appear as extraneous events, beyond human control.

Contrary to this approach, the field of critical sociology puts forth the view that disasters are socially produced and emphasize the political economy/ecology of disasters. By doing so, they argue that the political and economic forces operating at different levels (local, regional, and international) contribute to disaster vulnerability as well as to post-disaster recovery (Tierney 2019). In their influential book, At Risk: Natural Hazards, People's Vulnerability and Disasters, Wisner et al. (2004) argue that disasters originate in social conditions that may be far removed from "disaster triggers" such as earthquakes and

[1] Disaster according to Fritz is an "event, concentrated in time and space, in which a society, or a relatively self sufficient sub division of a society, undergoes severe danger and incurs such losses to its members and physical appurtenances that the social structure is disrupted and fulfillment of all or some of the essential functions of the society is prevented" (Fritz 1961: 655 in Tierney 2019).

hurricanes. The very same social, economic, and political forces that shape the occurrence of disasters also play a role in the recovery processes that follow.

In keeping with this line of thought, the links between disasters and the larger development process have been subject to closer scrutiny over the past few decades, with greater recognition of the ways in which existing development pathways undermine ecosystems and ecological services and also create or aggravate social vulnerabilities. Tierney argues that rather than focusing on calamitous events and their effects, there is a need to be critical of decisions and actions of government, elites and their financial supporters, and global industries and financial institutions (Tierney 2019).

The critique of the usage of the term "natural disasters" further substantiates this argument. It raises questions about the glossing over of factors such as poor urban planning, increasing socioeconomic inequalities, nonexistent or poorly regulated policies, and lack of well-conceived adaptation and mitigation in the exacerbation of disaster risks. The United Nations International Strategy for Disaster Reduction Secretariat, recognizing that disasters result from the intersection of natural hazards with social/human vulnerability and developmental activities that do not consider local hazardous conditions, stated that the term "natural disasters" is no longer to be used in their communication (Chmutina and von Meding 2019). This commitment is reflected in the publication of the Global Assessment Report as well (UNDRR 2019).

9.1.2 Disasters within the Framework of Justice

In addition to understanding the link between development and disasters, the justice framework echoes the arguments of environmental justice, unpacking the uneven distribution of risks and benefits (Clark, Chhotray, and Few 2013). When applied in a disaster context, the justice framework highlights how individuals or groups have to bear disproportionate risks without having proportionate access to the benefits of a development pathway that creates disaster risks and vulnerabilities in the long run (Clark, Chhotray, and Few 2013 in Krishnan 2020). Understanding of the social differentiation of vulnerability as well as intersecting vulnerabilities (Tierney 2019) illustrates how risk exposure is systemic in nature (Oliver-Smith 2013), enhancing the risk exposure of certain sections of society and resulting in certain sections of society being disproportionately affected by disasters, with class, gender, age, and ethnicity being some of the key factors (O'Keefe 1976 in Bankoff 2007).

Stallings discusses how the sudden social disruption caused by disasters lays bare the above mentioned social structures and processes that are often "hidden in the ordinariness of everyday life" (Stallings 2002: 283 in Curato and Ong 2015), leading Lukes (2006) to profoundly state that "disasters can lift veils," indicating that disasters lift the veils over social realities, bringing to light existing social and power inequalities. A classic case of this was how the unfolding of the coronavirus disease (COVID-19) pandemic in India unveiled the huge proportions of the migrant worker crisis in India. The large numbers of migrants walking back home from their workplaces during the months of March and April 2020 revealed the harsh social context in which their lives were located. The onset of disasters therefore unravels the multiple dimensions of vulnerability.

Operationalizing justice in the post-disaster framework needs to consider these structural vulnerabilities (Krishnan 2020), which are rooted in social inequalities that affect the ability of disaster victims to "escape, survive and/or bounce back from disasters" (Wisner et al. 2004; Islam and Lim 2015). Chmutina and von Meding (2019) argue for a rightful discourse around the themes of power, class, inequality, and marginalization in our attempt to understand disasters. This needs to pave the way for our understanding of post-disaster recovery as well, calling for a critical view of the concept of "normalcy." If normalcy implies a re-institutionalization of pre-disaster marginalities, then it will

result in reinstating the very same development pathways and social/power inequalities that trigger disasters and create unequal social impacts.

9.2 Post-Disaster Recovery

Historically, post-disaster reconstruction has consisted of simply repairing the physical damages induced by a disaster. More recently, post-disaster recovery is coming to be viewed as an opportunity to improve upon the pre-disaster state and to create a more resilient future (Boano 2009 in Mannakkara, Wilkinson, and Potangaroa 2018). The concept of "build back better" (BBB) outlines a concept of recovery that combines rehabilitation and enhancement of the built environment with psychological, economic, and social recovery in a holistic way (Boano 2009 in Mannakkara, Wilkinson, and Potangaroa 2018). There is increasing recognition of the fact that complete recovery requires active engagement with affected communities in order to rebuild their social and economic status as well as their natural and built environments (Boano 2009 in Mannakkara, Wilkinson, and Potangaroa 2018).

BBB emerged as a slogan during the 2004 Indian Ocean tsunami as a way to make use of the reconstruction process to improve a community's physical, social, environmental, and economic conditions to create a more resilient community, with resilience being defined as the capacity to bounce back after an event (Twigg 2007 in Mannakkara 2018). Post-disaster recovery requires recognition of multiple and intersectional vulnerabilities that the community experienced even before a disaster. Such an in-depth understanding of social processes is often missing from recovery processes, especially when those processes are planned and implemented by bureaucratic agencies.

9.2.1 Post-Disaster Recovery in Kerala

The state of Kerala has had to grapple with the complex issue of post-disaster recovery in a significant manner since 2017. After the tsunami of 2004, it was Cyclone Ockhi of 2017 that marked the beginning of an almost annual encounter with disasters. The cyclone in 2017 was followed by the Kerala floods and landslides in 2018. This was in turn followed by landslides in 2019 (Kavalappara and Puthumala), 2020 (Pettimudi in Idukki district), and 2021 (Kootikal). In addition, over the past 5–10 years, increasing coastal erosion in many parts of the state has led to the displacement and relocation of coastal communities.

This chapter looks into the recovery processes following the displacement and relocation of people affected by the Anakkayam landslides during the Kerala floods of 2018, the Kavalappara landslides of 2019, the relocation of households affected by coastal erosion in the Trivandrum district, and rehabilitation of those affected by the 2004 Indian Ocean tsunami. The chapter draws on insights gained from field visits to recovery sites in different parts of the state comprising key informant interviews, focus group discussions, and interviews with affected households. Insights from postgraduate student dissertation works in the area of post-disaster recovery during 2022 have also enriched the chapter.[2] The chapter analyzes the recovery process as it unfolds, highlighting the gaps in the process.

Housing Recovery

Reconstruction of houses is often one of the first activities taken up as a part of post-disaster recovery. Reconstruction of houses and setting up rehabilitation colonies is portrayed as proof of post-disaster

[2] Postgraduate students at the newly set up department of the Master of Social Work in Disaster Management Program at Loyola College of Social Sciences in Trivandrum have undertaken and continue to undertake dissertation work in the area of post-disaster recovery. Chapter coauthor Jyothi Krishnan has been involved in supervision of this work.

recovery, with completion of housing being treated as completion of rehabilitation. The following discussion examines the process of housing recovery in areas affected by landslides, coastal erosion, and the much older tsunami, and illustrates how inadequacies in the process of housing recovery create additional vulnerabilities.

Landslides, housing recovery, and tribal communities. The issue of housing recovery following landslides is examined through two contrasting cases in Kavalappara (Malappuram district) and Pothupara (Thrissur district) of Kerala. Both cases involved relocation away from the original site of habitation.

Kavalappara witnessed one of the most severe landslides in the state's history in August 2019, resulting in a death toll of 59, the washing away of 100 acres of land, and widespread damages to houses and other property (Savith, Vineetha, and Sheela 2021).[3] The majority of those affected by the Kavalappara landslides were forest dwelling tribal groups classified as Particularly Vulnerable Tribal Groups. The Cholanaikan, Kattunaikan, and Kaatupaniya communities were affected by the landslides, with most of their homes being washed away (Ramachandran 2019). The case of rehabilitation of the Kaatupaniya communities has been examined in detail (Sobhanan 2022).

Prior to the landslide, the Kaatupaniya tribal community lived in Muthappankunnu, and their livelihood consisted of collection of minor forest produce, daily wage work that was seasonally offered by the forest department as well as on private land, and MGNREGA[4] work. Soon after the landslide, 32 Kaatupaniya families (about 180 people) moved into the two-storied auditorium of the panchayat (self-government council), which functioned as a relief camp. They insisted that they be rehabilitated in one single location, and hence waited until land that could house all the affected Kaatupaniya families could be identified. Since living conditions were difficult in the camp, those who could afford to pay rent left to live in rented homes. As of 2022, 3 years after the landslide, 12 Kaatupaniya families (55 people) continued to live in the relief camp in about 2,000 square feet. They had not yet moved to the new housing site owing to incomplete construction.

One reason for the incomplete housing was the exhaustion of housing funds, which was related to the lack of information for the affected families about the total budget available for house construction. The funds for housing were released in installments to the bank accounts of affected families. Since the post-landslide period coincided with the COVID-19 lockdown period, many reported mistaking some of these amounts to be part of the COVID-19 relief funds. Some of them had received money as compensation following the death of their family members during the landslide, and they mistook the funds for housing as compensation for the death of their family members. The economic stress experienced after relocation to the relief camp also led to some of this money being spent. Reduced wage labor opportunities at the site where the camp was located, coupled with the restrictions imposed during the lockdown period, forced people to spend out of the money transferred to their accounts (Sobhanan 2022).

This lack of information and related spending has resulted in a situation wherein the kitchen or toilets of some of the houses have not been constructed due to paucity of funds, compelling people to take loans and complete the construction or to continue staying in the congested relief camps. Those not in

[3] Three severe landslides were reported in three locations on the same day: at Puthumala in Wayanad and in Kavalappara and Pathar in Malappuram (the latter two were separated by just a few hours). All three landslides were located in the catchment of the Chaliyar River (Krishnan 2020). The landslides in these two adjoining districts were located on either side of a section of the ecologically sensitive Western Ghats, close to the Nilgiri district in Tamil Nadu (Philip 2019).

[4] The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), earlier known as the National Rural Employment Guarantee Act (NREGA), guarantees 100 days of unskilled labor a year to anyone on demand. Introduced in 2005, this employment guarantee program is a significant social protection measure in rural areas across the country.

a position to take loans have not been able to complete construction. A few families moved into partially constructed homes. The prolonged stay in relief camps as well as living in partially constructed houses was a cause of stress. Staying on rent, on the other hand, posed an economic burden.

In contrast, the Kadar tribal community, displaced by the Anakkayam landslides in Thrissur district in 2018, spent a much shorter period in relief camps. Theirs is a unique case of resettlement, as they rejected the government's offer to relocate them to a location with rocky terrain. The community leaders identified a more suitable site at Pothupara, which is located on land that is under the custodianship of the forest department. As the selection of the site was made by the affected community, they did not get the necessary clearances from the forest department and have not been able to get legal title deeds for the land. Due to the absence of title deeds, neither the panchayat nor the tribal department has been able to extend housing support to the affected families. Discussions with the head of the Pothupara settlement during a field visit conducted in May 2022, 4 years after the relocation, revealed further details. In order to overcome the housing crisis, the affected Kadar households built their houses with bamboo, resorting to their Indigenous knowledge and skills in this regard. Many of the houses were given an additional tarpaulin roofing so as to withstand the onslaught of the monsoon downpour. The Pothupara case is one where the government has not been able to provide any facility (housing, electricity, toilets, drinking water) to the community, except for solar fencing. In this case however, the community's resolve to settle in Pothupara, coupled with the collective spirit with which they constructed their houses without any external support, has helped them to survive the post-disaster period (Soman 2023).

Relocation and housing recovery along the coast. The case of the fishing community displaced by coastal erosion and relocated in a flat complex at Uchakkada in Kulathoor panchayat in Trivandrum district is different (Rithika 2023). It is one of the most recently implemented rehabilitation programs for families affected by coastal erosion. The majority of the affected families used to live in the Pozhiyoor coastal tract (about 3–4 kilometers away), where sea surges had damaged houses located on the seafront. In 2021, they moved into the new flat complex, which has 128 flats spread through 4 blocks, all of which are located in close proximity on roughly 3 acres of land. Each flat is about 400 square feet in area. Poor-quality construction was revealed through the damp walls and the plastering falling off during field visits conducted merely a year after construction in October 2022. Residents of the newly constructed flats took out damp clothes from the built-in wardrobes as evidence of the damp walls. The discontent of the residents was not only about the poor construction quality, but also about the fact that they were unaware of the total budget allocated for housing and the expenditure incurred. This lack of information was similar to the predicament faced by the tribal community in Kavalappara. Some of the educated youth of the area reported that the poor-quality housing prompted them to believe that the money had been siphoned off.

The inadequacy of housing rehabilitation is clearly revealed in the case of the tsunami rehabilitation colony in Arattupuzha panchayat (Alappuzha district) and the Maharashtra colony (Alappad panchayat, Kollam district). Alappuzha and Kollam were the two districts most severely affected by the 2004 tsunami. In one of the tsunami relocation sites in Arattupuzha panchayat, 115 houses had been built by various private agencies and nongovernment organizations.[5] The Maharashtra colony in Kollam district was so named because 63 houses were built with financial support from the Maharashtra government, with the remaining 24 financed by the government of Kerala. Both the colonies were located on low lying swampy land, which enhanced the risks of flooding and sanitation problems during the monsoons. The houses were of a uniform size, with little variation in design and most houses located on about 870–1,300 square feet of land. Many of the displaced people were living in bigger

[5] These include Sevabharati, Manorama, World Vision, CASA, and Deepika.

houses on larger landholdings prior to the disaster, and they found it difficult to adapt to the small plots and houses in the colony. A common feature in both these colonies was the lack of maintenance work; as a result, leaking roofs and damp walls with plastering peeling off were commonly observed.[6] In the Maharashtra colony, this prompted some of the residents to move out on rent. In general, the houses had a worn-out look (Ashly and Kavya 2023).

Basic Facilities in the Resettlement Sites

In all of the above sites, the focus was primarily on housing. Very often, the completion of house construction is treated as completion of the rehabilitation process. The discussion in this chapter illustrates how other basic facilities such as quality access roads, drinking water, sanitation, washing facilities, drainage, and waste disposal are not treated as priority concerns. This becomes particularly critical when entire communities are relocated.

The difficulties imposed by the untarred access roads to the rehabilitation site at Kavalappara (Sobhanan 2022), or the steeply undulating access road to the Uchakkada flats, are not treated seriously. During focus group discussions conducted in October 2022, elder residents at the Uchakkada flats spoke of how it was difficult for them to walk from the main road to the flats, owing to the sloping road, compelling them to hire autorickshaws every time they went to town.[7] The lack of any other form of spatial planning in the flat complex at Uchakkada was found to result in mild tensions between residents. During the focus group discussions, residents expressed dissatisfaction about the lack of space demarcation for parking two-wheelers, which led to conflicts between neighbors. Likewise, the absence of a clearly designated washing space in a flat complex with 128 flats was another cause of conflict. The location of washing spaces on the terrace of the three-story flats and the resulting problem of damp walls on the flats immediately below the terrace triggered conflicts.

The complete absence of a waste disposal system at Uchakkada during a field visit in October 2022 (a year after residents had occupied the flats) led to a situation in which all 128 occupants dumped their unsorted waste in one corner of the campus, causing problems to the flat complex nearest to the dumping site. Kerala is a state that has witnessed a boom in construction of high-rise flats, all of which are equipped with basic facilities. It is therefore intriguing that such basic measures are neglected when flats are being constructed for communities displaced by disasters.

Equally serious was the problem of drainage and sanitation. The tsunami rehabilitation colony in Kollam was located on swampy land, and the rising water level during monsoons often led to sanitation problems. During field visits just before the 2022 monsoons, open drainage channels had become breeding grounds for mosquitos in the Arattupuzha tsunami rehabilitation colony. In the newly constructed Uchakkada flats, the sewage line that connected all the flat complexes gets blocked frequently, causing substantial inconvenience to residents and compelling them to hire laborers to clean the sewage line. In Kavalappara, many houses are without toilets due to the inadequacy of funds, discussed earlier.

Four years after the Kavalappara landslides, many of the homes in the relocation site were yet to be electrified. Drinking water availability was inadequate. A borewell dug for construction purposes had become the source of drinking water but was inadequate in meeting the needs of all the residents. The Kaatupaniyas often remorsefully recollected the fresh water they drank from the forest spring in their old village (Sobhanan 2022). The inadequate supply of drinking water led to the reluctance of people

[6] This was observed during field visits conducted in May 2022.

[7] Discussed at focus group discussions conducted at Uchakkada in October 2022.

to move into the new houses. The fact that something as essential as drinking water was not prioritized while arranging for rehabilitation is indicative of the quality of the rehabilitation.

Equally important is the availability of adequate space for recreation. While a small park was designed in the tsunami rehabilitation colony in Arattupuzha, its present state bespeaks negligence. The rusted swings and slides and other apparatus, overgrown with wild grass, makes it a space for antisocial activities. In the Maharashtra colony, the lack of playing space compels children to play in a small open space that is also the only space for cremation (Ashly and Kavya 2023). In the flat complex at Uchakkada, spaces for recreation for children and for elders to take evening strolls along with dispersed seating could have been created, had they been envisaged in the original plan.

Livelihood Recovery

The issue of livelihood recovery is often the most complex in post-disaster recovery, especially for communities who derive their livelihoods from the immediate natural environment (Krishnan 2020). Not giving due attention to this dimension results in reduced economic well-being in the post-disaster phase. The Kaatupaniya community, living off daily wage labor in the pre-disaster period, found it difficult to find adequate daily wage opportunities after their relocation to the relief camp (which was 5–6 kilometers away from their original hamlet), and they are likely to face the same problem even after relocating to the newly constructed colony. Sobhanan (2022) discusses how the lack of social networks in the new place makes it difficult for people to find work. The absence of social networks also makes it difficult for them to borrow small amounts of money to cope with the economic stress that results from inadequate work opportunities.

The coastal communities relocated in the Uchakkada flats also find it increasingly difficult to go to sea. While the flats are only 3–4 kilometers away from the coast, it is a significant distance for those who go fishing. This is because most of the fisherfolk go to sea around midnight or in the very early hours of the morning. The decision to go or not to go is taken collectively, at times in consultation with other fisherfolk. Living away from the coast therefore creates problems in coordinating with others. Those with two-wheelers cope with the additional distance, while others find it difficult to put up with the cost of hiring autorickshaws. Livelihood loss experienced by fishing communities when they are relocated from the coast has been well researched and documented. Irshad (2021) discusses how tsunami fisherfolk displaced from the coast lost the space to dock their boats and to dry and sell fish. They soon became workers on the boats of others (Irshad 2021). Fisherfolk displaced by coastal erosion in Trivandrum, living in relief camps for an extended period of time, also face similar livelihood issues.

Prolonged Stay in Relief Camps

In the event of relocation, most affected households are forced to live in relief camps until the resettlement sites are equipped with basic infrastructure. Prolonged stays in congested living conditions in relief camps are found to create multiple problems. The relief camps in Valiyatura, a coastal village in Trivandrum district, are a case in point. This camp has been home to households who have either lost their homes to coastal erosion or who are in danger of doing so. Some of the families lost their homes after Cyclone Ockhi in 2017. The state government's Punargeham project offers compensation of 1 million Indian rupees to those whose homes have been lost to sea erosion. This includes the cost of purchasing land and building a house. Since the amount is inadequate because of rising land prices and costs of construction, many prefer to live on rent rather than accept the package offered by the government. Those who are unable to pay rent live in the relief camps set up by the government. Visits to the camp in September 2022 revealed the difficult living conditions in the camp. Classrooms of Valiyatura Upper Primary School have been turned into living spaces, with three to four households

living in one classroom. These classrooms house the minimal possessions of each family. While some cook in these cramped conditions, some others cook in the verandas and in the available open space immediately outside the school building. The inadequate number of toilets makes sanitation a serious problem. Elder occupants find it difficult to use the toilets that are located away from their rooms. Water for drinking and cooking is stored in numerous Pepsi bottles (as the space is inadequate for storing water in large cans).

Similar conditions were observed in the relief camp at Pothukallu in Malappuram district, where an auditorium opposite the Pothukallu panchayat office had been functioning as a relief camp since 2019. Sobhanan (2022) takes note of the odor from the toilet in the room where 12 families had been living for more than 3 years. Leakage from the washing area resulted in damp floors, and people were compelled to cook in the open space (Sobhanan 2022). Sobhanan also takes note of how earlier amicable relations were strained from having to share limited facilities in the congested space in the relief camps for a prolonged period of time.

Grappling with a New Social Identity

Disasters often create a rupture in the social identity of displaced people. This was most evident in the case of the tsunami rehabilitation colonies in Kollam and Alappuzha districts. The passing of nearly 2 decades has not led to the social integration of the rehabilitated people in their new area. Their homes are referred to as "tsunami homes." In Kollam, they reported how they were referred to as *varatannmar* (those who were brought here). Residents resent the reference to their colony as the "tsunami colony." This identity crisis was also found to affect those who have been living in relief camps for an extended period of time (Ashly and Kavya 2023).

Moving into colonies with houses laid out in rows was also an uncomfortable experience for many of the relocated people. In the tsunami rehabilitation sites at Arattupuzha and Alappad, residents spoke of the loss of self-esteem they suffered when they had to move from bigger homes located on larger land holdings into houses that were 410 square feet in areas located on 3–4 cents of land. While acknowledging the financial implications in the location of land and building of houses, the general approach toward tsunami housing rehabilitation was to provide the bare minimum. Studies have taken note of how this uniform and minimalist housing pattern has shaped the new identity of the tsunami survivors, making tsunami housing colonies easily recognizable. Studies have also reported how families with some financial capacity have modified their housing structure to negate this identity that was imposed upon them (Irshad 2014).

Community Bonds

The rupturing of neighborhood bonds and other community/social networks following displacement has been much researched. This was found to affect different communities in different ways. The Kaatupaniya tribal community insisted on being relocated at a single site. However, living in the cramped and congested relief camp for 4 years did create conflicts and rifts amongst them. Sobhanan (2022) discusses the manner in which the common kitchen in the camp during the initial stages gave way to individual cooking arrangements for the families living there. The lack of adequate facilities for cooking for a larger group of people (55 families) contributed to this tension. The Pothupara case is distinct in this regard, as the community did not wait for the housing and related support to be provided by the government. Their collective resolve to move to a more suitable location, and to ensure that houses were built for all through collective effort, appears to have prevented social tensions in the course of relocation. All 23 families stayed in a large bamboo shed until individual house construction was complete. Staying together has allowed them to continue with their earlier livelihood

patterns, viz collection of minor forest produce. Minor forest produce collection often requires an extended stay in the forest (for a couple of weeks at least), during which time the families that remain in the hamlet take care of the homes of families who have gone to the forest.

In the case of the tsunami rehabilitation sites at Kollam and Arattupuzha and the Uchakkada flats for fishing communities, the residents include people who come from different affected pockets. While some residents were neighbors earlier, many were strangers. Hence, a new sense of community had to be forged. What links them together is their common livelihood and the common set of problems that they face in the new place of residence. The inadequacy of basic facilities (waste disposal system, clearly demarcated washing space, and a functional sewage system), however, threatens to make community bonding difficult.

9.2.2 Build Back Better?

Mannakkara, Wilkinson, and Potangaroa (2018) rightly articulate that the aim of recovery is for governments to work with communities to rebuild their social fabric (including their social and economic status) as well as their natural and built environments. This requires an appreciation of the social fabric as well as the natural and built environment that has been lost, both of which require an appreciation of social and ecological vulnerabilities. Just as disasters expose the social structures and processes that are often "hidden in the ordinariness of everyday life" (Stallings 2002 in Curato and Ong 2015), disaster recovery also reveals the unequal social and power relations that are normalized in everyday life (Lukes 2006) and thereby go unnoticed. The inability to extend the boundaries of rehabilitation by moving beyond the reconstruction of houses is revealed in the cases discussed in this chapter.

9.3 Recommendations for a Just and Sustainable Recovery Process

With the ongoing incidence of disasters, there is greater need to critically reflect upon past experiences with post-disaster recovery. Effective participation of the affected community in identification of relocation sites as well as in designing housing and other basic infrastructure is a prerequisite. It is the noninvolvement of the affected community in site identification that led to the Kadar community, displaced by the Anakkayam landslides, rejecting the site and choosing their own site for relocation. As discussed previously, this choice has not been duly supported by the concerned departments, so the community is yet to get permanent title deeds and connections for electricity and water supply.

Participatory disaster risk appraisals need to be conducted while identifying proposed resettlement sites in order to avoid future disaster risks. The location of tsunami rehabilitation colonies on land prone to waterlogging is a case in point.

Preferences of the community are also to be elicited while designing the resettlement site. It is not houses alone, but the alignment of houses and allocation of space for washing, recreation, cremation, and conduct of rituals, that also need to be considered. Equally important is the designing of the drainage and waste disposal system, the absence of which creates problems, as observed in the Uchakkada flat complex. The views of the community do not appear to find any space in the reconstruction process. A higher order of sensitivity is required when Indigenous communities are involved. In this context, it is particularly important that the team of experts and professionals involved in post-disaster recovery represents diverse domains of expertise. The focus on housing and related construction could lead to the reconstruction process being directed by engineers and contractors. There is a need to view reconstruction as a social process requiring the involvement of sociologists, anthropologists, planners,

social workers, and so on. There is also a need for constant engagement with the affected community while they are in the relief camps and after they have relocated.

There is also a need to emphasize livelihood recovery from the very beginning, particularly when communities rely on the immediate natural environment for their livelihoods. Ensuring livelihood stability during the time spent at relief camps will also facilitate a faster recovery process. When traditional livelihoods get disrupted, imaginative programs for alternative livelihoods need to be undertaken without any delay. In the case of entire communities being affected by disasters, restoring community bonds and networks should be an integral part of the livelihood recovery process. This would require the presence of trained and sensitized community facilitators.

The need for transparency and accountability in the recovery process is a mandatory prerequisite. This needs particular emphasis when the affected communities were socially marginalized even before the disaster. Measures need to be taken to ensure effective communication with the affected community such that they are fully informed about the process to follow as well as the allocation of budgets for housing and other facilities. Public hearings need to be conducted during the recovery process (at the time of commencement, during, and after the recovery). Such public hearings should be attended by the entire community, the local self-government representatives, and concerned department officers. The post-disaster recovery process needs to be anchored around democratic decision making, ensuring the informed participation of affected communities.

References

Ashly, A. R., and B. Kavya. 2023. Post-Disaster Rehabilitation: A Study of Tsunami Resettlement Villages in Kollam and Alapuzha Districts of Kerala. In K. G. Ajeesh, R. T. George, and N. S. Sajan, eds. *Disaster Resilience: Social Work Perspectives*. New Delhi: Authorspress.

Bankoff, G. 2007. Comparing Vulnerabilities: Toward Charting an Historical Trajectory of Disasters. *Historical Social Research / Historische Sozialforschung* 32(3): 121.

Chmutina, K., and J. von Meding. 2019. A Dilemma of Language: "Natural Disasters" in Academic Literature. *International Journal of Disaster Risk Science* 10: 283–292.

Clark, N., V. Chhotray, and R. Few. 2013. Global Justice and Disasters. *Geographical Journal* 179(2): 105–113.

Curato, N., and J. C. Ong. 2015. INTRODUCTION TO THE SPECIAL ISSUE: Disasters Can Lift Veils: Five Issues for Sociological Disaster Studies. *Philippine Sociological Review* 63(Special Issue: Sociology of Disasters): 1–26.

Irshad, S. M. 2014. Governing Disaster Risk and "Survivability": The Case of Two Villages in Kerala, India. *International Journal of Emergency Management* 10(3/4): 276–287.

____. 2021. Disaster and Institutionalising Rehabilitation: Survivors Experience and Institutional Contestations. *Disaster Response and Management Journal* 7(1).

Islam, M. S., and S. H. Lim. 2015. When "Nature" Strikes: A Sociology of Climate Change and Disaster Vulnerabilities in Asia. *Nature and Culture* 10(1): 57–80.

Krishnan, J. 2020. Living with Floods: Coping with Livelihood Uncertainties in Post-Flood Kerala. *Two Writings on Climate, Disasters and Displacement, Policies and Practices* 112. Mahanirban Calcutta Research Group.

Lukes, S. 2006. Questions about Power: Lessons from the Louisiana Hurricane. https://items.ssrc.org/understanding-katrina/questions-about-power-lessons-from-the-louisiana-hurricane/

Mannakkara, S., S. Wilkinson, and R. Potangaroa. 2018. *Resilient Post Disaster Recovery through Building Back Better*. London: Routledge.

Oliver-Smith, A. 2013. Disaster Risk Reduction and Climate Change Adaptation: The View from Applied Anthropology. *Human Organization* 72(4): 275–282.

Philip, S. 2019. Kavalappara Landslide: How a Hill in Western Ghats Buried Part of a Village in Kerala. *Indian Express*. 14 August. https://indianexpress.com/article/explained/how-a-hill-in-the-western-ghats-buried-a-part-of-a-village-in-kerala-kavalappara-landslide-5903013/

Ramachandran, K. G. 2019. Natural Disaster in Kerala, 2019. Using Diversity Network, Tamil Nadu, India. https://usingdiversity.keystone-foundation.org/natural-disaster-in-kerala-2019/

Rithika, R. 2023. Coastal Erosion, Displacement and the Punargeham Project in Pozhiyoor Coastal Village, Trivandrum. In K. G. Ajeesh, R. T. George, and N. S. Sajan, eds. *Disaster Resilience: Social Work Perspectives*. New Delhi: Authorspress.

Savith, S., P. Vineetha, and A. M. Sheela. 2021. Post Landslide Investigation of Shallow Landslide: A Case Study from the Southern Western Ghats, India. *Disaster Advances* 14(7): 52.

Sobhanan, A. 2022. Post Disaster Vulnerabilities and Disaster-Induced Changes in the Life and Livelihoods of the Kaatupaniya Tribal Community. Unpublished dissertation submitted to the University of Kerala.

Soman, A. 2023. Challenges in Community-Led Post Disaster Recovery: A Study in Pothupara Hamlet, Thrissur. In K. G. Ajeesh, R. T. George, and N. S. Sajan, eds. *Disaster Resilience: Social Work Perspectives*. New Delhi: Authorspress.

Tierney, K. 2019. *Disasters: A Sociological Approach*. Cambridge: Polity Press.

UNDRR (United Nations Office for Disaster Risk Reduction). 2019. Global Assessment Report on Disaster Risk Reduction. https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2019

Wisner, B., P. Blaikie, T. Cannon, and I. Davis. 2004. *At Risk: Natural Hazards, People's Vulnerability and Disasters*. New York: Routledge.

CHAPTER 10

Investigating Build-Forward-Better Disaster Recovery Policies for Nepal 2015 Earthquake Recovery: An Approach Using a Recursive General Equilibrium Model

Michael C. Huang, Santosh Kumar Rauniyar, Yoko Iwaki, and Damaru Ballabha Paudel

10.1 Introduction

Two great earthquakes over magnitude 7.6 hit Nepal in April 2015 in the Gorkha district, 180 kilometers northwest of the capital city, Kathmandu. As of 2019, the losses of 8,970 lives and 22,303 casualties were confirmed, with 893,786 partially and fully collapsed buildings; economic losses of 706 billion Nepalese rupees (NRs) or $7 billion were estimated, and more than 800,000 people were displaced (Subedi and Chhetri 2019). The aftermath and reconstruction work faced adversity: the affected area, including the capital city, which had already been damaged severely, was hit by an energy crisis the next year, 2016. Several investigations have been conducted to analyze the building damages and losses (Government of Nepal 2015a, 2015b). The recovery was focused on build-back-better plans, prioritizing the repair of vulnerable nonengineered buildings that were earthquake hazards due to being constructions by uncertificated architects and engineers. Thereafter, the preliminary assessment for build-forward-better approaches was critical to adequate recovery with new development technology (Ulak 2016; Molden, Sharma, and Acharya 2016)

Nepal is abundant in resources for hydropower and solar energy, but its development only contributes 5% of the total renewable energy supply. While biomass accounts for most of the household energy use, imported energy sources like oil and coal are mainly utilized for industry (IRENA 2022). The initial infrastructure investment may be unaffordable among ordinary households, as Nepal's gross domestic product (GDP) per capita reached just $1,180 in 2020 (IMF 2022). However, due to technological development and declining costs, renewable energy has become an important solution in achieving environmental sustainability, energy for supply, and economic development (Aoshima and Asano 2017). Furthermore, while approximately 76% of the Nepalese population has access to electricity, many households rely solely on traditional biomass sources for cooking, resulting in heavy air pollution and life-threatening diseases. Therefore, as Nepal undergoes reconstruction activities, better resilience in critical sectors has become an essential element in effective risk reduction toward sustainable development.

A steady power supply could greatly help disaster preparedness, increase resilience, and reduce vulnerability. However, a comprehensive approach combining renewable energy and disaster recovery is rarely mentioned, partly due to the data inaccessibility and limited market scale. While most impact assessments of the Nepal earthquake of 2015 focused on direct physical impact, they seemed to have left gaps for indirect impact analyses of recovery policy as well as the roles of fiscal, international trade, or technology policy. This research aims to construct an evidence-based approach to establish a comprehensive framework to visualize the options for build-forward-better policies, their potential impact, and their costs to help policymakers make recovery decisions with sectoral compensation/subsidy policy for Nepal's 2015 earthquake.

In addition to international aid, government revenue is a primary source of funds for disaster recovery plans. The breakdown of Nepal's government revenue (Table 10.1) has changed significantly over time, especially in the category of customs tax, which indicates that the tariff reduction on imported sources facilitates the reconstruction process and speeds up the recovery. For a landlocked country like Nepal, growing trade volume may also help reduce the burden of domestic production during the aftermath, allowing more capital factors to be reallocated for reconstruction.

Table 10.1: Tax Revenue for the Government of Nepal, 2010 and 2020

Fiscal Year 2010			
Form of Taxes	Amount (NRs million)	Total Tax Revenue Ratio (%)	GDP Ratio (%)
VAT	61,680	29.4	4.4
Income tax	41,720	19.9	3.0
Excise duty	26,450	12.6	1.9
Customs duty	80,200	38.2	5.7
Total	210,050	100.0	14.9
Fiscal Year 2020			
Form of Taxes	Amount (NRs million)	Total Tax Revenue Ratio (%)	GDP Ratio (%)
VAT	263,750	37.7	7.0
Income tax	197,690	28.2	5.2
Excise duty	100,620	14.4	2.7
Customs duty	137,990	19.7	3.7
Total	700,050	100.0	18.6

GDP = gross domestic product, NRs = Nepalese rupees, VAT = value-added tax.

Note: The GDP of Nepal was NRs1,409,730 million in 2010 and NRs3,767,040 million in 2020.

Source: Nepal Annual Economic Report 2067–2068 [2010–2011 CE], published by the Inland Revenue Department, Government of Nepal.

To provide an evidence-based quantitative approach to investigate the cost-effectiveness of recovery policy for Nepal's 2015 earthquake, we developed a dynamic computable general equilibrium (CGE) model applying Nepal's 2010 input–output table to examine further the sectoral impact and the government's fiscal, trade, and technology policy for build-back-better and build-forward-better approaches.

10.2 Methodology

The purpose of this research is to develop a practical framework of disaster policy analysis for Nepal's earthquake recovery through a macroeconomic scope, focusing on the disaster impact assessments and with an effective compensation/subsidy policy to help the damaged sectors to recover with resilience, an approach that is often called "build forward better." The macroeconomic framework developed in this research will enable us to combine the estimates of the direct physical impact of a disaster from an engineering viewpoint with an economic model. More specifically, the research aims to develop a method to estimate loss production factors (e.g., capital, labor) and a new composite of

power generation invested in the new technology infrastructure. Compared with conventional disaster studies from engineering viewpoints of physical losses, the research aims to demonstrate the disaster impact assessment and the recovery framework by constructing a recursive multi-sector CGE model based on the optimization behavior of individual households and firms and their market competition (Hosoe, Gasawa, and Hashimoto 2010; Rose and Guha 2004) to analyze the earthquake's economic impact on Nepal. In addition, the CGE models to be used in the research would help analyze the aggregate welfare and distributional impacts of policies through multiple markets for various types of fiscal measures (e.g., taxation and subsidy) by the government (Adam 2013).

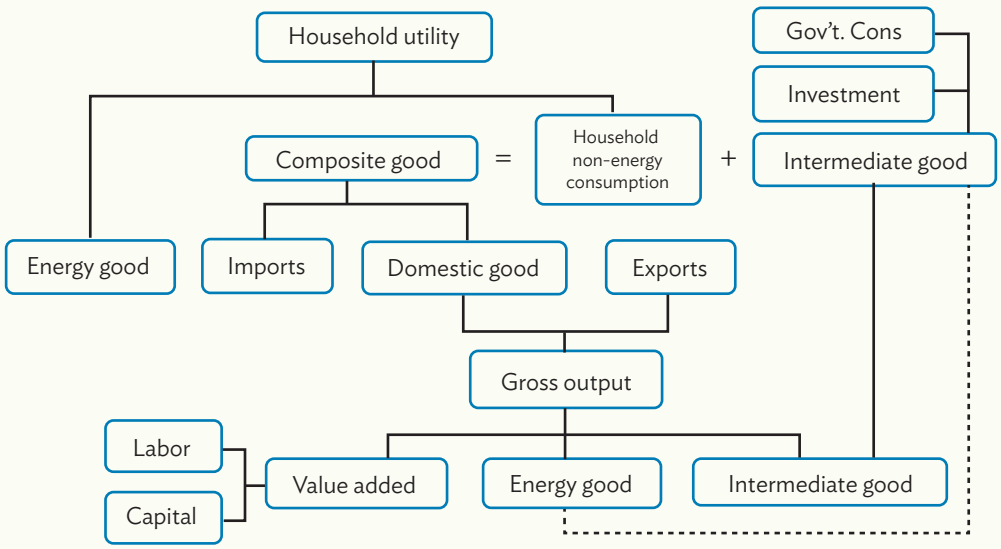
In addition to the statistics surveyed by the disaster recovery agency, the research focuses on designing a survey question and index method for collecting the most informative data (Kajitani and Tatano 2009). An input–output table on the selected region and key sectors were used to construct the empirical model. The government mechanisms and policy practices were grounded for making plausible policy instruments for simulations with the calibration of collected data. Constructing a framework to demonstrate the economic impact and recovery policy in various disaster scenarios could enable the quantification of the sectoral disaster impact and provide recovery policy options (Huang and Hosoe 2016, 2017; Tanaka and Huang 2021).

The research was conducted using general equilibrium analysis to construct a disaster impact assessment and recovery framework through various policy simulations. The Nepalese 2010 input–output table (Paudel 2014) was applied and aggregated from 38 to 10 sectors to obtain the realistic coefficient to examine sectoral interdependence (details in Table A10.1). To better capture the international economy feature, we extended Nepal's input–output table by including the tariff rates based on the trade policy review (WTO 2014). This framework is expected to assist policymakers in better managing disaster risks and developing industrial recovery plans based on quantitative assessments. In addition, such a synergic instrument could describe how disaster shocks are propagated in an economy and how indirect loss amounts are generated. The implementation of a recovery policy by providing compensation/subsidies was made in policy simulations using the CGE model following the capacity and estimated construction cost. The framework was used to simulate different policy options on the investment amount in renewable sectors and examine the sectoral impact.

10.2.1 Analytical Process

The disaster impact assessments and the input–output table for renewable energy made it possible to construct a recursive CGE model for the disaster recovery policy simulations (Figure 10.1). In all scenarios, a 10-year compensation for (i) capital-use subsidy as renovation for manufacturing facilities, (ii) production subsidy as an incentive for production, and (iii) tariff removal as trade liberalization was made for all sectors to examine its cost-effectiveness and recovery resilience. Thanks to data availability, technical assistance, and collaboration between Nepal and Japan, we were able to calibrate the energy technology improvement parameter from Japan (Huang and Kuroda 2021) to scrutinize its application in the recovery process with higher energy efficiency in Nepal. This allowed us to observe its impact in the build-forward-better recovery process. This technological parameter is for macroeconomic simulations and is thus not limited to the products from a certain country in sectors of machinery or energy. Finally, this recursive CGE model was applied to examine the fiscal cost of compensation/subsidy recovery policy and the consequences of welfare change. The simulation results provide quantified information on the recovery speed and fiscal and social benefits/costs as consequences.

Figure 10.1: The Computable General Equilibrium Model Structure



Source: Compiled from Huang and Hosoe (2016).

10.2.2 Scenarios

Nepal's 2015 earthquake. There has been no specific quantitative analysis on the losses of sectors in the Nepal earthquake of 2015. To recreate the scenario of the earthquake, we used the sectoral impact estimated by the Government of Nepal (2015b) divided by the pre-disaster stock sourced from the 2014–2015 national accounts (Ministry of Finance 2015). To estimate the loss in the capital stock, we multiplied the sectoral output reduction by the capital ratio to determine the damage in sectors and the labor endowment loss. The sectoral damage and labor endowment are stated in Table 10.2.

Table 10.2: Sectoral Damage from the 2015 Earthquake

Sector	2014 Output (NRs million)	2015 Loss (NRs million)	Capital Ratio (%)	Damage (%)
Agriculture	831,007	62,387	50.7	3.8
Energy	62,863	6,529	82.8	8.6
Food*	452,400	121,696	80.3	21.6
Metals*			79.8	21.5
Machinery*			76.4	20.6
Manufacturing*			76.4	20.6
Trade	354,858	16,593	57.5	2.7
Tourism	123,683	76,522	48.4	29.9
Transportation	287,807	35,533	67.9	8.4
Service	744,408	105,707	62.9	8.9
Labor endowment (million people)	26.5	5.6	49.3	10.4

* These four sectors are aggregated in the same sector in Government of Nepal (2015b).

Source: Estimated by authors based on Government of Nepal (2015b) and Ministry of Finance (2015).

Based on the recursive CGE model structure of recovery policy (Huang and Hosoe 2017; Tanaka and Huang 2021), the capital factor is immobile and sector specific. This indicates that the capital stock would not increase as time passed unless the surplus occurred as an investment. By contrast, the labor factor is mobile among production sectors, allowing the flow from sectors upon their optimal rationales. The labor losses do not necessarily imply mortality, but may reflect the temporary shortage, displacement, or unavailability in damaged facilities due to the earthquake. Based on the large-scale disaster recovery process, employment was assumed to resume within 5 years (Huang and Hosoe 2017; Tanaka and Huang 2021). Finally, social welfare was determined as equivalent variations of the household utility change affected by the price changes triggered by the policies.

Ten-year recovery policy for building back better. To examine the effective compensation and recovery policy toward the target year—the 11th year after the disaster—we designed three types of subsidies as incentives to be implemented for 10 years to stimulate the sectoral output to rebound to its pre-disaster business-as-usual level and further investigate the welfare change for the tariff removal policy. In the model structure, the policy should be financed from a lump-sum tax, and it also could be referable as the budget needed to reach the recovery target. These policy simulations demonstrate a numerical approach for build-back-better policy analysis. The required subsidy rates are stated in Table 10.3 for the following recovery policies:

- **Capital-use subsidy:** Provide a subsidy to reconstruct the damaged buildings, factories, or facilities such as machines for production operation.
- **Production subsidy:** Provide a subsidy as an incentive for firms to produce more.
- **Tariff removal:** Remove the current sectoral tariff as trade liberalization.

Table 10.3: Sectoral Subsidy Rates for Recovery Policies
(%)

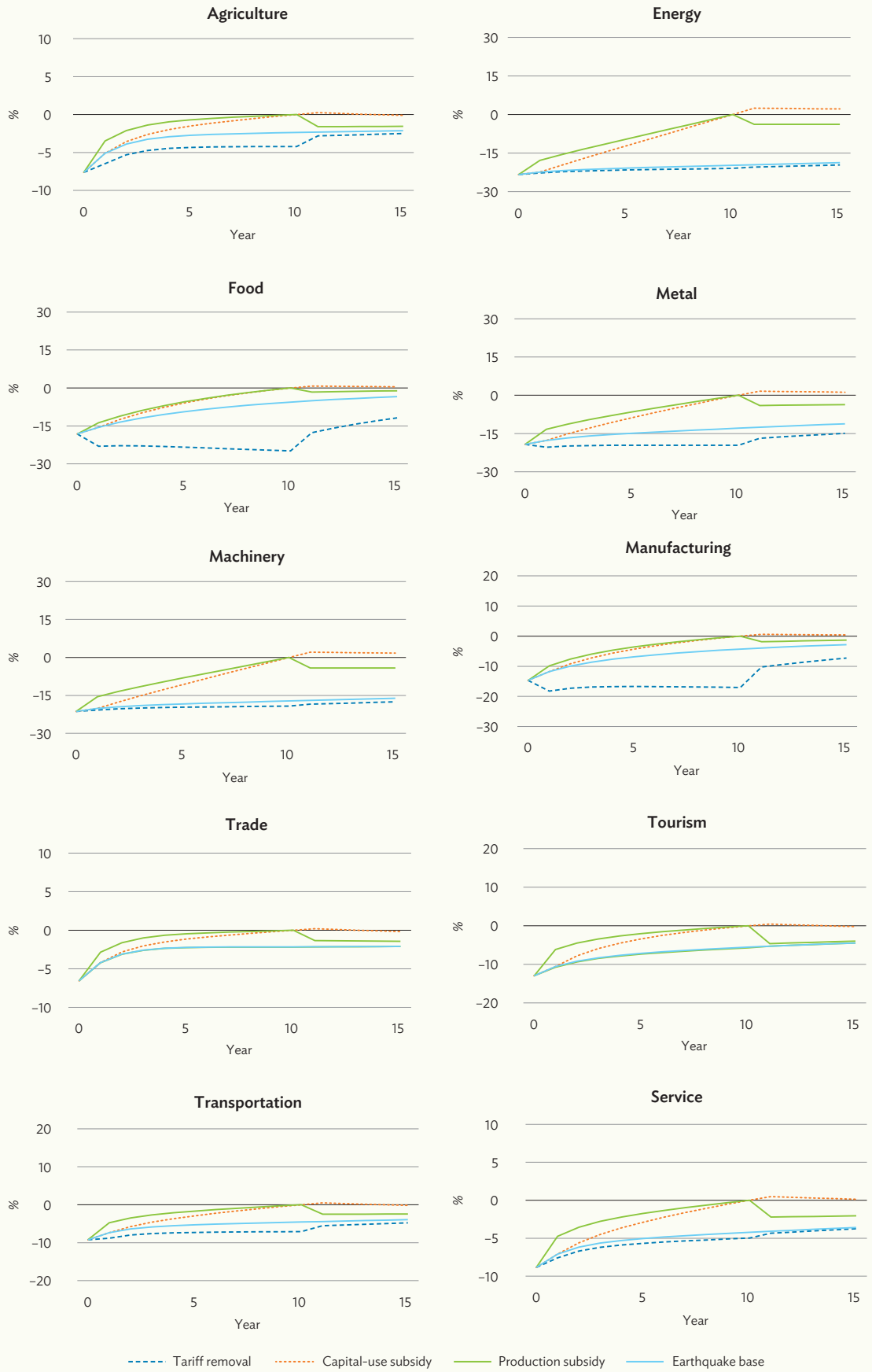
	Capital-Use Subsidy	Production Subsidy	Tariff Removal
Agriculture	20.0	5.2	69.7
Energy	36.0	22.6	17.5
Food	20.5	3.8	74.5
Metal	29.2	1.0	33.9
Machinery	32.6	44.2	30.3
Manufacturing	17.7	2.1	36.9
Trade	11.2	3.6	14.8
Tourism	55.5	10.4	14.8
Transportation	20.5	7.0	14.8
Service	25.2	7.3	13.4

10.3 Simulation Results

10.3.1 Sectoral Output Recovery Process

We demonstrate 10-year build-back-better recovery policies to be explicitly implemented with the earthquake impact baseline (thick line) in Figure 10.2. The policy targets of capital use and production subsidies are to return the sectoral output to the pre-disaster business-as-usual level in the 11th year, while the policy of tariff removal is implemented for 10 years regardless of output change.

Figure 10.2: Sectoral Recovery Process under Subsidy Policies

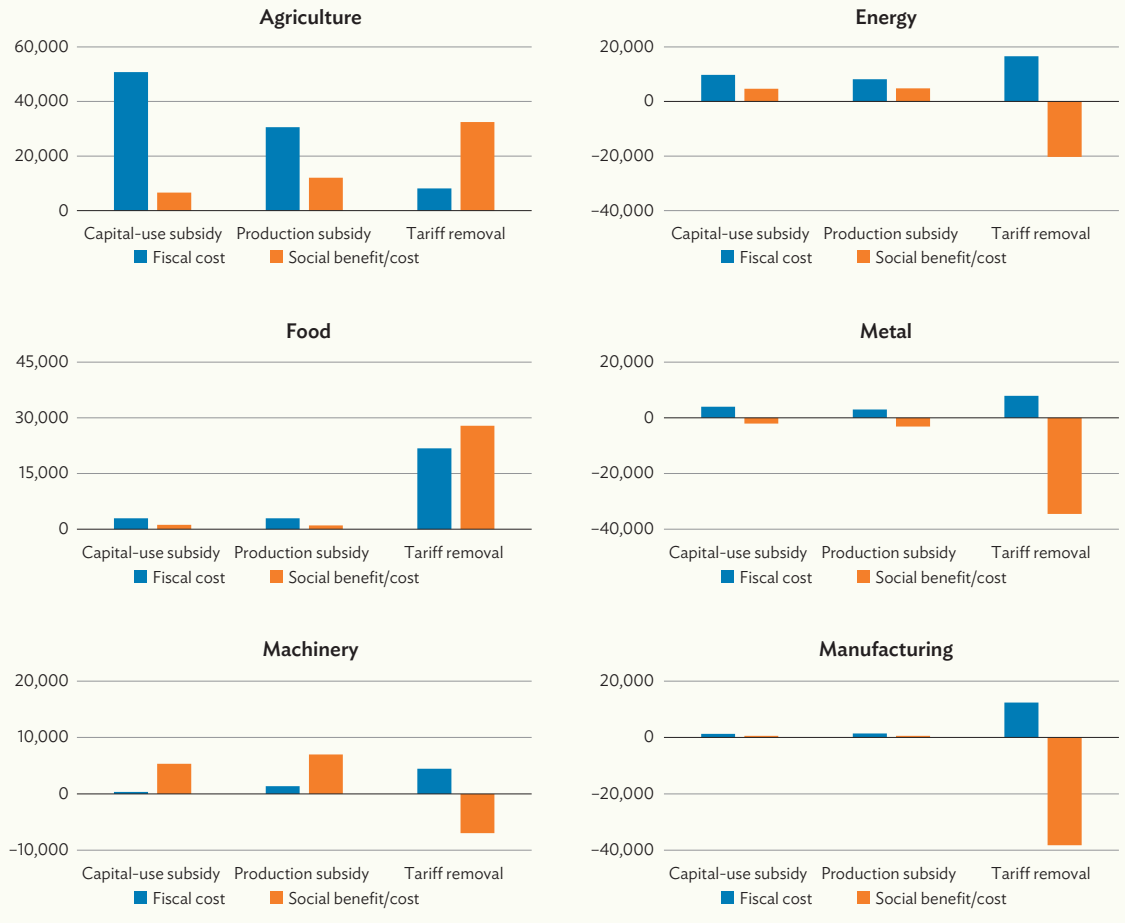


The baseline disaster scenario shows that no sector could recover without the support of a recovery policy, suggesting the indispensability of government intervention. In all sectors, the recovery path of the capital-use subsidy is more sustainable than the production subsidy, which shows a dip right after the termination of the program. For the production subsidy policy, we see that the output drops by 3%–4% after the termination of the subsidy policy, implying that the production was distorted from the free market rule. Moreover, the tariff removal policy does not appear to affect production recovery; its impact needs reference with the perspective of social benefits.

10.3.2 Fiscal Cost and Social Benefit/Cost

In addition to observing the output path, we looked further into the consequences of annual fiscal cost and the social benefit/cost at the present price of the policies (Figure 10.3). The visualized comparison may give stakeholders a clearer picture of policy options. The social benefit/cost is determined by the sum of household utility in the equivalent variations between the status before and after the policy intervention. The social benefit represents social welfare improvement, providing policymakers with a positive sign to proceed with the policy, while the social cost may raise caution that the policy may worsen social welfare in addition to the fiscal costs.

Figure 10.3: Comparison of Fiscal and Social Benefit/Cost (NRs million)



continued on next page

Figure 10.3 *continued*

NRs = Nepalese rupees.

On the basis of the same objective of recovery of output to the pre-disaster level in the 11th year, the fiscal costs of the production subsidy are significantly smaller than those of the capital-use subsidy, especially in the agriculture, trade, tourism, transportation, and service sectors. The production subsidy policy could also generate more social benefits than the capital-use subsidy in the agriculture, machinery, and tourism sectors.

All of the recovery policies actually worsened social benefits in the metal, trade, and service sectors, implying that such interventions might negatively distort the market. In contrast, the simulation results show that tariff removal could also make households substantially better off in the agriculture and food sectors, suggesting that trade liberalization in these two sectors could improve resource allocation in the aftermath and recovery process for Nepal. Most interestingly, for the energy, metal, and manufacturing sectors, the removal of the customs tax for import goods could neither contribute to their output recovery nor generate social benefits, indicating the high vulnerability of these sectors toward international competition.

10.3.3 Cost-Effectiveness of Policies

Next, we derived the ratio of social benefits/costs to fiscal costs to acquire indicators of the cost-effectiveness of the policies. The indicators could provide a quick reference and identification of sectoral resilience and help the government to decide on the highest ratio (Table 10.3). Based on the cost–benefit ratio, we could infer that for the agriculture, energy, recreation, and transportation sectors, providing production subsidies would be more cost-effective for the recovery, while capital-use subsidies may work better in the food, machinery, and manufacturing sectors despite their higher fiscal costs. Policymakers should also be aware that the provisional subsidy policies for the metal, trade, and service sectors may negatively distort the market and thus require additional consideration.

On the other hand, the tariff removal policy showed a substantially higher ratio in the agriculture and food sectors, indicating that such a policy could be applied as a supplementary instrument to improve the social benefit.

Table 10.3: Ratio of Fiscal Costs to Social Benefits

	Capital-Use Subsidy	Production Subsidy	Tariff Removal
Agriculture	0.13	0.39	3.97*
Energy	0.48	0.59	−1.23
Food	0.39	0.34	1.28*
Metal	−0.51	−1.05	−4.36
Machinery	15.37	5.12	−1.56
Manufacturing	0.46	0.42	−3.07
Trade	−0.07	−0.22	−0.75
Recreation	0.32	0.67	−0.63
Transportation	0.12	0.19	−0.55
Service	−0.28	−0.73	−2.65

Note: *Output level does not recover in the policy.

10.3.4 Toward Building Forward Better in the Energy Sector

The demonstration of production and capital-use subsidies plus tariff removal showed the build-back-better path of the recovery. The energy sector, including electricity, petroleum, and natural gas, remains vulnerable in Nepal; thus, innovative reinforcement for the sector's recovery would be necessary. Being a landlocked nation, Nepal has limited access to fossil fuel from the international market, which is why people in Nepal use less commercial energy than in any other South Asian countries. The scant commercial energy sources leave Nepal to rely heavily on traditional energy resources. Despite the rapidly falling cost of solar photovoltaics, Nepal's share of modern renewable energy is less than 3%. As a result, energy poverty remains exceptionally high. On this basis, earthquake recovery projects could take advantage of the opportunity to designate favorable and aggressive policies to support the improvement of the energy system from renewable sources, such as the utilization of solar or hydropower in Nepal.

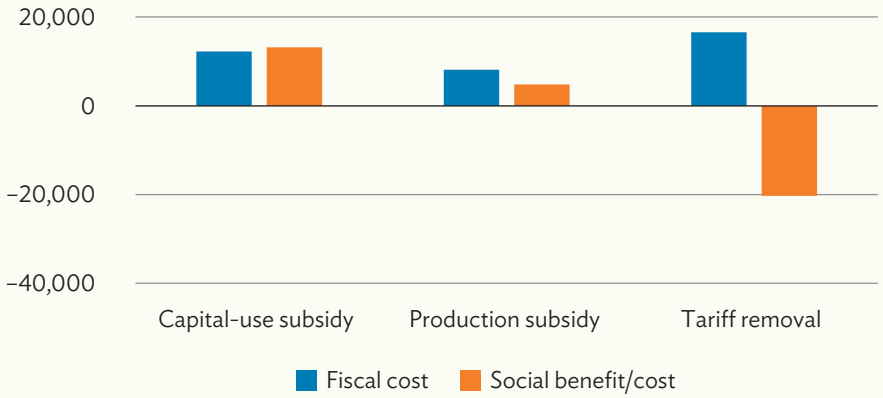
These reinforcements would be equipped with solar power generation with battery storage and balanced with storage such as off-river pumped hydropower technology. This implementation is expected to generate spillover effects to other systems of service sectors such as tourism, trade, transportation, and service. Therefore, we examined the build-forward-better approach based on the method developed by Huang and Kim (2021) and Nakano and Washizu (2013) of utilizing renewable energy in Japan (Table 10.4; Figure 10.4).

Table 10.4: Indicators for Build-Forward-Better Policy in the Energy Sector
(NRs million)

	Capital-Use Subsidy	Production Subsidy	Tariff Removal	BFB
Fiscal cost	9,719	8,141	16,550	12,229
Social benefit	4,676	4,809	–20,290	13,145
Cost–benefit (%)	0.48	0.59	–1.23	1.07

BFB = build forward better, NRs = Nepalese rupees.

Figure 10.4: Energy Sector in Build-Forward-Better Policy



Based on the technology parameters projected by Huang and Kuroda (2021), we calibrated the 2015–2020 estimate of a technology improvement of 5.9% in the energy sector with a 10% efficiency rise as a spillover effect to occur from the fifth year of the policy implementation in the trade, transportation, tourism, and service sectors. It is notable that although the fiscal burden of this build-forward-better policy would be higher than for capital-use and production subsidies, the performance in social benefits and the cost–benefit ratio makes it a more favorable policy.

10.4 Conclusion

10.4.1 Discussion and Policy Implications

While the focus of the world has been on the reconstruction of Nepal, this chapter has examined recovery policy recommendations for sectoral output recovery and welfare analysis as a build-back-better approach. The study demonstrates a comprehensive analysis of the direct impact of physical damage and the indirect impact of production disruption as economic losses. The evidence-based simulation results could help visualize possible reconstruction costs and policy effectiveness by identifying the fiscal and social benefits/costs.

Based on the simulation results, the capital-use subsidy is more costly than the production subsidy in all sectors for the recovery target designated in the 11th year after the disaster. Nevertheless, the food, machinery, and manufacturing sectors may recover with higher cost-effectiveness when referring to the cost–benefit ratio. If the target is to improve social welfare regardless of output recovery,

the tariff removal policy could substantially improve the social benefit in the agriculture and food sectors. Additionally, we calibrated the energy technology parameter to evaluate its spillover effects of efficiency improvement on other service-related sectors. While such a recovery policy may require more resource input with international collaboration for technology transfer, as a build-forward-better approach, it could generate greater social benefit than a mere return to the pre-disaster output level.

These quantitative results enable decision makers to consider the policy options in advance so that after a disaster, resources could be allocated more efficiently. Such indicators also serve as useful measures of sectoral vulnerability as well as resilience. The research results also provide policymakers with an empirical and scientific framework for developing policy options to foresee the possible consequences and budget needed for the recovery.

10.4.2 Limitations and Future Prospective

Despite this chapter's comprehensive coverage of the recovery process following the Nepal earthquake of 2015 for all industries, and despite the in-depth policy implications we are able to offer, the approach we used remains limited in scope for evaluating the well-being of disaster-affected people in a scenario in which residential buildings have been substantially damaged. Additionally, the calibration of technology parameters might be too simplified. The technology transfer platform should be illustrated with more supporting evidence.

In future research, an input–output analysis would be indispensable to interpret further the transition and overall impact of the policy intervention. Updates and more specific sectors, such as carbon dioxide emission compilation, would be desirable to connect the decarbonization approach, which is highly expected to provide essential evidence and incentive for the build-forward-better scope. In addition to a single-country model, the research hopes to utilize firsthand data collection for constructing a world trade model with the Global Trade Analysis Project (GTAP) to examine the impact of foreign direct investment based on the approaches by Hosoe (2014) and Ko (2014), especially for the sectors related to renewable energy goods and construction. This extension is expected to allow research to interpret the recovery impact with a broader scope including Nepal and foreign direct investment outflow countries such as Japan, the European Union, and the United States, with further implications for international cooperation.

References

Adam, C. 2013. Coping with Adversity: The Macroeconomic Management of Natural Disasters. *Environmental Science and Policy* 27S: S99–S111.

Asano, K., and Y. Aoshima. 2017. Effects of Local Government Subsidy on Rooftop Solar PV in Japan. 2017 IEEE 6th International Conference on Renewable Energy Research and Applications (ICRERA) (2017): 828–832.

Government of Nepal. 2015a. *Nepal Earthquake 2015—Post Disaster Needs Assessment, Vol. A: Key Findings*. Kathmandu: National Planning Commission, Government of Nepal.

____. 2015b. *Nepal Earthquake 2015—Post Disaster Needs Assessment, Vol. B: Sector Reports*. Kathmandu: National Planning Commission, Government of Nepal.

Hosoe, N. 2014. Japanese Manufacturing Facing Post-Fukushima Power Crisis: A Dynamic Computable General Equilibrium Analysis with Foreign Direct Investment. *Applied Economics* 46(17): 2010–2020.

Hosoe, N., K. Gasawa, and H. Hashimoto. 2010. *Textbook of Computable General Equilibrium Modelling*. London: Palgrave Macmillan.

Huang, M., and N. Hosoe. 2016. Computable General Equilibrium Assessment of a Compound Disaster in Northern [Taipei,China]. *Review of Urban and Regional Development Studies* 28(2): 89–106.

____. 2017. Fiscal and Social Costs of Recovery Programs for an Earthquake Disaster in Northern [Taipei,China]. *Journal of Asian Economics 53*: 1–17.

Huang, M., and M. Kuroda. 2021. Investigation of Japan's Value Chain through R&D and Innovation under Demographic Change: Implications for Digitalization in the Post-COVID-19 Era. In S. Park, N. Ogawa, C. Kim, P. Sirivunnabood, and T. Le, eds. *Demographic Transition and Its Impacts in Asia and Europe*. Tokyo: ADBI Press.

Huang, M., and C. Kim. 2021. Investigating Cost-Effectiveness Policy Incentives for Renewable Energy for Japan: A Recursive CGE Approach for Optimal Energy Mix. *Singapore Economic Review* 66(2): 507–528.

International Monetary Fund (IMF). 2022. Nepal at Glance. Washington, DC: IMF. https://www.imf.org/en/Countries/NPL

International Renewable Energy Agency (IRENA). 2022. Energy Profile: Nepal. Abu Dhabi: IRENA. https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Asia/Nepal_Asia_RE_SP.pdf

Kajitani, Y., and H. Tatano. 2009. Estimation of Lifeline Resilience Factors Based on Surveys of Japanese Industries. *Earthquake Spectra* 25(4): 755–776.

Ko, J. 2014. Economic Assessment of Korea-EU FTA using a CGE Model with FDI. *Journal of European Union Studies* 36: 37–71.

Ministry of Finance. 2015. National Account of Nepal 2014/15 (Compilation of tables after earthquake). Ministry of Finance, Government of Nepal.

Molden, D., E. Sharma, and G. Acharya. 2016. Lessons from Nepal Earthquake for Indian Himalayas and Gangetic Plains In S. P. Singh, S. C. Khanal, and M. Joshi, eds. *Lessons from Nepal's Earthquake for the Indian Himalayas and the Gangetic Plains*. Central Himalayan Environment Association (CHEA).

Nakano, S., and Y. Washizu. 2013. Development of a Japanese Input-Output Table for Renewable Energy and Smart Grid Systems. *Waseda University Working Paper No. 2013-7*. Tokyo: Waseda University.

Paudel, D. 2014. *Land Reform in Nepal: Equity, Efficiency and Economy*. Unpublished PhD Thesis, Department of Agricultural and Resource Economics, The University of Tokyo, Japan.

Rose, A., and G. Guha. 2004. Computable General Equilibrium Modeling of Electric Utility Lifeline Losses from Earthquakes. In Y. Okuyama and S. Chang, eds. *Modeling Spatial and Economic Impacts of Disasters*. Heidelberg: Springer.

Subedi, S., and M. Chhetri. 2019. Impacts of the 2015 Gorkha Earthquake: Lessons Learnt from Nepal. In J. Santos-Reyes, ed. *Earthquakes: Impact, Community Vulnerability and Resilience*. IntechOpen.

Tanaka H., and M. Huang. 2021. Impact Assessment and a Fiscal Recovery Policy for Tsunami Risk: GIS and the General Equilibrium Approach in Hakodate City, Japan. *Environment and Planning B: Urban Analytics and City Science* 48(5): 1144–1160.

Ulak, N. 2016. Nepal's Earthquake-2015: Its Impact on Various Sectors. *The Gaze: Journal of Tourism and Hospitality* 7: 58–86.

World Trade Organization (WTO). 2014. Nepal Trade Policy Review WT/TPR/S/257. https://docsonline.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/TPR/S257-04.pdf

Appendix 10

Table A10.1: The 2010 Social Accounting Matrix of Nepal (million Nepalese rupees)

	Agriculture	Energy	Food	Metal	Machinery	Manufacturing	Trade	Tourism	Transportation	Service	Labor	Capital	Tax	Tariff	Household	Government	Investment	Import	Total
Agriculture	121,445	7	61,793	0	0	13,582	0	2,850	0	7,945					492,537	0	19,189	7,444	726,793
Energy	4,714	3,400	770	95	437	1,758	916	741	1,329	35,320					61,075	0	40,344	24,983	175,883
Food	37,576	0	5,322	0	0	218	0	21	0	20,480					60,513	0	7,641	24,875	156,645
Metal	0	504	0	14,903	964	537	0	0	0	9,010					4,052	0	41,059	201	71,233
Machinery	4,436	1,393	0	59	657	24	0	0	1,063	134					13,227	0	10,596	11,104	42,694
Manufacturing	0	127	219	0	0	14,205	56	5,727	10,804	32,461					12,370	0	40,198	17,769	133,935
Trade	12,187	4,324	2,518	2,755	347	23,801	983	2,274	8,717	7,752					83,022	0	34,642	23,700	207,021
Tourism	318	370	0	0	0	0	855	1,464	791	22,183					37,648	0	0	0	63,628
Transportation	17,057	824	1,245	932	141	2,708	622	16,568	10,859	45,391					97,938	0	22,927	7,153	224,366
Service	5,258	4,428	107	78	91	2,311	10,051	7,599	25,658	75,895					223,349	138,429	255,058	10,155	758,467
Labor	246,038	4,677	2,577	3,757	236	2,403	81,787	9,865	31,059	122,628									505,027
Capital	253,180	22,650	12,578	12,167	932	6,719	110,618	9,257	65,721	254,691									748,514
Tax	2,533	10,402	13,061	1,820	17,643	14,591	200	6,542	14,057	40,561									121,412
Tariff	9,058	18,319	24,106	8,771	4,943	13,778	121	93	7,006	9,938									96,133
Household											505,027	748,514							1,253,541
Government													121,412	96,133	129,850				347,395
Investment															37,959	208,966		224,729	471,654
Export	12,991	104,457	32,348	25,897	16,303	37,299	814	627	47,302	74,076									352,113
Total	726,793	175,883	156,645	71,233	42,694	133,935	207,021	63,628	224,366	758,467	505,027	748,514	121,412	96,133	1,253,541	347,395	471,654	352,113	

CHAPTER 11

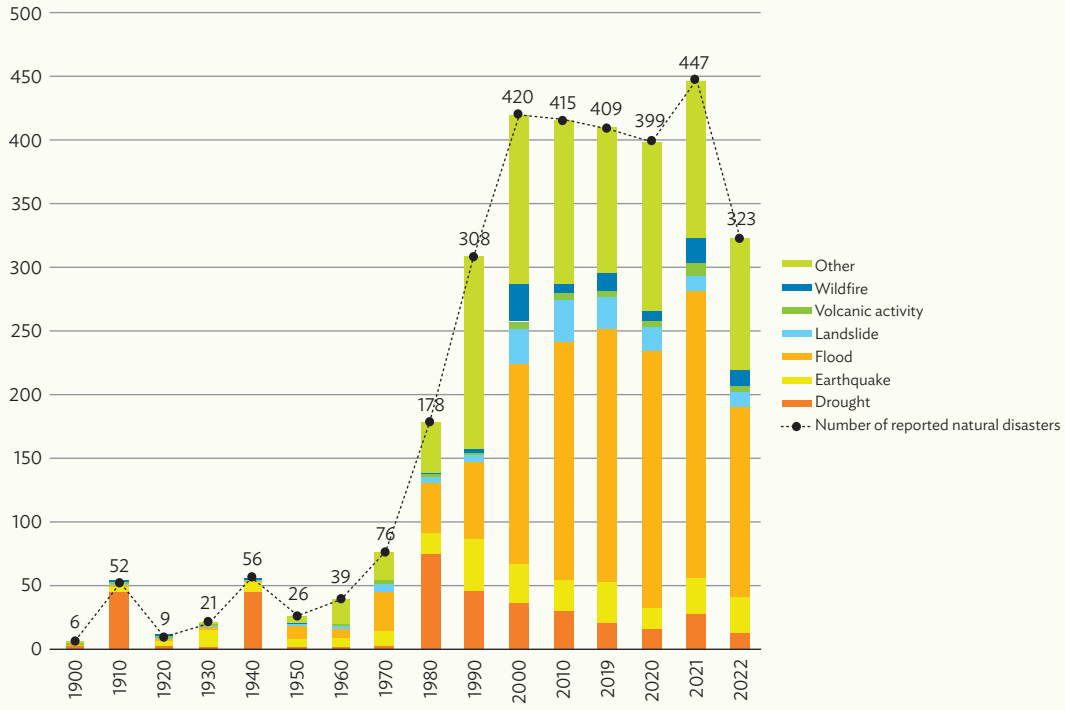
Acknowledging Indigenous Knowledge of Environmental Management: A Global Perspective

Jyoti Shukla

11.1 Introduction

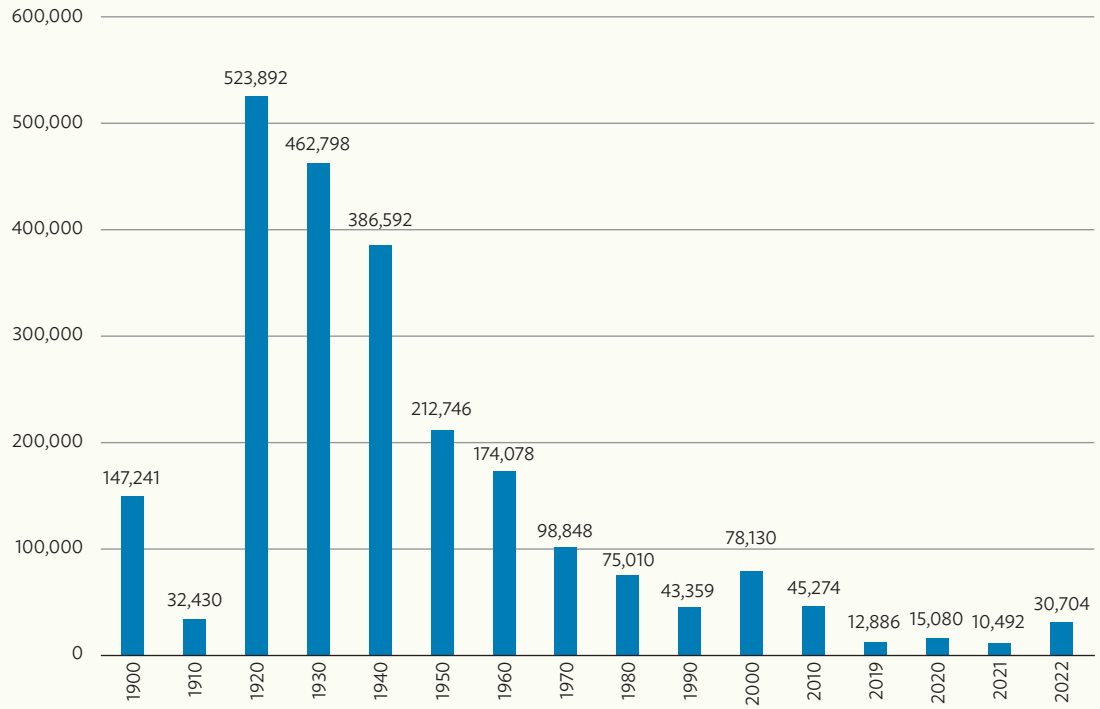
Climate change and natural disasters impede global efforts to eliminate poverty, risk food security, and cause instability, displacement, and conflict (UNEP 2023). Evidence suggests that climate change intensifies the threat to global peace and security (UNEP 2023). The negative impact of environmental degradation and climate change observed through the number of disaster events has increased significantly in the past century (Figure 11.1), even as the number of deaths due to natural disasters has been controlled since the 1920s (Figure 11.2).

Figure 11.1: Number of Natural Disasters across the Globe (1900–2022)



Source: Created by the author using data from Our World in Data (2022).

Figure 11.2: Number of Deaths from Disasters across the Globe (1900–2022)



Source: Created by the author based on data from Ritchie, Rosado, and Roser (2022) and CRED (2022).

The idea of sustainable development reflects one of the leading aspirations of the contemporary society of the 21st century, like the idea of socialism in the early 20th century and the Declaration of Human Rights after World War II (De Vries and Petersen 2009). There is a pressing need for disaster risk reduction through a systematic development and application of policies, strategies and practices to minimize vulnerabilities, hazards and the unfolding of disaster impacts throughout a society, in the broad context of sustainable development (UNISDR 2004). There is a significant emphasis by policy and polity on environmental problems, which urge comprehensive solutions requiring collaboration across geographies, values and beliefs, worldviews, and knowledge and systems of traditional and contemporary environment management (De Vries and Petersen 2009; Mercer et al. 2010; Williams, Sikutshwa, and Shackleton 2020).

There is a growing realization of inadequate participation and representation of an important stakeholder group, Indigenous communities, in the design and execution of approaches to sustainable development (Jollands and Harmsworth 2007). Jollands and Harmsworth (2007) emphasize the need for (i) an indicator of the level of participation of Indigenous communities in sustainability programs and (ii) participation of Indigenous communities in the formulation of ecological economic theory and national and international policies on sustainable development, without which the concept of sustainable development is elusive and likely to result in inadequate outcomes.

The body of literature that acknowledges the benefits of incorporating Indigenous knowledge in disaster risk reduction strategies has expanded across disciplines since the 1970s (Mercer et al. 2010).

For example, in the aftermath of Cyclone Zoe in 2002, Indigenous residents of Tikopia Islands in the Solomon Islands survived using age-old practices of taking shelter in traditional housing and under overhanging rocks on higher grounds (Anderson-Berry, Iroi, and Rangi 2003). Such Indigenous practices of survival have directly challenged the mainstream scientific views that underrate the importance of Indigenous knowledge (Mercer et al. 2010). The importance of Indigenous knowledge is increasingly realized by small island developing states because of the urgent need to reduce their vulnerability to environmental hazards (Mercer et al. 2010). Nonetheless, the role of Indigenous knowledge in contemporary systems of environment management is less acknowledged.

This chapter synthesizes popular discourse from across disciplines and paves the way for further investigation on examining conflicts and synergies in worldviews of Indigenous and contemporary societies, identifying challenges to integrating Indigenous and contemporary/scientific knowledge on environment management, and designing a framework for integration of Indigenous and contemporary systems of environment management.

11.2 Defining Indigenous Knowledge

Knowledge of the natural environment is acquired either through scientific research or through experiences of Indigenous and local people (Mercer et al. 2010). While the former is a well-established field that uses scientific tools and methodology, the latter lacks a concise definition (Neale 2022). Other popular terms for Indigenous knowledge are local knowledge, folk knowledge, cultural knowledge, popular knowledge, traditional knowledge, traditional environmental knowledge, Indigenous technical knowledge, and Indigenous ecological knowledge (Sillitoe 1998; Mercer et al. 2010). Often Indigenous knowledge is contrasted with scientific knowledge, thus inviting scrutiny of the assumption that "Indigenous" equates to "nonscientific." In support, a growing body of scientific research validates the efficiency of Indigenous methods of environment management, such as bushfire[1] management by First Nations Australians.

A popular terminology is "Indigenous and local knowledge systems" or LINKS as abbreviated by UNESCO (2021). Both Indigenous peoples and local people, who are not Indigenous but have accumulated knowledge through the personal and collective experience of their local environment over time, are acknowledged under LINKS as the carrier of knowledge (UNESCO 2021). UNESCO (2021) defines local and Indigenous knowledge as "the understandings, skills, and philosophies developed by societies with long histories of interaction with their natural surroundings."

11.3 Impact of Different Worldviews on Human–Nature Relationships

A growing body of works examines the importance of Indigenous knowledge of environment management and explores opportunities and challenges of adopting them in the current policy (refer to Mercer et al. 2010; Williams, Sikutshwa, and Shackleton 2020). The evolution of policy sectors on complex topics, such as the natural environment, is influenced by scientific and technical developments and dominant worldviews of society and polity (Ruane 2018). Worldviews are "inescapable frameworks of meaning and meaning-making that profoundly inform our very understanding and enactment of reality … shape how individuals perceive particular (ecological) issues and their potential solutions" (Hedlund-de Witt 2012: 74). There is considerable influence of the dominant worldview, guiding society

[1] A bushfire is lit accidently or naturally (Gammage 2011). Also referred to as "wildfire" in the United States, it is difficult or impossible to control (Gammage 2011).

and polity, on the importance and inclusion of Indigenous knowledge in approaches to environment management (Ruane 2018). Therefore, it is interesting to examine the influence of different worldviews on public responses to sustainability issues such as climate change (De Witt et al. 2016; Shi, Visschers, and Siegrist 2015) and bushfires (Ruane 2018).

De Witt et al. (2016) identify four distinct worldviews to explain the human–nature relationship and why we disagree on approaches to manage climate change: traditional, modern, postmodern, and a proposed integrative worldview. The worldview of traditional societies, relying on subsistence farming, interpreted nature as a creation of God and humans in a managerial stewardship role (De Witt et al. 2016). Industrial society was dominated by the "modern worldview" that interprets nature as a resource for human exploitation. Humans, self-optimizing independent beings, were assumed to have Promethean control over nature. The postmodern worldview of post-industrial, service sector societies concerned with societal and environmental problems considers humanity in a cautious relationship to nature. As per the postmodern worldview, the meaning of nature, like any other reality, is a plural construct of cultural values, meanings, and interests (De Witt et al. 2016). An integrative worldview places high importance on nature as intrinsically valuable and a divine force that humanity is part and expression of.

By understanding the differences in human–nature relationships perceived by the above groups, we can better understand their perception of reality. Hedlund-de Witt (2012) synthesizes four kinds of relationships from across disciplines of political science, environmental philosophy, social and ecological psychology, and value theory. The rest of this section examines each of these classifications in turn.

11.3.1 Social and Ecological Psychology Classification: New Environmental Paradigm versus Dominant Social Paradigm

The New Environmental Paradigm (NEP) advocates that human beings, as a part of the natural world and ecosystem, depend on the biophysical environment for survival and are governed by physical laws like all other species. This is better explained in contrast with the Dominant Social Paradigm (DSP), which, according to Dunlap (1980), assumes that Homo sapiens, unlike other species, are exempted from ecological constraints. The NEP rejects the DSP's "exemptionalist" perspective (Dunlap 1980). Even though the NEP takes account of the instrumental and environmental interconnectedness of the human and natural world, it misses out on the intrinsic and spiritual connection (Lockwood 1999; Van den Born 2008).

11.3.2 Value Theory Classification: Intrinsic and Instrumental Value of Nature/Ecocentric versus Anthropocentric Attitudes

The intrinsic value of nature, and its acceptance or rejection, lies at the epicenter of environmental debates (Hedlund-de Witt 2012). The intrinsic value of nature is derived from the right of nature to exist, even if it does not offer any use to human beings (Hedlund-de Witt 2012). Two distinct groups of pro-environmentalists have emerged based on the acceptance or rejection of intrinsic value: The first group is of "ecocentric individuals" who "value nature for its own sake and, therefore, judge that it deserves protection because of its intrinsic value or 'the transcendental dimension'" (Hedlund-de Witt 2012: 76). The opposite group of "anthropocentrics emphasize that the environment should be protected because of its value in maintaining or enhancing the quality of life for humans, which can be called instrumental value" (Hedlund-de Witt 2012: 76). The distinction between the two groups lies in their reason or motive for environmental protection, while both groups acknowledge the connectedness between humans and nature. Although ecocentric and anthropocentric groups believe that nature is important, they may or may not believe in its sacredness.

A similar worldview considers nature sacred because God created it or because it is spiritual and sacred. Dietz, Stern, and Gaugnano (1998) study the difference in the environmental behavior of those who believe in nature being a godly creation and those who consider it sacred in its own account and find that the former group is more likely to sacrifice their self-interests while the latter demonstrate pro-environmental consumer behavior. This research, therefore, suggests that attaching religious and spiritual importance to nature is conducive to environmental protection (Hedlund-de Witt 2012).

While all the above groups are pro-environmentalists, their approach and level of concern toward nature differ.

11.3.3 Environmental Psychological Classification: Egoistic, Social-Altruistic, and Biospheric

Environmental psychological literature identifies three different value orientations of human perception of "self" and its influence on human–nature relationships: "egoistics" who care for self; "social-altruistics" who care for others; and "biospherics" who care for nature and the environment (Schultz 2001). The three groups differ in their definition of "self" or the degree to which they include other people and other living beings in their perception of self (Schultz 2001). For example, egoistics are a self-enhancing group that narrowly defines "self" to exclude everything outside their body, such as other people, animals, and nature more broadly (Schultz 2001). At the other end of the spectrum are the "biospherics" who define self as a part of nature and are concerned with the environment. The empirical findings of Schultz and Zelezny (1999) confirm a positive correlation between biospheric concerns and the degree to which people consider themselves a part of nature and found this pattern consistent across 14 countries.

11.3.4 Political Science Classification: Public versus Private Approach to Environmental Solutions

Based on an individual's perception of effective social organization and solutions to environmental problems, the Netherlands Environmental Assessment Agency developed a four-quadrant model. The horizontal axis ranges from a local orientation to a global exposure. The vertical axis runs from a free market approach (emphasis on efficiency) to a government-regulated system (focus on fairness and nature). The resultant four quadrants identify worldviews relating to dominant institutional forces that determine solutions to developmental and environmental issues: globalized market forces, localized market forces, globalized government institutions, and localized government institutions together with civic society (De Vries and Petersen 2009). The four quadrants differ in their institutional approach to tackling environmental problems, for example ranging from a belief in free markets as a solution finder to government institutions and civic societies as leaders and regulators who would maximize environmental conservation (Hedlund-de Witt 2012).

11.4 Integration of Indigenous and Contemporary Systems

As discussed earlier in this chapter, it is crucial to understand and bridge the worldviews of traditional and contemporary societies to facilitate the integration of their knowledge. Indigenous and local knowledge complements State-based scientific knowledge because the two operate at different geographical scales, and together, they can comprehensively create sound environment management systems (Berkes 2009). There is scope for future research on integrating knowledge from across geographies and cultures and codesigning strategies of environment management at global and local levels.

Dekens's (2007) framework identifies factors influencing the need to understand the nature of local knowledge, the transformation processes affecting local knowledge, the critical dimensions of local knowledge on disaster preparedness, and the links between local knowledge, disaster preparedness, and poverty reduction. Mercer et al. (2010) expand the model to integrate local and contemporary knowledge. Discussions below draw upon the framework proposed by Mercer et al. (2010) based on their practical experience of working with Indigenous communities in Papua New Guinea and propose a staged approach to reducing the disaster vulnerability of Indigenous communities through the integration of Indigenous and contemporary knowledge:

11.4.1 Stage 1: Identification of Intrinsic and Extrinsic Factors Causing Vulnerability to Disasters

The objective at this stage is to identify extrinsic factors outside the control of the community and intrinsic factors the community can control to reduce their vulnerability to disasters. A thorough understanding of the physical and social characteristics of the place informs factors influencing vulnerability. This is achieved by undertaking a situation analysis, as described by Vrolijks (1998). A cause–effect tree is often used to establish the interplay between extrinsic causes and their intrinsic effects on the community. For example, in Kumalu village in Papua New Guinea, extrinsic factors such as globalization, climate change, and geological characteristics of the village (soil and terrain) have culminated in intrinsic effects of loss of community cohesiveness, inadequate land available for farming, change in soil conditions, house construction in disaster-prone regions, and similar other factors contributing to their vulnerability to disasters.

11.4.2 Stage 2: Identification of Important Intrinsic Factors Causing Vulnerabilities

Mercer et al. (2010) advocate using ranking techniques and order intrinsic factors identified by the community. The objective is to identify those intrinsic factors that are of significant importance to the community. Findings at this stage set the focus for designing an integrated approach to reducing vulnerability. Also, the effectiveness of proposed strategies can be measured using indicators of vulnerabilities prioritized by the community.

11.4.3 Stage 3: Identification of Indigenous and Scientific Strategies by the Members of the Community

Identifying Indigenous and contemporary/scientific systems the community uses requires a careful, in-depth discussion of strategies that the community has used in the past and present. Different areas of knowledge should be considered during these discussions, such as land management strategies, water management strategies, building construction methods, environmental management strategies, food management strategies, social linkages and their role during disasters, and other areas identified by the community. During these discussions, it is essential to have a balanced representation of all community segments, including elders, women, youth, and any minorities.

11.4.4 Stage 4: Identification of Indigenous and Scientific Strategies by Other Groups, Indigenous and Non-Indigenous

Mercer et al. (2010) relied heavily on the community to share information on both Indigenous and scientific strategies. For an unbiased, comprehensive, cross-cultural understanding of Indigenous and contemporary/scientific strategies, it may be worth discussing with other sources of knowledge outside

the concerned community, such as the representatives of the local government, planners, policymakers, nongovernment organizations, academics, and Indigenous members of other communities. This may be an opportunity for the community to familiarize themselves and synchronize their strategies with scientific solutions proposed by national and international experts from across the globe and also take account of relevant Indigenous solutions adopted by other communities.

Stage 4 creates opportunities for interactions and allows the exchange of knowledge between Indigenous communities, government institutions, and researchers as the first step toward integrating their combined knowledge on Indigenous and scientific solutions to reduce vulnerabilities to disasters for a community.

11.4.5 Stage 5: Integration of Knowledge, Indigenous and Contemporary, by the Members of the Community

To ensure that culturally appropriate and relevant solutions are adopted, the community members should have the opportunity to debate newly acquired information disseminated by nonmember groups and accept or reject it after critical scrutiny. Mercer et al. (2010: 232) emphasize that "it is the community who are most aware of their situation and therefore the community who are best able to make the decisions about an appropriate strategy."

Emphasis should be on reducing vulnerability to the most important intrinsic factor identified by the community at Stage 2. For informed decision making by the community, Mercer et al. (2010) suggest an assessment of each solution strategy across four criteria (i) sustainability—whether the solution will be relevant in a changing environment; (ii) cost—whether it makes effective use of resources; (iii) equity—whether it is equally accessible to all members of the community; and (iv) stability—whether it will bring change incrementally and systematically with minimal disruption to livelihood, social structure, and ecology of the place.

Adopting a similar approach, the community can target other intrinsic factors not addressed in the initial stage and further reduce their vulnerability to disaster. Regular revision and evaluation of strategies are necessary to keep up with new knowledge and change in circumstances and to ensure that relevant intrinsic factors are targeted to reduce disaster vulnerability (Mercer et al. 2010).

11.5 Challenges in Effective Integration of Indigenous Knowledge into Mainstream Environment Management Systems

Understanding worldviews and their evolution over time provides a valuable lens to examine shifting attitudes of the polity and policy toward the importance of Indigenous and local knowledge and its incorporation in matters concerning the natural environment. Ruane (2018) studies Australian society and its relationship with the above worldviews and writes that First Nations Australians share traits with the traditional worldview described earlier. Ruane (2018) also assumes that the views of English-settler colonial society in Australia resonate with the modern worldview and that opinions of contemporary Australians are distributed between the postmodern and integrative worldviews. Although Ruane's (2018) assumptions are questionable without empirical support, they provide a valuable framework to examine challenges regarding worldview differences in incorporating Indigenous knowledge in current policy. For example, De Witt et al. (2016) and Hedlund-de Witt (2012) designed an innovative conceptual framework and methodology for an empirical quantitative

study of citizens' worldviews in the Netherlands and the United States. Their findings suggest that in both countries, there is significantly more concern for the environment and sustainable behaviors by those with postmodern and integrative worldviews when compared with those having traditional and modern worldviews (De Witt et al. 2016). The study reveals the importance of understanding the worldviews of members of contemporary society to generate public support for changes in policy and changes in individual behavior (De Witt et al. 2016). An in-depth understanding of mismatches in the worldviews of members of the society is the prerequisite to harnessing changes in the attitude of the polity and policy toward Indigenous knowledge and incorporating it into the mainstream environment management systems.

It is observed that worldviews of modern society and polity have been in denial of the relevance of Indigenous knowledge and have oppressed it through Indigenous peoples' prolonged marginalization, exploitation, disempowering, cultural imperialism, and violence (Laws 1994; Mercer et al. 2010). The contemporary cultural landscape experiences tensions between opposing worldviews regarding human–nature relationships, with post-Romantic expressivism on one side and Enlightenment-inspired instrumental reason on the other (Taylor 1989). In the words of Louis Bruyere, the President Native Council of Canada in 1986 (WCED 1987: 69):

Indigenous peoples are the base of what I guess could be called the environmental security system. We are the gatekeepers of success or failure to husband our resources. For many of us, however, the last few centuries have meant a major loss of control over our lands and waters. We are still the first to know about environmental changes, but we are now the last to be asked or consulted. We are the first to detect when the forests are being threatened, as they are under the slash-and-grab economics of this country. And we are the last to be asked about the future of our forests. We are the first to feel the pollution of our waters, as the Ojibway peoples of my own homelands in northern Ontario will attest. And, of course, we are the last to be consulted about how, when, and where developments should take place in order to assure continuing harmony for the seventh generation. The most we have learned to expect is to be compensated, always too late and too little. We are seldom asked to help avoid the need for compensation by lending our expertise and our consent to development.

There is inadequate representation of views of Indigenous people in academic discourse even though they have been a popular subject of analysis (Laws 1994). This may be attributed to inadequate effort to engage with Indigenous participants (Williams et al. 2020), inadequate innovation of ways to incorporate Indigenous knowledge in studies (Williams et al. 2020), insufficient skill to analyze Indigenous knowledge shared by the participants, and similar other factors. On the other hand, Indigenous participants may vary in participating due to apprehensions that they will experience exploitation, disrespect for their beliefs and values, and misuse of their knowledge (Mcgregor 2014). At times Indigenous knowledge may be intentionally held back by knowledge bearers because it is considered secret or private (Austin et al. 2017).

In a society where scientific culture is dominant, Indigenous knowledge is often considered inferior to scientific knowledge (Laws 1994). It is dismissed as experiential and non-generalizable (or local and specific to geography) instead of scientific knowledge based on synchronic observations (Agrawal 1995; Dekens 2007).

Forced relocation from the place of origin meant discontinuing location-based traditional practices, dispersal of people who are the carriers of knowledge, and consequential loss of traditional knowledge (Gammage and Pascoe 2021). Under the modern approach to development, limited attention has been paid to preserving Indigenous knowledge. There has not been adequate development support to revitalize and protect Indigenous and local knowledge (Stump 2013; Ray, Kolden, and Chapin 2012).

Due to the above factors of suppressing Indigenous knowledge, its integration with current scientific knowledge and policy has been challenging. Rigid governance and management structure are institutional constraints that further impede the interaction of Indigenous knowledge with higher scales of policies/strategies, e.g., at the State level (Padt et al. 2014).

11.6 Case Study: Cultural Burning as an Indigenous Strategy of Land Management by First Nations Australians and Its Acknowledgement in the Contemporary Society

The year 1788 marks the contact between Aboriginal people and Europeans after their settlement began in Sydney Cove (Gammage 2011). As Gammage (2011: xviii) says, "1788 is also shorthand for the beliefs and actions of Aboriginal people at the time of first contact." Essential facts about Australia in 1788, which the British were unaware of and which determined Indigenous approaches to land management at that time, are listed by Gammage (2011). Firstly, 70% of Australian plants needed or tolerated fire. Land management strategies were underpinned by Indigenous knowledge of which plants welcomed fire, when, and how much (Gammage 2011). Secondly, the burning plant pattern determined the movement of grazing animals. Therefore, burning was also a strategy to herd grazing animals because they had no other natural predators except humans. This was unique to Australia. Thirdly, "there was no wilderness. The Law—an ecological philosophy enforced by religious sanction—compelled people to care for all their country. People lived and died to ensure this" (Gammage 2011: 2).

11.6.1 Caring for Country

In the words of Gammage and Pascoe (2021: 11), "Country is central to everything Aboriginal: it is a continuum, without beginning or ending. In this worldview, everything is living—people, animals, plants, rocks, earth, water, stars, and air. There is no division between animate and inanimate." The term "caring for the country" was first used by Elspeth Young (1987) to mean being able to visit the country, witness and contribute toward its preservation, and live near the country where practical. "Caring for the country was first and foremost a spiritual affair, through which its ecological and environmental future would be assured" (Young 1987: 170). "If you care for country, Country will care for you" is the belief of Gammage and Pascoe (2021: 11) that acknowledges the deep symbiosis between humans and the natural world around them. Rose (1996: 7) defines "country" as a multidimensional term encompassing "people, animals, plants, Dreamings; underground, earth, soils, minerals and water, air ... People talk about the country in the same way that they would talk about a person: they speak to the country, sing to the country, visit the country, worry about the country, feel sorry for the country, and long for the country." In "caring for country," Aboriginal peoples deliver a wide range of services of national and global significance such as biodiversity conservation, water resource management, control of invasive weeds and feral animals, fisheries management, sustainable commercial use of wildlife, wildlife abatement/carbon sequestration, and cultural maintenance activities (Burgess et al. 2009). "Caring for country" encompasses cultural burning practices, aiming at long-term objectives of protecting and promoting ecological, spiritual, and human health (Burgess et al. 2009).

Gammage and Pascoe (2021) claim that Aboriginal management styles (land and water) kept the Australian continent healthy and productive for millennia and prevented the environmental and climatic disasters of fire, flood, and drought, which are an outcome of geographically irresponsive practices imported by the colonists. Even before the arrival of non-Aboriginal settlers, the system of land responsibility among Aboriginal societies had a discontinuous ancestry from time to time (Young 1987). This is because, consequential to the demise of key people in small population groups, the spiritual

responsibility was sometimes transferred to other groups and individuals not necessarily related to the former traditional owners through descent (Young 1987). Individuals' skills and capabilities were acknowledged, and the knowledge was transferred to only those who could contribute (Young 1987). Non-Aboriginal settlers created other pressures, leading to similar adaptations (Young 1987).

11.6.2 Cultural Burning as an Indigenous Strategy of Land Management

Dilkes-Hall et al. (2019: 5) describe the importance of plants in human evolution and their geographical dispersal across the globe and write that "ecological knowledge undoubtedly aided the expeditious expansion of people across the Australian continent and played an important role in the colonization of all major biomes by 40,000 years ago (Balme 2013; Florin and Carah 2018; O'Connell and Allen 2004, 2015)." Through an archaeological investigation combined with local traditional ecological knowledge, Dilkes-Hall et al. (2019) study the use of plants in the past in Moonggaroonggoo and Riwi in the south-central Kimberley region and find that they were used for several purposes, such as primary and secondary sources of food, fuel, medicine, plant-based technologies, and shade, as well as in ceremonial roles. Dreaming narratives (Hercus 2012) and rock art (Veth et al. 2018) demonstrate the importance of plants in the life of First Nations Australians. These ancient narratives also describe the skillful use of fire by the community as a tool for ecological sustainability. This intimate knowledge was developed over thousands of years through firsthand interaction with different regions within a country and multiple environmental settings in each, all of which changes differently with the use of fire. While the ecological role of fire has gained recognition over time in Western scientific discourse (refer to Gammage 2011), its more complex role in Aboriginal people's cultural, social, and spiritual dimensions of life is less acknowledged.

Empirical evidence from different regions in Australia confirms human management of precolonial landscape covers with frequent, landscape-wide use of fire, often referred to as cultural burning (Mariani et al. 2022). A recent empirical work by Mariani et al. (2022) is supposedly the first quantitative evidence to confirm fewer shrubs and more grass in southeast Australia before colonization. As per Mariani et al. (2022), the disruption of cultural burning by European settlement has caused the overgrowth of shrubs. Discontinuing Indigenous fire management practices combined with climate change is likely preconditioning fire-prone regions for unexpected disasters (Mariani et al. 2022).

There is ample evidence to suggest that cultural burning plays a significant role in shaping pyrodiversity (Bliege Bird, Bird, and Codding 2016). However, there is a limited understanding of the biophysical and socioeconomic drivers of human decisions on cultural burning (Spies et al. 2014) and a lack of consensus on the historical and contemporary role of people (as compared to climate and nature) in the spatial and temporal pattern of fire on the landscape (Bliege Bird, Bird, and Codding 2016). Bliege Bird, Bird, and Codding (2016) identify two contradictory viewpoints on the significance of human management of fire regimes or cultural burning. The first viewpoint nullifies the human role and suggests that cultural burning, as a human intervention, was insignificant at a landscape scale and that the primary driver of a fire regime is the dynamics between climate and vegetation (Williams et al. 2015; Daniau et al. 2013; Marlon et al. 2013; Grissino-Mayer et al. 2004). The second viewpoint holds that cultural burning plays a significant role in shaping plant and animal communities (Trauernicht et al. 2015), reduces the intensity and or frequency of climate-driver fires (Bliege Bird et al. 2012; Bilbao, Leal, and Méndez 2010), increases pyrodiversity ,and maintains ecological equilibrium (Bliege Bird, Bird, and Codding 2016). However, there is limited understanding of whether people make burning decisions independent of climate or whether climate informs how and why people use burning as an instrument (Bliege Bird, Bird, and Codding 2016). In an empirical study of the Western Desert of Australia by Bliege Bird, Bird, and Codding (2016), they find that climate plays a vital role in structuring human decisions concerning the use of fire.

Evidence-based research in recent years supports cultural burning and emphasizes revitalizing the practice in Australia's fire-prone regions. The recognition of cultural burning as an instrument of land management is growing globally (Mariani et al. 2022). Referring to California, Mariani et al. (2022) write that Native American tribes, organizations, and agencies that recognize the importance of cultural practices are working together toward reestablishing cultural burning and associated benefits of promoting traditional food and material, the exercise of sovereignty in land management, and strengthening well-being of Indigenous communities. Similar efforts to revive cultural burning are being observed in Australia (Steffensen 2020), although there are doubts about how efficiently the practice can mitigate catastrophic bushfires (Cary, Dovers, and Lindenmayer 2003).

11.6.3 Contemporary Polity versus Indigenous Worldviews

In recent years, a growing range of popular texts explicitly reappraises the importance of Aboriginal Australians' traditional knowledge acquired over thousands of years. One of the most successful academic acknowledgements is the book *The Biggest Estate on Earth: How Aborigines Made Australia* by historian Bill Gammage (2011). Another noteworthy mention is the book *Dark Emu: Black Seeds: Agriculture or Accident?* by Tasmanian Aboriginal author Bruce Pascoe (2014), which has won many book awards and has been adapted into a stage show and television series. However, Aboriginal authors and public intellectuals like Bruce Pascoe have been subjected to continuing criticism and racist abuse over several years by right-wing media in Australia (Neale 2022).

MacDonald (2008: 342) argues that "the English-speaking settler nations have refused to support the International Declaration of the Rights of Indigenous Peoples,[2] and neo-liberalism, by putting an end to the welfare state in favour of the 'user pays' philosophy." Such an approach increases the marginalization of those already at the periphery, such as Indigenous peoples (MacDonald 2008). As a response to non-inclusive neoliberalism experienced in English-speaking settler nations such as Australia, social inclusion concerns occupy the center stage of social policy discourse (MacDonald 2008). An observable emphasis on social inclusion is noticed in contemporary discourse on natural resource management through the involvement of First Nations Australians. The Australia State of the Environment 2011 report noted the formal participation of First Nations Australians in designing contemporary approaches to natural resource management as a significant trend in environment management over the last decade.

Even globally, local and traditional knowledge has received serious attention only since the late 20th century and has not, to any extent, entered mainstream (environment) conservation science (Berkes 2009). For example, a formal recognition at a global level of the importance of local and Indigenous knowledge systems was first observed in the report by the World Commission on Environment and Development in 1987 titled *Our Common Future*. Therefore, it is vital to identify the barriers to integrating Indigenous and contemporary knowledge and encourage an inclusive, comprehensive approach to environmental management.

[2] "The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) was adopted by the General Assembly on Thursday, 13 September 2007, by a majority of 144 states in favour, 4 votes against (Australia, Canada, New Zealand and the United States) and 11 abstentions (Azerbaijan, Bangladesh, Bhutan, Burundi, Colombia, Georgia, Kenya, Nigeria, Russian Federation, Samoa and Ukraine) … Years later the four countries that voted against have reversed their position and now support the UN Declaration" (Department of Economic and Social Affairs 2023).

11.7 Conclusion

Global efforts to reduce poverty, food insecurity, displacement, and conflict are hampered by climate change and natural disasters. The average number of natural disasters in the 20th century was approximately 77 per year, whereas, in the 21st century, the average has increased to 402 disasters per year. This serious indicator of climate change requires urgent attention from policy, polity, and society.

A comprehensive approach to sustainability compels the integration of knowledge across geographies, cultures, and worldviews. There is a growing realization of the need to incorporate Indigenous knowledge of environmental management into current systems. This chapter discusses confusion on the definition of "Indigenous knowledge," the impact of different worldviews on approaches to environment conservation, the framework to integrate Indigenous and contemporary knowledge on environment management and disaster risk reduction, and challenges in the same.

Figure 11.3: Figurative Explanation of the Influence of Worldviews regarding the Human–Nature Relationship on Approaches to Sustainable Development

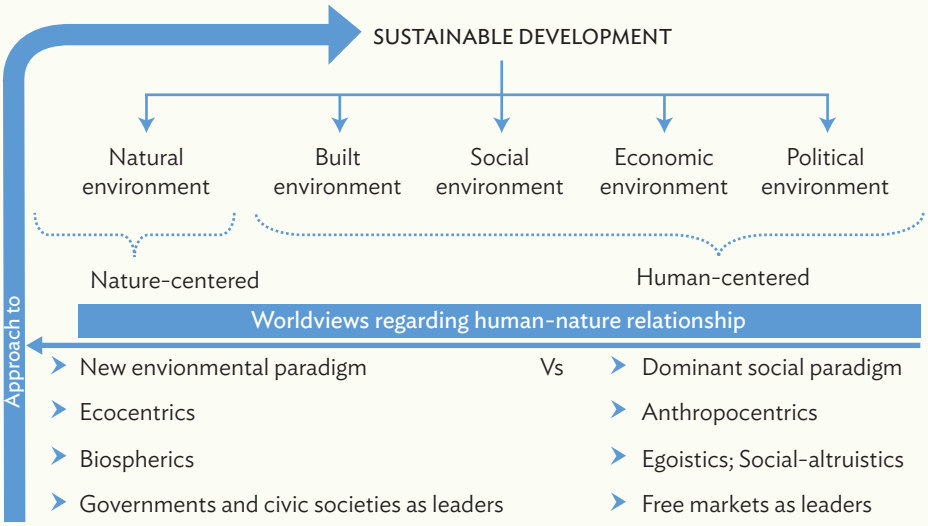


Figure 11.3 presents five dimensions of sustainable development: natural environment, built environment, social environment, economic environment, and political environment. These can be broadly classified under nature-centered and human-centered dimensions of sustainable development. This chapter discusses the worldviews of these two groups and identifies the difference in their priority (nature versus humans) and, thus, their approach to sustainability. This framework explains why Indigenous societies prioritize environmental conservation and have designed management systems that result in a sustainable relationship with the environment. On the contrary, non-Indigenous societies are grappling with the consequences of unsustainable exploitation of environmental resources and ways to fix the situation. Borrowing environment management techniques from Indigenous societies is a way to expand contemporary knowledge by overcoming the difference in worldviews of the two societies.

A comprehensive approach to sustainable development demands rigorous and meaningful discussions on:

- establishing the interconnectedness and interdependency between the sustainability of natural, built, social, economic, and political environments;
- identification of human-centered causes of natural disasters;
- identification of different worldviews regarding human–nature relationships, and consequential differences in approaches to sustainable development, environment conservation, and natural disaster risk reduction;
- ways to integrate knowledge about environment management from across geographies, cultures, and societies, with particular emphasis on Indigenous knowledge of the local environment and its integration in the current management system at the local level and state policies; and
- identification of barriers to revitalizing Indigenous knowledge on environment management and ways to overcome these.

This chapter synthesizes the literature on these topics and paves the way for future research that can identify the worldviews of contemporary society and their approach to environmental management and benefits and barriers to incorporating Indigenous knowledge in the mainstream policy on environment management and disaster risk reduction.

References

Agrawal, A. 1995. Dismantling the Divide Between Indigenous and Scientific Knowledge. *Development and Change* 26(3): 413–439.

Anderson-Berry, L., C. Iroi, and A. Rangi. 2003. *The Environmental and Societal Impacts of Cyclone Zoe and the Effectiveness of the Tropical Cyclone Warning Systems in Tikopia and Anuta*. Cairns: Report for the Centre for Disaster Studies, James Cook University.

Austin, K. G., et al. 2017. An Assessment of High Carbon Stock and High Conservation Value Approaches to Sustainable Oil Palm Cultivation in Gabon. *Environmental Research Letters* 12(1): https://doi.org/10.1088/1748-9326/aa5437

Balme, J. 2013. Of Boats and String: The Maritime Colonisation of Australia. *Quaternary International* 285: 68–75. https://doi.org/10.1016/j.quaint.2011.02.029

Berkes, F. 2009. Community Conserved Areas: Policy Issues in Historic and Contemporary Context. *Conservation Letters* 2: 19–24. https://doi.org/10.1111/j.1755-263X.2008.00040.x

Bilbao, B. A., A. V. Leal, and C. L. Méndez. 2010. Indigenous Use of Fire and Forest Loss in Canaima National Park, Venezuela. Assessment of and Tools for Alternative Strategies of Fire Management in Pemón Indigenous Lands. *Human Ecology* 38: 663–673. https://doi.org/10.1007/ s10745-010-9344-0

Bliege Bird, R., D. W. Bird, and B. F. Codding. 2016. People, El Niño Southern Oscillation and Fire in Australia: Fire Regimes and Climate Controls in Hummock Grasslands. *Philosophical Transactions* 371(20150343). http://dx.doi.org/10.1098/rstb.2015.0343

Bliege Bird, R., B. F. Codding, P. G. Kauhanen, and D. W. Bird. 2012. Aboriginal Hunting Buffers Climate-Driven Fire-Size Variability in Australia's Spinifex Grasslands. *Proceedings of the National Academy of Sciences* 109(26): 10287–10292: https://doi.org/10.1073/pnas.1204585109

Burgess, C. P., et al. 2009. Healthy Country, Healthy People: The Relationship between Indigenous Health Status and "Caring for Country." *Medical Journal of Australia* 190(10): 567–572. https://doi.org/10.5694/j.1326-5377.2009.tb02566.x

Cary, G., S. Dovers, and D. Lindenmayer. 2003. *Australia Burning: Fire Ecology, Policy and Management Issues.* Canberra, Australia: CSIRO Publishing.

CRED. 2022. *Centre for Research on the Epidemiology of Disasters.* https://cred.be/sites/default/files/CredCrunch70.pdf (accessed 5 May 2023).

Daniau, A.-L., M. F. S. Goñi, P. Martinez, and J. R. Marlon. 2013. Orbital-Scale Climate Forcing of Grassland Burning in Southern Africa. *Proceedings of the National Academy of Sciences.* 110(13): 5069–5073. https://doi.org/10.1073/pnas.1214292110

De Vries, B. J., and A. C. Petersen. 2009. Conceptualizing Sustainable Development: An Assessment Methodology Connecting Values, Knowledge, Worldviews and Scenarios. *Ecological Economics* 68: 1006–1019.

De Witt, A., J. de Boer, N. Hedlund, and P. Osseweijer. 2016. A New Tool to Map the Major Worldviews in the Netherlands and USA, and Explore How They Relate to Climate Change. *Environmental Science and Policy* 63: 101–112. https://doi.org/10.1016/j.envsci.2016.05.012

Dekens, J. 2007. *Local Knowledge for Disaster Preparedness: A Literature Review.* Kathmandu: International Centre for Integrated Mountain Development.

Department of Economic and Social Affairs. 2023. *United Nations Declaration on the Rights of Indigenous Peoples*. https://social.desa.un.org/issues/indigenous-peoples/united-nations-declaration-on-the-rights-of-indigenous-peoples (accessed 25 October 2023).

Dietz, T., P. Stern, and G. Gaugnano. 1998. Social Structural and Social Psychological Bases of Environmental Concern. *Environment and Behavior* 30: 450–471.

Dilkes-Hall, I. E., et al. 2019. Understanding Archaeobotany through Ethnobotany: An Example from Gooniyandi Country, Northwest, Western Australia. *Journal of the Anthropological Society of South Australia* 43(December): 4–32.

Dunlap, R. 1980. Paradigmatic Change in Social Science: From Human Exemptionalism to an Ecological Paradigm. *American Behavioral Scientist* 24: 5–14.

Florin, S., and X. Carah. 2018. Moving Past the "Neolithic Problem": The Development and Interaction of Subsistence Systems across Northern Sahul. *Quaternary International* 489: 46–62. https://doi.org/10.1016/j.quaint.2016.12.033

Gammage, B. 2011. *The Biggest Estate on Earth: How Aborigines Made Australia*. Sydney, Melbourne: Allen and Unwin.

Gammage, B., and B. Pascoe. 2021. *Country: Future Fire, Future Farming*. 1st ed. Australia: Thames and Hudson.

Grissino-Mayer, H. D., W. H. Romme, M. L. Floyd, and D. D. Hanna. 2004. Climatic and Human Influences on Fire Regimes of the Southern San Juan Mountains, Colorado, United States. *Ecology* 85(6): 1708–1724. https://doi.org/10.1890/02-0425

Hedlund-de Witt, A. 2012. Exploring Worldviews and Their Relationships to Sustainable Lifestyles: Towards a New Conceptual and Methodological Approach. *Ecological Economics* 84(December): 74–83: https://doi.org/10.1016/j.ecolecon.2012.09.009

Hercus, L. 2012. Trees from the Dreaming. *The Artefact* 35: 40–49.

Jollands, N., and G. Harmsworth. 2007. Participation of Indigenous Groups in Sustainable Development Monitoring: Rationale and Examples from New Zealand. *Ecological Economics* 62(3-4): 716–726. https://doi.org/10.1016/j.ecolecon.2006.09.010

Laws, G. 1994. Oppression, Knowledge and the Built Environment. *Political Geography* 13(1): 7–32. https://doi.org/10.1016/0962-6298(94)90008-6

Lockwood, M. 1999. Humans Valuing Nature: Synthesizing Insights from Philosophy, Psychology and Economics. *Environmental Values* 8(3): 381–401.

MacDonald, G. 2008. Difference or Disappearance: The Politics of Indigenous Inclusion in the Liberal State. *Anthropologica* 50(2): 341–358.

Mariani, M., et al. 2022. Disruption of Cultural Burning Promotes Shrub Encroachment and Unprecedented Wildfires. *Frontiers in Ecology and the Environment* 20(5): 292–300.

Marlon, J. R., et al. 2013. Global Biomass Burning: A Synthesis and Review of Holocene Paleofire Records and Their Controls. *Quaternary Science Reviews* 65(1): 5–25. https://doi.org/10.1016/j.quascirev.2012.11.029

Mcgregor, D. 2014. Lessons for Collaboration Involving Traditional Knowledge and Environmental Governance in Ontario, Canada. *AlterNative: An International Journal of Indigenous Peoples* 10(4): 340–353. https://doi.org/10.1177/117718011401000403

Mercer, J., I. Kelman, L. Taranis, and S. Suchet-Pearson. 2010. Framework for Integrating Indigenous and Scientific Knowledge for Disaster Risk Reduction. *Disasters* 34(1): 214–239. https://doi.org/10.1111/j.1467-7717.2009.01126.x

Neale, T. 2022. What Tradition Affords: Articulations of Indigeneity in Contemporary Bushfire Management. *Current Anthropology* 64(1): Ahead of Print. https://doi.org/10.1086/722533

O'Connell, J., and J. Allen. 2004. Dating the Colonization of Sahul (Pleistocene Australia–New Guinea): A Review of Recent Research. *Journal of Archaeological Science* 31(6): 835–853.

____. 2015. The Process, Biotic Impact, and Global Implications of the Human Colonization of Sahul about 47,000 Years Ago. *Journal of Archaeological Science* 56: 73–84.

Our World in Data. 2022. *Number of Recorded Natural Disaster Events, 1900 to 2022*. https://ourworldindata.org/grapher/number-of-natural-disaster-events (accessed 5 May 2023).

Padt, F., P. Opdam, N. Polman, and C. Termeer. 2014. *Scale-Sensitive Governance of the Environment*. Chichester, West Sussex, United Kingdom; Hoboken, New Jersey: Wiley Blackwell.

Pascoe, B. 2014. *Dark Emu: Black Seeds: Accident or Agriculture?* Broome: Magabala Book.

Ray, L. A., C. A. Kolden, and F. S. Chapin III. 2012. A Case for Developing Place-Based Fire Management Strategies from Traditional Ecological Knowledge. *Ecology and Society* 17(3): 37–72. https://www.jstor.org/stable/26269081

Ritchie, H., P. Rosado, and M. Roser. 2022. *Natural Disasters*. https://ourworldindata.org/natural-disasters (accessed 5 May 2023).

Rose, D. 1996. *Nourishing Terrains: Australian Aboriginal Views of Landscape and Wilderness*. Canberra: Australian Heritage Commission, Commonwealth of Australia.

Ruane, S. 2018. Using a Worldview Lens to Examine Complex Policy Issues: A Historical Review of Bushfire Management in the South West of Australia. *Local Environment* 23(8): 777–795.

Schultz, P. 2001. The Structure of Environmental Concern: Concern for Self, Other People, and the Biosphere. *Journal of Environmental Psychology* 21: 327–339.

Schultz, P. W., and L. Zelezny. 1999. Values as Predictors of Environmental Attitudes: Evidence for Consistency across 14 Countries. *Journal of Environmental Psychology* 19(3): 255–265. https://psycnet.apa.org/doi/10.1006/jevp.1999.0129

Shi, J., V. H. M. Visschers, and M. Siegrist. 2015. Public Perception of Climate Change: The Importance of Knowledge and Cultural Worldviews. *Risk Analysis* 35(12): 2183–2201.

Sillitoe, P. 1998. The Development of Indigenous Knowledge: A New Applied Anthropology. *Current Anthropology* 39(2): 223–252.

Spies, T. A., et al. 2014. Examining Fire-Prone Forest Landscapes as Coupled Human and Natural Systems. *Ecology and Society* 19(3). http://dx.doi.org/10.5751/ES-06584-190309

Steffensen, V. 2020. *Fire Country: How Indigenous Fire Management Could Help Save Australia*. Melbourne: Hardie Grant.

Stump, D. 2013. On Applied Archaeology, Indigenous Knowledge, and the Usable Past. *Current Anthropology* 54(3): 268–298.

Taylor, C. 1989. *Sources of the Self: The Making of the Modern Identity*. Cambridge: Harvard University Press.

Trauernicht, C., et al. 2015. Local and Global Pyrogeographic Evidence That Indigenous Fire Management Creates Pyrodiversity. *Ecology and Evolution* 5(9): 1908–1918.

United Nations. 2008. United Nations Declaration on the Rights of Indigenous Peoples. https://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

UNEP (United Nations Environment Programme). 2023. *From Disasters to Conflicts: Tackling the Impact on People and Planet*. https://www.unep.org/news-and-stories/story/disasters-conflicts-tackling-impact-people-and-planet (accessed 5 May 2023).

UNESCO (United Nations Educational, Scientific and Cultural Organization). 2021. *Local and Indigenous Knowledge Systems (LINKS)*. https://en.unesco.org/links (accessed 5 May 2023).

UNISDR (United Nations Office for Disaster Risk Reduction). 2004. *Terminology: Basic Terms of Disaster Risk Reduction*. Geneva: United Nations International Strategy for Disaster Reduction.

Van den Born, R. 2008. Rethinking Nature: Public Visions in the Netherlands. *Environmental Values* 17(1): 83–109.

Veth, P., C. Myers, P. Heaney, and S. Ouzmen. 2018. Plants before Farming: The Deep History of Plant Use and Representation in the Rock-Art of Australia's Kimberley Region. *Quaternary International* 489: 26–45.

Vrolijks, L. 1998. *Guidelines for Community Vulnerability Analysis: An Approach for Pacific Island Countries*. Suva: United Nations Department for Humanitarian Affairs; United Nations Department for Economic and Social Affairs.

WCED (World Commission on Environment and Development). 1987. *Our Common Future*. Washington, DC: World Commission on Environment and Development.

Williams, A. N., S. D. Mooney, S. A. Sisson, and J. Marlon. 2015. Exploring the Relationship between Aboriginal Population Indices and Fire in Australia over the Last 20,000 Years. *Palaeogeography, Palaeoclimatology, Palaeoecology* 432: 49–57.

Williams, P. A., L. Sikutshwa, and S. Shackleton. 2020. Acknowledging Indigenous and Local Knowledge to Facilitate Collaboration in Landscape Approaches: Lessons from a Systematic Review. *Land MDPI* 9(9). https://doi.org/10.3390/land9090331

Young, E. 1987. Resettlement and Caring for Country: The Anmatyerre Experience. *Aboriginal History* 11(1/2): 156–170.

PART III

Tools and Mechanisms in Post-Disaster Recovery

CHAPTER 12

Financial Support for Housing Reconstruction: Lessons from the Great East Japan Earthquake and Tsunami[1]

Mikio Ishiwatari, D. P. Aldrich, and D. Sasaki

12.1 Introduction

Some governments provide strong financial support to people affected by disasters to rehabilitate their daily lives and houses, while others do not. Providing financial support brings with it a number of potential issues. Whether it is fair to support the people affected by large-scale disasters but not victims of other shocks such as traffic accidents and fires remains an open question. Also, the question of government support to recreate the lost assets of houses and properties is a tough one.

Through examining these issues, Japan developed mechanisms of financial support for housing reconstruction following the Great Hanshin-Awaji (Kobe) Earthquake in 1995. The Japanese experience is useful reference for other countries seeking to establish support mechanisms for housing reconstruction. People affected by the Great East Japan Earthquake (GEJE) in 2011 received financial support from local and national governments. Local governments prohibited new housing construction in the at-risk areas of tsunamis and developed relocation sites at high and safe areas.

This chapter seeks to clarify factors that affect cost-sharing between governments and affected people for housing reconstruction following disasters. It reviews the recent literature about financial support for housing reconstruction in Japan and examines the evolving policies of financial support. Semistructured interviews were conducted with government officers, civil society organizations, and affected people in Higashimatsushima City, Sendai City, and Tokyo in September 2022.

12.2 Controversial Issues about Financial Support to Reconstruct Houses

This section reviews the recent literature on housing reconstruction support in Japan. Sato (2005) raises four main points to consider when examining financial support programs: (i) the financial feasibility of the program, (ii) fairness targeting vulnerable groups, (iii) the potential discouragement of self-help, and (iv) prompt transition to normal programs.

For financial feasibility, Tajika and Miyazaki (2014) assumed that financial support at large-scale disasters, such as earthquakes in the Tokyo Metropolitan areas and Nankai Trough tsunamis, would need enormous budgets of over ¥4 trillion, or $26 billion, which affect the national finance. This amount is over 10 times the cost of GEJE, but it is a manageable scale considering the total recovery budget for GEJE of ¥37 trillion.

Ranghieri and Ishiwatari (2014) point out the importance of financial support to vulnerable and low-income groups. Maly and Shiosaki (2012) reviewed the policy changes of housing reconstruction from a people-centered perspective. They argue that the housing policies implemented after the Kobe Earthquake divided local communities and severely impacted the daily lives of the affected people.

[1] This study is supported by the Japan Foundation's Japan–US Global Partnership grant program for Government and Market in Disasters: Capacity Building, Burden Sharing and Insurance.

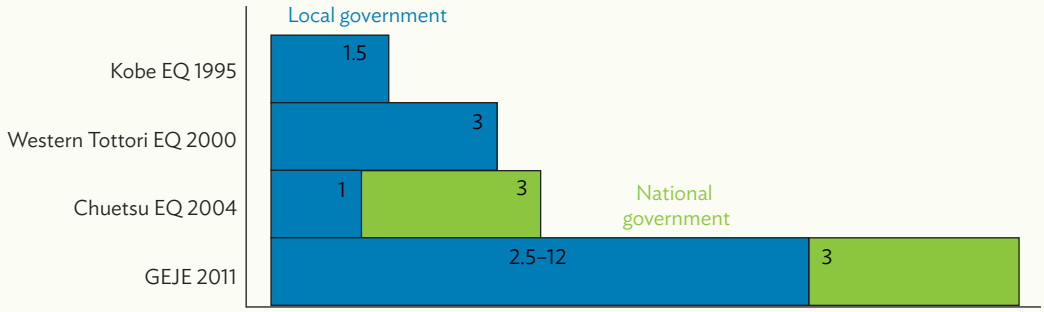
Tajika and Miyazaki (2014) argue that financial support from the government for housing reconstruction discourages ordinary people from building disaster-resilient houses and from purchasing earthquake insurance. This is because people can expect financial support for reconstructing their houses if they are damaged by disasters.

Shiosaki (2021) stresses that the budget for reconstructing houses and daily lives is limited to less than 10% of the total reconstruction budgets for GEJE, much smaller than the budget for infrastructure reconstruction. He proposes creating flexible programs that integrate transition shelters and housing reconstruction as well as expanding financial support for self-reconstruction instead of public apartments. Inoue (2021) reviewed recovery budgets for 10 years and argues that the current financial support to self-help reconstruction would be insufficient because disasters have become more frequent and large-scale.

12.3 Evolving Process of Financial Support to Rehabilitate Houses in Japan

Housing reconstruction policy in Japan has improved since the Kobe Earthquake in 1995, and the amount of support by the national and local governments has increased gradually (Figure 12.1). The Kobe Earthquake of magnitude 7.3 killed some 6,400 people and damaged over 600,000 houses. The national and local governments provided various relief goods and transition shelters to the affected people as well as condolence money to bereaved families based on the disaster management regulations. The national government did not have a scheme of financial support for house owners to reconstruct their houses but supported the construction of high-rise public apartments where the affected people could live in units with subsidized rent. Before the Kobe Earthquake, the people affected by disasters used donations from the public for housing reconstruction. Because of the large-scale damage, donations were limited to ¥400,000, or $3,000, per household, far less than the necessary cost of housing reconstruction. The governments of Hyogo Prefecture and Kobe City provided house owners with ¥1.5 million at maximum from their recovery funds to reconstruct houses.

Figure 12.1: Trend of Government Financial Support to Housing Reconstruction (¥ million per household)



EQ = earthquake, GEJE = Great East Japan Earthquake.

Source: Authors' elaboration using data from Kondo (2015).

Government support for people's daily lives was not sufficient after the Kobe Earthquake. Civil society organizations and mass media stressed the need for direct financial support by the government as a safety net for the affected people (Tajika and Miyazaki 2014). Because of limited income and assets, some residents could not afford to purchase insurance or earthquake-proof their homes before the disaster or to rebuild their daily lives after the disaster.

Three years after the Kobe Earthquake, the central Japanese government created legislation supporting the rehabilitation of people's daily lives by providing ¥1 million, some $7,000, to each household for obtaining daily necessities (Yamazaki 2011). Until then, the government had provided no support for rehabilitating the personal assets of the affected people. The government insisted that it did not support the recreation of personal assets and argued that it had no responsibility for damage caused by natural hazards (Tajika and Miyazaki 2014). However, this was inconsistent with other rehabilitation policies. The government had supported rebuilding the private assets of agricultural fields and facilities owned by farmers as well as fishing boats and fishery equipment owned by fisherfolk.

The Tottori Prefecture government supported housing reconstruction by providing ¥3 million directly to house owners following the Western Tottori Earthquake in 2000. The prefectural governor recognized housing reconstruction as the key to rehabilitating local communities in aging and depopulating rural areas. Without financial support for housing reconstruction, affected people would not remain in remote areas and would move to urban areas, even if the government rehabilitated infrastructure and public facilities. The Tottori prefectural government independently started providing financial support for reconstructing houses to prevent communities from collapsing. Other prefectural governments of Miyagi, Tokyo, Ishikawa, and Niigata followed to establish similar schemes of financial support (Yamazaki 2011). In 2004, the support amount by the national government was raised from ¥1 million to ¥3 million per household, or $22,000 with the addition of a housing-related subsidy. However, the house owners could not use this subsidy for construction or repair of houses, but only for demolition of damaged houses, loan payments for new houses, and rent for apartments.

The national government followed the efforts of the local governments and allowed assistance for housing reconstruction in 2007. Anyone who had their houses destroyed could receive financial support without restrictions on income and age. Local governments established their own support schemes on top of the national government support.

The government maintained the position that affected people had the responsibility of rebuilding their daily lives. The government's financial assistance is intended to "support" the rebuilding of livelihoods and is not seen as "compensation" for damage caused by disasters. Thus, the support does not cover the full cost of rebuilding people's daily lives.

12.4 Support to Housing Reconstruction after the Great East Japan Earthquake

At the time of the Great East Japan Earthquake (GEJE) in 2011, the magnitude 9.0 earthquake caused a tsunami with waves up to 40 meters high. Over 22,000 were dead, and over 650,000 houses were fully or partially destroyed. The total economic damage is estimated at ¥16.9 trillion, or $120 billion (Ranghieri and Ishiwatari 2014; Aldrich 2019).

The national government spent some ¥2.2 trillion, or $16 billion, on programs related to reconstructing housing (Shiosaki 2021). This budget included developing relocation sites for housing reconstruction

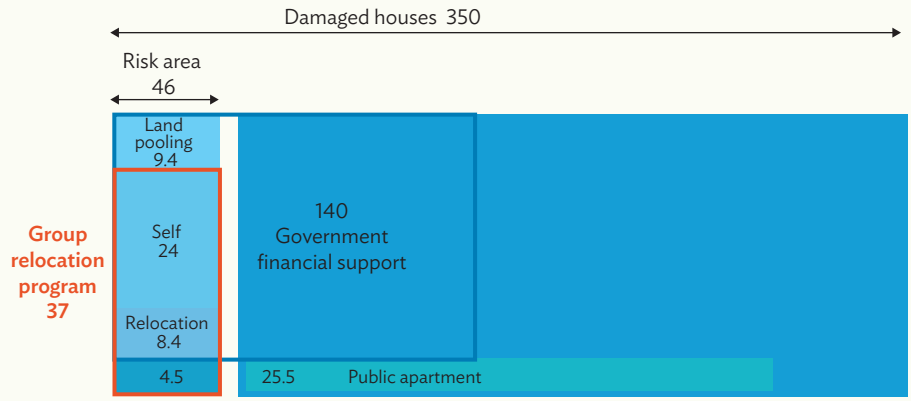
in areas safe against tsunami risks, constructing public apartments, and providing financial assistance to house owners. This budget accounted for 6% of total recovery budgets of ¥37 trillion.

Out of the ¥2.2 trillion, the national government spent some ¥1 trillion on programs of group relocation and land pooling for constructing new housing sites. While the whole picture of reconstruction is unclear, related documents on the three severely damaged prefectures of Iwate, Miyagi, and Fukushima provide some estimates (Figure 12.2). Local governments provided 17,800 housing lots, which accounts for over 10% of the total 140,000 units of reconstructed houses (Review Committee 2021). The average cost per house of the two programs, excluding housing construction costs, reached ¥61 million, or $440,000. Affected families needed to cover the construction costs of new houses at lots developed under these programs. Some 87% of affected families did not join the two government programs and reconstructed their houses by their own effort with financial support of the government program.

Group relocation programs developed housing lots at higher, safe ground and constructed critical infrastructure such as roads, water supply, sewerage, schools, and electricity as well as the facilities of community centers. Local governments bought out a total of 37,000 houses at tsunami-risk areas. They developed 321 relocation sites for 8,400 houses using ¥56 billion, $400 million.

Under land pooling programs of constructing lots for housing reconstruction, local governments raised lands to levels that would be safe against potential tsunamis and readjusted land titles among affected families for 9,400 houses using ¥46 billion.

Figure 12.2: Housing Reconstruction in Three Major Prefectures (thousand households)



Source: Authors' elaboration based on Review Committee (2021) and Shiosaki (2021).

Table 12.1: Development Costs for Relocation Sites

City	Units	Average Cost per Housing Lot (¥ million)
Higashimatsushima	1,285	23.6
Ishinomaki	2,639	33.3
Iwaki	54	37.4
Minamisoma	304	65.4
Namie	142	50.2
Naraha	36	48.9
Ofunato	366	38.9
Onagawa	220	72.7
Shinchi	224	41.6

Sources: Modified from Miyagi Kenmin Center 2021; Matsuzaki and Kawasaki 2016; data from Higashimatsushima City.

The costs of developing relocation sites vary by municipality. The average costs ranged from ¥24 million to ¥73 million, $170,000 to $520,000, excluding housing construction (Table 12.1). New development for small-scale sites in difficult geographical conditions cost significantly more. Ishinomaki City invested some ¥140 million per house for constructing relocation sites at small-scale sites (Nikkei Xtech 2021). Most of these sites were in hilly areas in peninsulas, which required the additional work of landslide protection. This cost per house is higher than the average cost of ¥33.3 million in the city. Ofunato City relocated houses to existing communities to reduce the development costs and implementation periods of relocation sites. Resettling houses in existing communities did not require land development or new critical infrastructure systems. This approach of relocation cost some ¥32 million per house, which is lower than the average cost of ¥39 million in the city and about one fourth of the high-cost case in Ishinomaki City (Kenmin Center 2021).

At the relocation sites developed under two programs, the affected people rebuilt their own houses. The house owners received public financial assistance of some one-fifth to three-fifths of the average construction cost per house of ¥25 million. The national government disbursed a total of ¥300 billion, $2.1 billion, in housing reconstruction assistance, with a maximum of ¥3 million, or $20,000, per house (Shiosaki 2021). Some 140,000 houses received this financial assistance in three severely damaged prefectures, Iwate, Miyagi, and Fukushima prefectures (Review Committee 2021). In addition, local governments provided financial assistance under their own programs. The Iwate Prefecture government provided ¥3.3 to ¥5.3 million per house, while the Miyagi Prefecture government did not have an assistance program. Each municipality government implemented its own programs of financial support ranging from ¥0 to ¥12.3 million per house (Kondo 2015). Local governments filled the gaps of financial assistance among various schemes. For example, some schemes did not cover the costs of moving or of purchasing lands. Higashimatsushima City provided financial assistance to house owners who moved from outside the city. Furthermore, local governments reduced the leasing fee for the relocated land, making it virtually free of charge.

Local governments provided public apartments to vulnerable families, such as low-income people and elders, who could not afford to reconstruct houses. The rent was subsidized for 10 years. The programs of developing public apartments needed ¥900 billion, $6.4 billion, for 30,000 houses, some ¥30 million per house.

The law of supporting the rehabilitation of people's daily lives does not cover business assets such as stores and rental apartments. These are crucial for rehabilitating their livelihoods and daily lives. This situation is unfair compared with programs for rehabilitation support in agriculture and fishery, in which the national government covers such business assets.

While local governments usually shoulder some of the reconstruction costs, after the 11 March 2011 triple disasters, the national government covered most of the costs of recovery programs as an exceptional case. The Hyogo Prefecture and Kobe City governments shared half of the recovery costs from the Kobe Earthquake in 1995. Japan recognized GEJE as a national calamity with the unprecedented damage of a death toll of over 20,000 and decided that the entire country would support the recovery efforts in Tohoku. Japanese taxpayers accepted a special income tax that adds a 2.1% levy to individual income tax for the Tohoku recovery.

12.5 Discussion

Japan's experience shows an evolution in the way that the national government has handled financial assistance for housing reconstruction following disasters. The Japanese argument that affected people should recover from natural hazards by themselves in principle is relatively rare; it posits that people should prepare for disasters by constructing resilient houses and paying insurance. The government has not financed recreating the personal assets of houses or compensating economic damage caused by natural hazards. Financial support can be justified only to support rehabilitating local communities. Without financial support for housing reconstruction, people will leave their original communities, leading to the collapse of communities. There are no clear criteria of cost-sharing between governments and victims. Thus, Japan is still discussing an appropriate level of financial support. Governments need to support vulnerable groups such as elders and low-income groups who cannot afford to reconstruct their houses.

To support housing reconstruction following Japan's 11 March disasters, local governments provided different levels of support to house owners. The existence of various programs implies a kind of competition among municipalities. Some groups, especially younger generations, wanted to move to larger cities, such as Sendai City, to seek better job opportunities and stronger children's education. Local governments provided financial assistance to victims to reconstruct their houses in their original cities. Financial support covers moving costs and loan interest as well.

The approach of the national government of covering all reconstruction costs may lead to both overplanning and major cost increases. Local governments could plan relocation sites on higher ground in hilly areas even with high costs based on the opinions of the affected people. Mayors did not prefer recovery plans that assumed a population decrease (Kahoshinposha 2022). Local communities unnecessarily decided to merge communities at relocation sites to maintain original communities. And the government softened the minimum lots required for group relocation from 10 houses to 5 houses, leading to a cost increase.

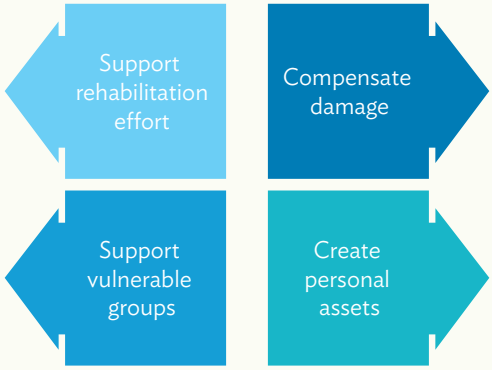
These mechanisms have been developed on ad hoc bases. Under current recovery programs, the government provides nonmonetary assistance, such as relief goods and transition shelters, as well as financial assistance for housing reconstruction. Further studies should analyze integrated approaches of nonmonetary and financial supports for housing assistance including transition shelters and insurance.

12.6 Conclusion

This chapter examines factors that affect cost-sharing of housing reconstruction between governments and people affected by disasters through reviewing the evolving process of financial support programs by national and local governments in Japan. The country has gradually developed support mechanisms following the Kobe Earthquake in 1995. It was found that the support programs do not aim at compensating damage from natural hazards or creating personal assets but assist victims' efforts of rehabilitating their daily lives. The country recognizes that housing reconstruction is crucial in rehabilitating local communities. During the recovery from the Great East Japan Earthquake, 140,000 houses were reconstructed under government support. The national government covered all construction costs of relocation sites and provided financial support to construct individual houses. Local governments developed different programs allowing the affected people to remain and reconstruct houses in the original municipality. Low-income households and elders need support for housing reconstruction. In Japan, governments constructed 30,000 units of affordable public apartments with subsidized rent.

These findings are useful for helping other countries to consider financial support programs for housing reconstruction. Such supports need clear policies covering objectives and justification (Figure 12.3). Otherwise, the supports may be regarded as unfair in comparison to recovery support for other events.

Figure 12.3: Objectives and Issues of Financial Support for Housing Reconstruction



Source: Authors' elaboration.

References

Aldrich, D. P. 2019. *Black Wave: How Networks and Governance Shaped Japan's 3/11 Disasters*. Chicago: University of Chicago Press.

Inoue, H. 2021. Review of 10-Year Recovery Budget for the Great East Japan Earthquake, *Research Bureau* 18: 1–24.

Kahoshinposha. 2022. *Living in Recovery: Great East Japan Earthquake-Voices from Affected Areas* (in Japanese). Tokyo: Iwanami Shoten.

Kondo, T. 2015. The Founding Background and Characteristics of Housing Rebuilding Assistance Subsidy Programs by Local Governments after the Great East Japan Earthquake. *Journal of Architecture and Planning* 80(707): 135–144.

Maly, E., and Y. Shiozaki. 2012. Towards a Policy That Supports People-Centered Housing Recovery—Learning from Housing Reconstruction after the Hanshin-Awaji Earthquake in Kobe, Japan. *International Journal of Disaster Risk Science* 3, 56–65. https://doi.org/10.1007/s13753-012-0007-1

Matsuzaki, Y., and K. Kawasaki. 2016. Analysis of Development Plans of Group Relocation Projects for Disaster Mitigation for Reconstruction in Response to the Great East Japan Earthquake: A Case Study of Fukushima Prefecture. *Reports of the City Planning Institute of Japan* (14): 230–235.

Miyagi Kenmin Center for Supporting Recovery form Great East Japan Earthquake (Miyagi Kenmin Center). 2021. Newsletter (in Japanese) 68. Sendai: Miyagi Kenmin Center.

Nikkei Xtech. 2021. *Difficulties of Investing over 100 Million JPY per House: Study Cases of Resettling into Existing Communities* (in Japanese). 11 March. https://xtech.nikkei.com/atcl/nxt/mag/na/18/00131/030300007/

Ranghieri, F., and M. Ishiwatari, eds. 2014. Learning from Megadisasters: Lessons from the Great East Japan Earthquake. Washington, DC: World Bank.

Review Committee of Town Recovery Programs from the Tsunami Damage by Great East Japan Earthquake (Review Committee). 2021. *Final Report* (in Japanese). Tokyo: MLIT.

Sato, M. 2005. Economic Perspective of Government Support at Disasters (in Japanese). *Auditing Research* 32: 33–50.

Shiosaki, Y. 2021. 10 Years from the Great East Japan Earthquake and Housing Reconstruction (in Japanese). *Recovery* 9(2): 3–10.

Tajika, E., and T. Miyazaki. 2014. Approaches of Rehabilitating Daily Lives of the People Affected by Earthquake Disasters (in Japanese). *Urban Housing Study* 86: 53–57.

Yamazaki, E. 2011. Current State of Policies Instituted by Local Governments: Based on an Institute for the Research of Disaster Area Reconstruction Questionnaire. *Research on Disaster Recovery* 3.

CHAPTER 13

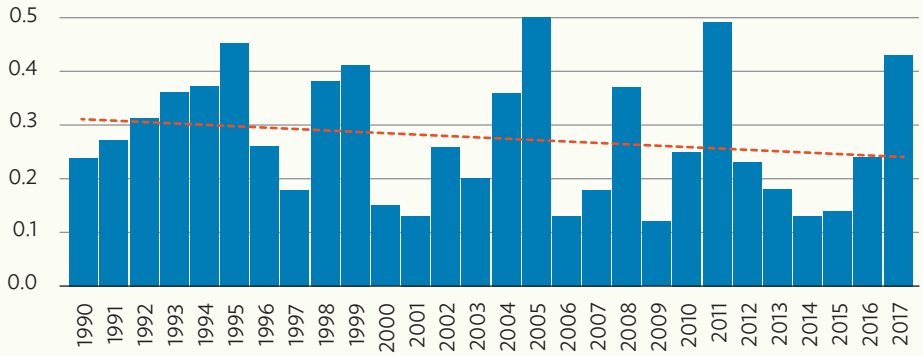
Big Data in Asian Post-Disaster Recovery and Reconstruction: A Systematic Literature Review

Carmelita G. Esclanda

13.1 Introduction

Disasters are large-scale disruptions in the operation of a community or society of any size caused by hazardous occurrences interacting with circumstances of exposure, susceptibility, and capacity, resulting in one or more of the following: human, material, economic, and environmental losses and impacts (UNDRR 2020). They can devastate people's livelihoods and undermine the social, environmental, and economic pillars of any nation, whether they occur in developed or developing countries. This harmful effect of disasters is unfolding faster and more unpredictably than expected, spanning numerous sectors, dimensions, and scales (FAO 2021). Every year, disasters strike all across the world, killing thousands, displacing many more, and ruining billions of dollars in property and infrastructure (Altay and Green 2006; Galindo 2013). From 1990 to 2017, global weather-related disaster losses amounted to 0.27% of gross domestic product (GDP), as seen in Figure 13.1.

Figure 13.1: Disaster-Related Losses as a Percentage of Global Gross Domestic Product, 1990–2017 (%)



Source: Pielke (2019).

Regardless of the location, disasters have been a regular threat to people's lives and property throughout history. Asia is one of the most affected regions, where 38% of natural disasters occurred in 2019, as seen in Table 13.1. Between 2014 and 2017, Asian countries were hit by 55 earthquakes, 217 storms and cyclones, and 236 occurrences of extreme flooding, affecting 650 million people and leading to 33,000 deaths (WEF 2018). From 2011 to 2015, the region experienced 45% of global disasters, resulting in a surge in disaster impacts to GDP from around 0.1% in the 1970s to 0.4% in the recent decades (ESCAP 2017). According to the Emergency Events Database on International Disasters (ADB 2013), the region accounted for 50% of the estimated economic cost of disasters from 2003 to 2013, or $927 billion in

Asia and $956 billion outside Asia. While the region produced over 25% of the global GDP between 1980 and 2009, it also incurred 38% of global economic losses resulting from natural disasters during that time (ADB 2013).

Table 13.1: Share of Impact of Natural Disasters per Region, 2019

	Occurrences		Deaths		Affected		Damage	
Region	No.	%	No.	%	No.	%	No.	%
Africa	114	25.9	12,659	52.5	23,588,362	23.5	2,447	2.4
Americas	87	19.8	1,306	5.4	1,536,965	1.5	29,633	28.9
Asia	168	38.2	7,282	30.2	74,604,093	74.4	62,175	60.6
Europe	57	13.0	2,757	11.4	436,851	0.4	4,310	4.2
Oceania	14	3.2	108	0.4	57,465	0.1	4,000	3.9
Total	440	100.0	24,112	100.0	100,223,736	100.0	102,565	100.0

Source: Asian Disaster Reduction Center (2019).

The overall GDP of Asia and the Pacific went up from $9 trillion in 2000 to $35 trillion by 2021, accounting for approximately 37% of GDP (Biswas 2022). The majority the increase came from Southeast Asia, along with the People's Republic of China and India. As such, the onus is on these countries to steer Asia's development in an equitable manner that addresses a slew of social and economic issues. The Association of Southeast Asian Nations (ASEAN) region was indeed one of the most dynamic and fastest growing regions in the world. Except during the Asian financial crisis in 1998, ASEAN has consistently posted positive real GDP growth throughout the decades. Since 1999, real GDP growth has ranged from 2.5% to 7.5%. Meanwhile, ASEAN's proportion of global GDP has nearly doubled, from 3.3% in 1967 to 6.2% in 2016.

When the coronavirus disease (COVID-19) was announced by the World Health Organization in January 2020, Southeast Asia was among the first regions to be affected due to its economic proximity to Chinese businesses (OECD 2020). In early April 2020, the Asian Development Bank cut its growth forecast for the 10 ASEAN countries to 1.0% from 4.4% in the previous year. While the most current economic estimate reduced growth to 4.0% in 2021, followed by 5.2% in 2022, ASEAN countries are already being hurt by supply and trade delays from the People's Republic of China, as well as a substantial decline in foreign tourists. These are exacerbated by lockdowns and social restriction efforts in many countries, which have significantly impeded economic activity in many areas of the economy. Small and medium-sized businesses, services, and tourism are among the hardest hit. Frequent natural disasters throughout Asia and the Pacific, such as the pandemic, serve as a reminder of the importance of establishing and sustaining resilience against future disasters so that economies and societies can continue to thrive in difficult times.

Income, governance, academic achievement, urbanization, infrastructure, trade accessibility, and financial expansion and integration at the country level may all have an effect on the degree of consequences from natural disasters. Studies have found that economic progress results in implicit protection against natural shocks. Richer countries incur less death from disasters, even though they do not experience fewer natural disasters than poorer countries. Moreover, natural disaster–related deaths are significantly lower in democracies and in countries with better institutions (Kahn 2005).

Incontrovertibly, economic preparedness affects disaster-related consequences. Hence, various studies suggest poverty abatement strategies to improve outcomes after disasters. Faber, for instance, cites previous research in emphasizing the need to understand how attempts to mitigate poverty are connected to initiatives aimed at improving catastrophe and post-disaster consequences (Eakin and Luers 2006, as cited in Faber 2015).

In ASEAN, while rapid economic and social recovery is likely to conceal significant economic and social damages, the road to recovery will be long and difficult in much of the region, considering the varying income and development level of its economies (Vu 2020). The region is steered by the ASEAN Economic Community Blueprint 2025, the ASEAN Comprehensive Recovery Framework, and its Implementation Plan, which were adopted in 2020 and serve as the region's whole-of-community recovery plan from the COVID-19 crisis through the phases of reopening, recovery, and long-term resilience.

In the digital world, governments use technology not only to enhance the economy, but also to provide assistance during disasters. With the enormous amount of data coming from the vast sensor network, social media, and surveys, big data analysis and management can play a critical role even in all phases of disaster management. Because big data use in disaster management is still in its early stages, numerous improvements in capacity, management, and research will assist to maximize the benefits of this modern potential (Rahman, Di, and Esraz-Ul-Zannat 2017).

Emerging digital technologies will be more important as Asian countries recuperate from the pandemic. With this, the purposes of this research are the following:

(i) to investigate the role of technology and big data in disaster rehabilitation policies and practices during and after a disaster;
(ii) to analyze the obstacles and challenges in leveraging technology and data; and
(iii) to provide recommendations to advance ASEAN's post-disaster efforts using big data.

This chapter systematically reviews the ways in which big data technology is used in disaster management, particularly in post-disaster recovery. For this purpose, empirical studies that utilized big data and analytics were searched to identify challenges and policy recommendations for post-disaster reconstruction. Based on the previously described research gaps, this study focuses on the following three research questions:

(i) What big data applications for post-disaster recovery in Asia were examined in the existing literature?
(ii) What are the challenges in utilizing big data applications for disaster recovery?
(iii) How can post-disaster recovery plans be improved using big data?

The key goal of this research is to give a thorough literature assessment on big data applications in Asian post-disaster recovery and reconstruction. This chapter presents a graphic concept of disaster management, discusses big data, and presents the findings of the systematic literature study.

13.2 Literature Review

Governments frequently make challenging choices during a tragedy or crisis due to uncertainty and time restrictions. These choices must be culturally relevant as well as population sensitive (Wang, Ng, and Brook 2020).

13.2.1 Disaster Management

Disaster management is a methodical procedure with the main goal of reducing the adverse repercussions and effects of disasters, therefore protecting human, material, and even social infrastructure (Velev and Zlateva 2011). As shown in Figure 13.2, the disaster management life cycle includes four phases:

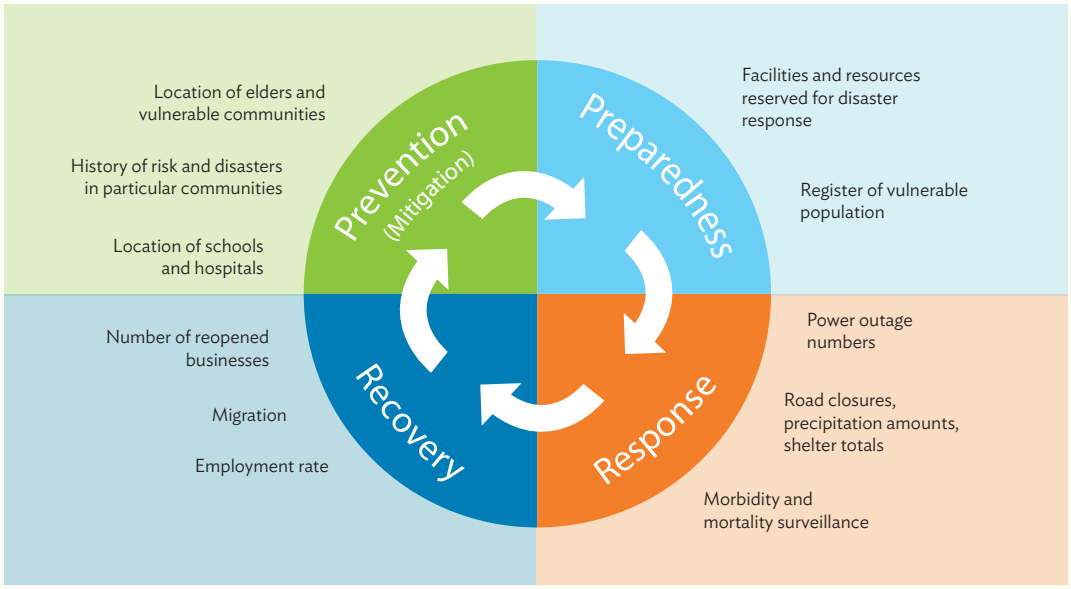
(i) **Prevention/Mitigation:** This encompasses averting forthcoming disasters and/or abating their negative effects. It necessitates hazard risk assessment and the implementation of solutions to limit the possibility of risks becoming disasters, such as flood-proofing dwellings or purchasing insurance.

(ii) **Preparedness:** This includes pre-emergency planning or preparations that assist individuals and communities in making preparations. It might involve stockpiling food and water or assembling and assessing potential volunteers to mobilize after a disaster.

(iii) **Response:** This involves measures conducted immediately following an emergency, such as efforts to preserve lives while avoiding further property damage. When possible, disaster response entails implementing previously recognized disaster preparedness plans. This stage of the disaster development cycle typically receives the greatest consideration. It is also referred to as "disaster relief."

(iv) **Recovery:** This occurs subsequently, once the examination of damages has been completed, and entails steps to restore the distressed community to their condition prior to the disaster or better. Ideally, the implementation of disaster recovery should reduce the susceptibility of the community to subsequent threats, and understanding the nature of risks as well as vulnerabilities is essential for risk identification. Physical improvements to education as well as training and campaigns to raise awareness may be considered as subsequent efforts.

Figure 13.2: Disaster Management Cycle with Examples of Data Categories



Source: Campaign for Action (2021), with minor revisions by the author.

In every stage of a disaster, technologies and big data are critical. For instance, big data application can support in determining the success of post-disaster response as well as render it further responsible by dynamically collecting data gathered through, e.g., unmanned aerial vehicles or social media. Technology trends like big crisis data analytics can potentially revolutionize all the stages of a crisis life cycle (i.e., before, during, and after the crisis) and can be effective for emergency anticipation, preparation, response, and recovery (Qadir et al. 2016).

Some of the critical data points for crisis response and recovery are listed in Table 13.2.

Table 13.2: Data Sets Related to Crisis Response and Recovery

Phase	Data Set	Potential Sources
Mitigation and preparedness	Maps with boundaries of areas used for forecasting and warnings	• Satellite data (e.g., Lidar) • Spatial data (e.g., OpenStreetMap) • Weather authorities • Government websites • Sensors • Social media
	Key infrastructure (e.g., water and drainage, public transport)	
	Evacuation sites and capacities	
	Natural environment (e.g., floodplains, mangroves)	
	Information on location, maximum winds, central pressure, and size of tropical cyclones	
	Storm event database and damage statistics	
	Public health factors and relevant indices	
Response	Inventory of buildings	• Crowdsourcing • Satellite data • Spatial data • Sensors • Social media
	Event data (area of impact and severity to affected population)	
	Roads and place names for efficient routing and navigation	
Recovery	Population estimates	• Government data • Social media • Spatial data • Sensor web and Internet of Things • Satellite data
	Routing and logistics of humanitarian aid	
	Damage assessments	
	Humanitarian and development needs assessment	
	Type of disaster	

13.2.2 Post-Disaster Recovery

Post-disaster recovery is as critical as pre-disaster preparedness. Recovery and reconstruction allow cities to be rebuilt beyond their pre-disaster states, resulting in safer, healthier and stronger communities. Post-disaster recovery, if done properly, can be a chance for growth to lower future risk and successfully enable a holistic disaster risk reduction approach (Shaw 2014).

Disaster recovery refers to the methods, strategies, and practices used to ensure an immediate and easy recovery of an organization's data and infrastructure following a disaster, whether caused by humans or nature. Using innovative technology, this phase can be maximized to uplift citizens' lives. Planning, community information dissemination, operational integration, economic recapture, health and social services provision, and heritage assets preservation are among the key competences that will be reinforced by technology (Iglesias, Favenza, and Carrera 2020).

Institutional limitations, disconnects in communication, a shortage of expertise and skills needed to support grassroots efforts, and management failures all compromise the safety and stability of post-disaster recovery. Based on a paper by the University of Westminster, substantial proof exists of a "gap" in finance, administration, and delivery between immediate, successful emergency assistance and lasting rebuilding (Lloyd-Jones 2006). The following are some of the factors contributing to prolonged reconstruction after big disasters:

(i) Large-scale emergencies disproportionately affect impoverished communities in the form of the number of people impacted immediately and via extended distress throughout reconstruction.
(ii) Notwithstanding significant advances in emergency response to disasters, long-term rebuilding is frequently poorly operated, unorganized, and stalled.
(iii) Devastated victims are often overextending themselves in inadequate transitory housing, uncertain as to whether they will eventually get a fixed dwelling.
(iv) The financial support available for recovery from disasters is excessively inflexible and focused on immediate needs. This hinders attempts to strategize and implement a seamless and swift transition to lasting reconstruction and recovery.

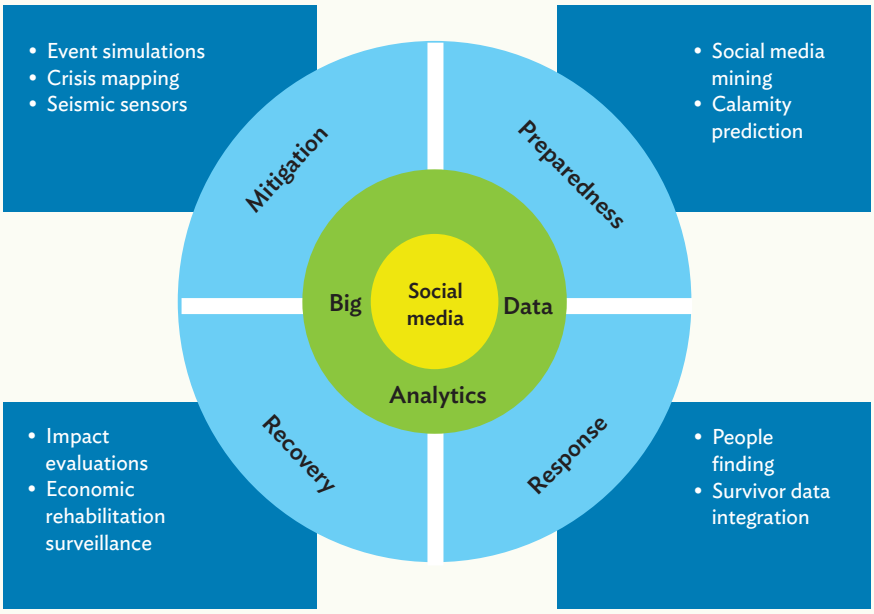
Disaster recovery and reconstruction are challenging to oversee and examine effectively on a wide scale. Considerable time gaps, a lack of ongoing commitment from both national and international partners, and dwindling resource pledges are frequently problems for post-disaster reconstruction. After post-disaster evaluations, momentum typically slows down, leaving it difficult to organize and carry out final phases of recovery and reconstruction. Despite numerous attempts to boost capacity, countries continue to confront significant obstacles when it comes to organizing and conducting recovery procedures (United Nations World Conference on Disaster Risk Reduction 2015).

13.2.3 Big Data Analytics

Big data is a developing concept that describes collections or mixtures of data sets that are challenging to collect, organize, handle, and analyze using conventional methods and technologies due to the size, complexity, and rapid increase of data (Kailser et al. 2013). It is set to disrupt business, education, the field of economics and finance, and the social sciences, among others (Mayer-Schönberger and Cukier 2014). The quantity of produced and preserved data (volume), the kind and characteristics of the data (variety), the rate at which data is being generated and processed (velocity), the inconsistent characteristics of the data set (variability), and the overall integrity of collected data (veracity) are generally used to define big data. Data can be structured (i.e., arranged in predefined fields, like spreadsheets) or unstructured, contingent upon how it was collected (e.g., photos or words in documents and reports).

The references for big data analysis in an emergency include insights supplied by people as a result of relief efforts; readily accessible data; internet content regarding personal posts and current affairs; information proactively generated or uploaded by citizens for big data analysis through surveys via the internet, text messages, emergency lines and so on; and satellite photographs of landscapes, mobile congestion, and urban development (Letouzé 2012). Disasters create tremendous changes in a relatively brief amount of time. Big data is crucial in the disaster management cycle, in particular during the recovery phase, when countries and corporations attempt to recuperate what has been destroyed and reorganize for the future. Figure 13.3 depicts examples of big data usage at every phase of the disaster management life cycle.

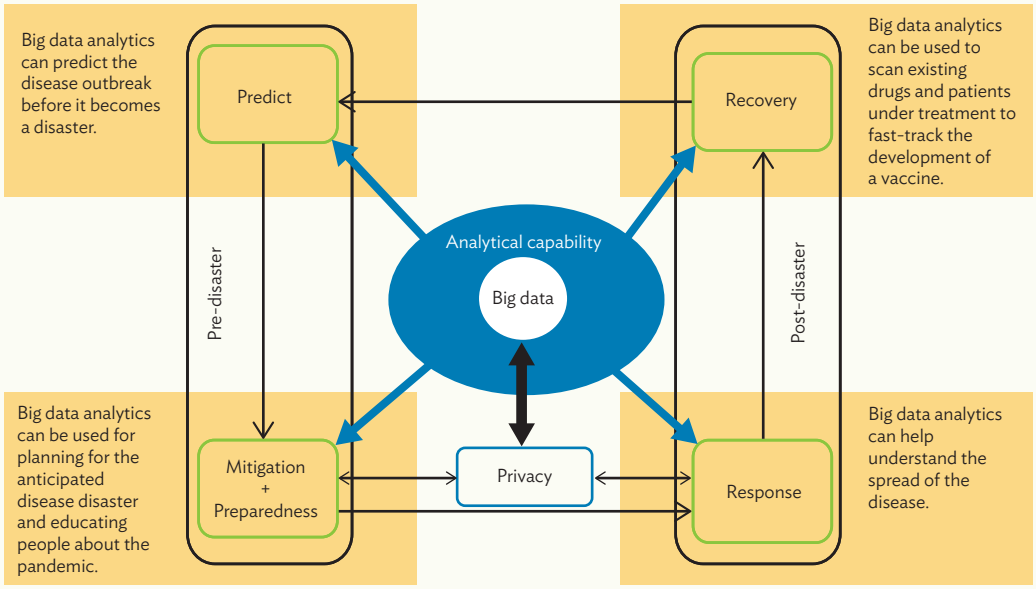
Figure 13.3: Big Data Analytics and the Use of Social Media in the Process of Disaster Management



Source: Joseph et al. (2018).

To develop lessons learned, big data can be utilized to investigate, assess, and predict complicated data structures. As a result, scholars and practitioners are eager to capitalize on it. De Albuquerque et al. (2015), for example, employed a location-based method to combine social networking sites and credible data to discover useful knowledge for disaster management, whereas Landwehr et al. (2016) utilized tweets to aid in disaster management preparation, notification, and response. Dufty (2016) examined Twitter's use in disaster management by analyzing the available research spanning the last 10 years. Granell and Ostermann (2016) outlined goals and techniques for disaster management with the help of contributed spatial data as well as geosocial media. Wu et al. (2018) also examined how information extraction and statistical methods might be used to anticipate, recognize, and build an effective disaster management approach. For instance, Figure 13.4 details how big data analytics support governments in case of a pandemic.

Figure 13.4: Pandemic Disaster Management Approach Based on Big Data



Source: Elsotouhy, Jain, and Shrivastava (2021).

13.2.4 Systematic Literature Review

A systematic literature review deals with the difficulty of compiling scientific proof gathered through numerous approaches and in (academically) vastly distinct settings (Brereton et al. 2007). The seven main criteria guiding systematic literature reviews are disclosure, transparency, integration, focus, fairness, availability, and comprehensiveness (Pittway 2008).

Within the medical practice, the procedures required for applying evidence-based medicine have been uncovered and recorded (Sackett 2000). Consequently, these were reengineered to deal with a research-based technological development (Dyba, Kampenes, and Sjøberg 2005).

The steps for conducting a systematic literature review are:

(i) Translate the demand for knowledge (relating to an approach, operation, etc.) to a query that can be answered.
(ii) Gather the best proof to respond to the inquiry with.
(iii) Examine the documentation for its veracity (truthfulness), significance (magnitude of the effect), and usefulness (utility).
(iv) Combine the thorough examination with software engineering knowledge as well as the principles and conditions of stakeholders.
(v) Examine how efficient and effective the execution of stages 1–4 has been while researching opportunities to enhance them.

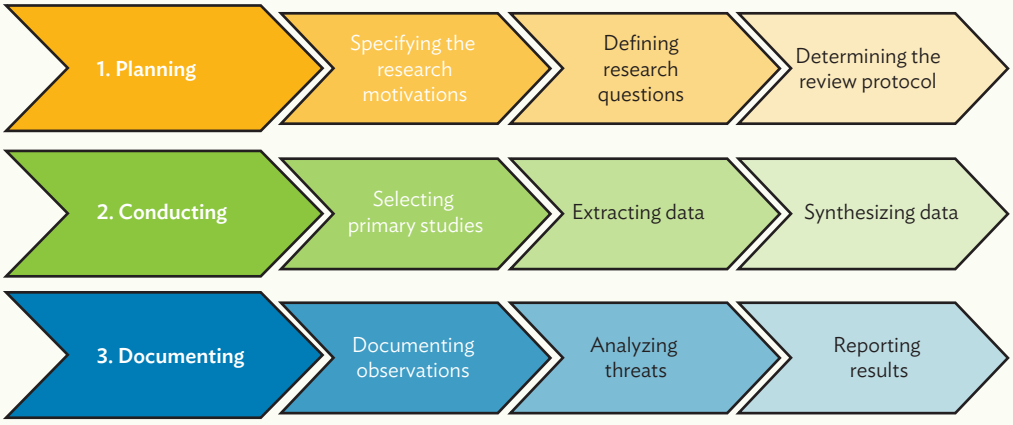
This compilation procedure is essential for any evidence-based strategy that seeks to give impartial summaries of empirical evidence (Brereton et al. 2007).

13.3 Analytical Framework

In this study, a systematic literature review will be used for analysis. A systematic literature review differs from standard literature reviews in that the assessment process is deliberate and methodical (Khan et al. 2003). This form of assessment is deemed to be original work given that it is carried out in accordance with a strict, systematic procedure (Rother 2007). It is done in a way that can be duplicated, yielding similar outcomes given the same data.

Figure 13.5 depicts a three-phase guideline for planning, conducting, and archiving research papers to undertake a systematic literature review (Brereton et al. 2007). During the planning process, queries have to be determined. The publications related to the queries are then chosen in the conducting phase based on inclusion and exclusion criteria. Lastly, during the documentation phase, the observations are identified, and the results are evaluated, contrasted, and envisioned, yielding insights that respond to the study's objectives.

Figure 13.5: Overview of Systematic Literature Review Procedure



Source: Research determination method adapted from Bazzaz Abkenar et al. (2021) and Durach, Kembro, and Wieland (2017).

13.4 Data Overview

In performing the systematic literature review, databases and keywords are identified. A list of databases that contain literature (on technical subjects, business, and social science) matching the research objectives are stated in Table 13.3, and the keywords or direct literal texts that are relevant to the topic are listed in Table 13.4.

Table 13.3: Table of Information Bases

Number	Database
1	Google Scholar
2	Science Direct
3	Springer Link

Table 13.4: Key Terms Chosen for Literature Exploration

Number	Terms
1	"big data" AND "post-disaster recovery"
2	"big data technology" AND "post-disaster recovery"
3	"technology" AND "post-disaster reconstruction"
4	"big data" AND "post-disaster reconstruction"

Table 13.5 includes eligibility criteria that are employed to narrow down the pertinent content. The inclusion and exclusion criteria are adopted from preceding papers focusing on the applications of big data in the public sector (Ahmad et al. 2020; Zhan 2017).

Table 13.5: Eligibility Criteria

Inclusion	Exclusion
Articles in academic journals	Nonacademic text
Empirical studies	Interviews
Books	Book reviews
Conference papers	Summaries of meetings
Theoretical research	
Case studies	
Editorials	

13.5 Methodology

Big data usage in government and business has progressively gained ground. However, its use in disaster management, particularly in the aftermath and restoration stages, has not yet completely developed into a specialized field of academic study. The goal of this work is to determine the state of the field at the moment and to demonstrate that there is enough room for a thorough investigation into potential new avenues and paths for continued study.

In accordance with the recommendations made by Altay and Green (2006), Galindo et al. (2013), and Akter et al. (2016), this work concentrates on research that has been published in journals and whose findings contribute to the body of knowledge and applications of theory already in existence. This research only considers pertinent publications released from 2012 to 2021 because there were hardly any relevant articles published before 2012. This led to a complete collection of articles on the selected subject, although it is possible that documents were involuntarily overlooked. The literature review was conducted using a three-stage protocol:

(i) The selected search phrases and their variations were used to explore the published databases' title and abstract fields.
   a. Wide search: ("big data" OR "big data technology") AND ("disaster recovery" OR "disaster reconstruction")
   b. Narrow search: ("big data" OR "big data technology") AND ("post-disaster recovery" OR "post-disaster reconstruction")
   c. Focused search: ("big data" OR "big data technology") AND ("Asia" or "Asia-Pacific") AND ("post-disaster recovery" OR "post-disaster reconstruction")

This resulted in a total of 8,483 articles for the wide, 1,015 for the narrow, and 106 for the focused search (see Figures 13.6 and 13.7).

Figure 13.6: Extracted Papers per Publication Year

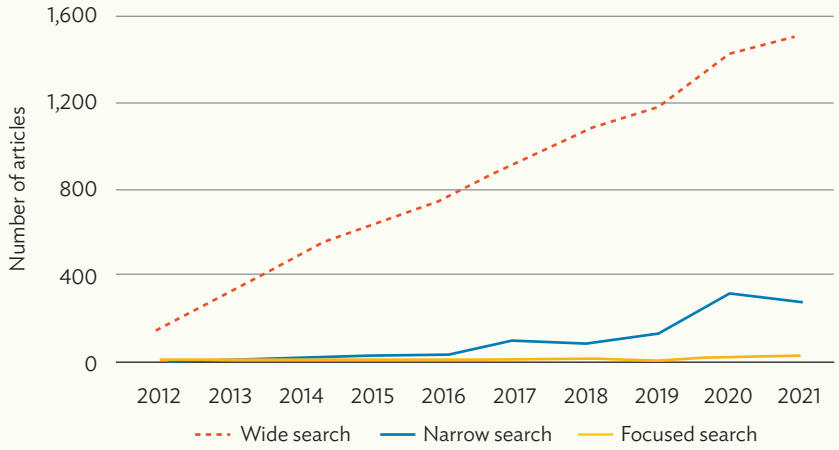
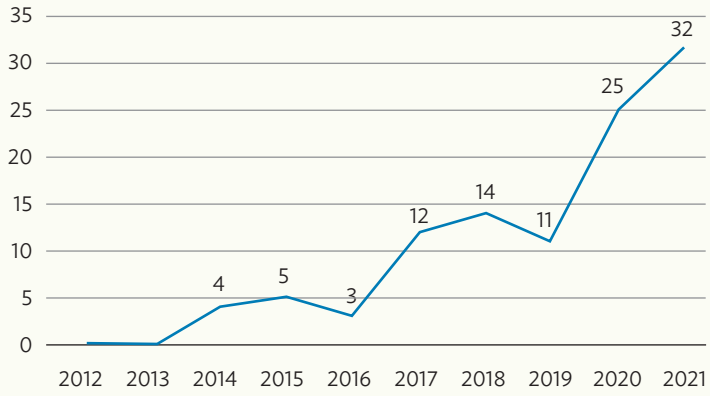


Figure 13.7: Selected Focused Papers per Publication Year



(ii) The selected focused papers were then filtered to remove duplicates and keep only the journal articles. This resulted in a reduction to a remaining 74 articles.

(iii) For further evaluation, complete papers were acquired and examined separately (Table 13.6). To conduct the analysis, the remaining information and data were abstracted. The eventual tally, divided among 16 journals, was 19 articles.

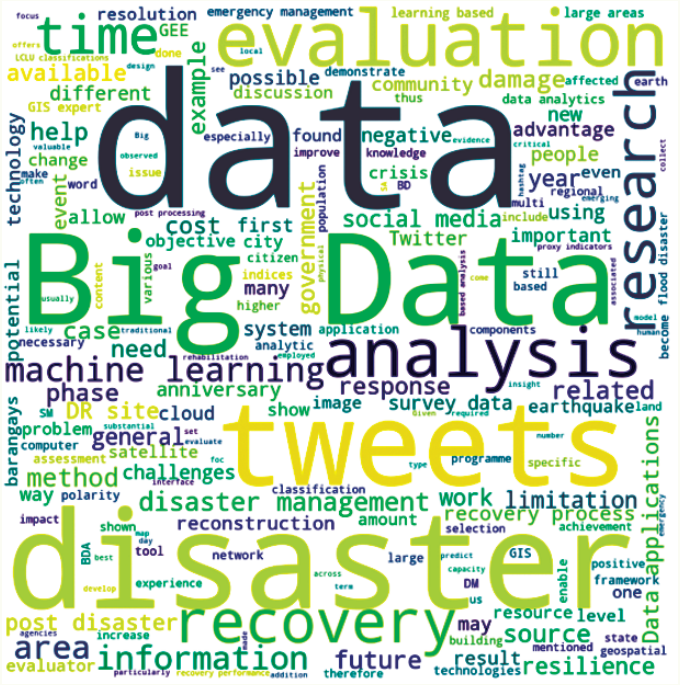
Table 13.6: Step by Step Results of Literature Review Scanning and Filtering

Stage	Consideration	Reviewed Papers
Wide search	Big data in disaster management	8,483
Narrow search	Big data in post-disaster management	1,015
Focused search	Big data in Asian post-disaster recovery	106
Cleaned shortlist	Duplicate title/abstract review and filtering to journal articles	74
Final list	Full text review	19

13.6 Results

Shortlisted articles were visualized through a word cloud and classified based on big data applications and data sources discussed. In creating the word cloud, text summaries of research identified through a focused search were collated. Figure 13.8 shows the dominant keywords such as "data," "disaster," "Big Data," "tweets," "evaluation," "analysis," "recovery," "research," "time," and "machine learning."

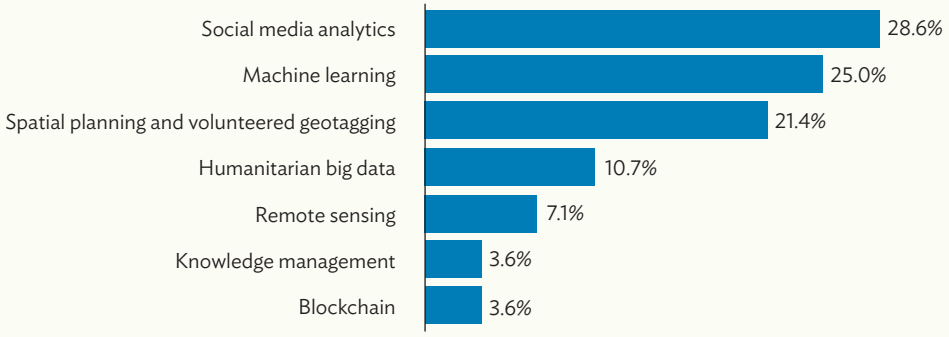
Figure 13.8: Word Cloud of Research Studies on Post-Disaster Recovery Using Big Data



13.6.1 Classification by Big Data Applications

This study also assessed the extant works on the technologies examined or used for research. Figure 13.9 shows the current big data applications utilized for post-disaster response and recovery. Most of the literature explored the use of social media analytics, machine learning, and spatial planning for disaster management and post-disaster recovery.

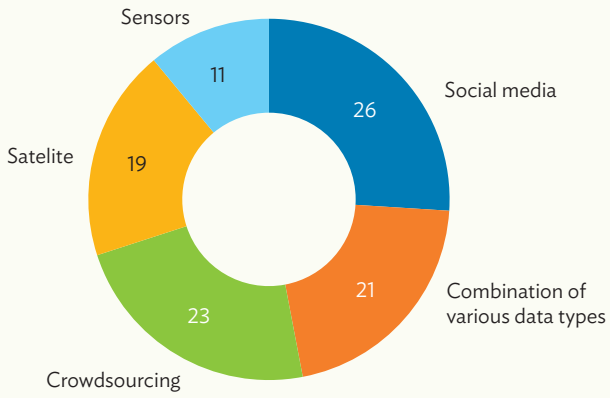
Figure 13.9: Big Data Applications for Post-Disaster Recovery



13.6.2 Classification by Data Sources

The main data sources for post-disaster response and recovery surveillance, including social media, crowdsourcing, satellite, sensors, and combinations of different data types, were further evaluated in this study. The dispersion of examined studies across various data sources is shown in Figure 13.10.

Figure 13.10: Data Sources for Post-Disaster Recovery



13.6.3 Case Studies

As observed in the identified literature, social media analytics, machine learning, and spatial analysis are the most used or studied applications for analyzing big data. Several countries are reported to have utilized these methodologies to aid in post-disaster response and recovery.

Social media analytics. Social media is characterized as a platform where individuals may post data, including text, images, audio, and video (Tang et al. 2011). Social media does indeed have a greater influence than old channels during a crisis since conventional communication has become less popular recently because of an upsurge in engagement with social media (Himelboim, McCreery, and Smith 2013; Matar et al. 2016). A convenient conduit for public knowledge distribution is provided

by digital platforms. Social media helped in intelligence gathering and advising households concerning their well-being and safety during the 2011 earthquake and tsunami in Japan (Thakur and Pitinanondha 2012). A study (Nagar, Seth, and Joshi 2012) investigated how certain news was disseminated on social media following the 2011 Japan earthquake and the hurricane that hit the Philippines in 2010; the study utilized data from Twitter. According to the study, while news about the disaster may start out in different places across the social network, it quickly finds a core group that is interested in the disaster, and there is little prospect of escaping the community through social network ties alone.

Throughout the 2013 floods in Kuantan, Malaysia, data from social networking sites had been utilized for exchange of emergency relief information and news updates, and algorithms were employed to examine social media articles (such as posts and tweets) to gather the necessary topics for surveillance. According to a study (Salihu, Latiff, and Ismail 2016) that employed the uses and gratifications theory, users were reluctant to post about well-known people during the crisis. The preference of users is to post about individuals with whom they have had direct personal contact or for residents who were there at the flood sites. Analytics can be used to evaluate social media data, such as tweets and postings, according to what they contain to pinpoint the main topics.

Machine learning. Construction managers set out to record building damage following the Puebla-Morelos earthquake in September 2017 and to offer professional assistance to regional structural inspection activities. Before the vital task of cleaning and reconstruction got underway, the team took pictures of the types of structure destruction. Also, they helped city leaders identify vital and severely destroyed infrastructure. The experts took numerous photographs as part of the records, noting particular observations such as the damage observed, the degree of the damage, and whether it was structural.

Machine learning trains computers to mimic human learning to analyze large amounts of disaster data to generate new insights about current and future similar events. To do this, hundreds of photographs were uploaded in a consolidated database from various Mexico City survey teams. The machine learning tool increased the uniformity, efficiency, and depth of the photo cataloging process for various databases. For instance, the tool would be capable of using algorithms to classify and grade various portions of the photograph independently instead of assigning one damage category and level to each image. Hence, the more pictures the tool analyzes via learning algorithms, the more capable it becomes. The kind of structure, the height of the facility, and the construction material are further details that may be gleaned from this tool. Further applications for the evaluation of structures at all phases of construction were investigated, building on this productive machine learning initiative in Mexico (Diaz, Murren, and Walker 2011).

Spatial analysis using remote sensing. Leveraging satellite remote sensing techniques for spatial analysis offers qualitative and quantitative potential for a variety of purposes, including risk reduction, operational aid distribution, and post-disaster hazard assessment. The most impressive application of remote sensing photography is the evaluation of post-disaster damage using change detection (Pradhan, Tehrany, and Jebur 2016).

Among the most catastrophic natural disasters to occur in the province of Davao in the Philippines is flooding, which is mostly caused by a high frequency of tropical storms and persistent heavy rains. Researchers conducted an analytic hierarchy process–based flood risk geographical assessment utilizing a geographic information system (GIS) to depict flood-prone risk zones using the combination of several variables, such as rainfall, slope, elevation, drainage density, soil type, distance to the main channel, and population density. This resulted in the designation of vulnerable areas, which required the immediate attention of decision makers to create countermeasures for potential floods in Davao Oriental in the long term (Cabrera and Lee 2019).

13.7 Conclusion

Given the growing quantity of disaster management publications, it is difficult to gain an overview and comprehension of how new technologies and the introduction of new data sources are being exploited for such purposes. Previous studies have found that the main goal of the majority of researchers is to examine the various facets of big data to figure out how to best use available technologies to store the information in well-integrated structures and utilize it for the betterment of human communities. However, after reviewing the literature available and analyzing the recent achievements and data applications related to leveraging big data for post-disaster response and recovery, this chapter revealed that few studies focus on the post-disaster stage compared to the other stages of the disaster management cycle.

The systematic literature review showed social media analytics, machine learning, and spatial analysis using remote sensing to be the most discussed methods in utilizing big data for post-disaster recovery. Data sources are mostly from social media, satellites, and crowdsourcing. Using these data and methodologies, the manual checking and monitoring of post-disaster situations could now be automated and augmented by technology. Collecting effective data, developing standardized procedures for recovery evaluation, persuading citizens to freely share their data, and combining various technologies and approaches for better results are the primary challenges. Additional difficulties include creating learning algorithms for systems that may be applied to solve operational problems and make disaster prediction more precise.

The government sector has to create technology for tracking the negative effects of catastrophes after they happen as well as utilize post-disaster lessons to reinforce preventive plans. As a result, more research on big data applications is required. Overall, additional research is required to examine the problems brought on by "big sensing data," particularly in light of the growing volume of data generated by video streaming services. These requirements include effective data management, quick data transport, and clear data visualization.

Considering the technologies, accomplishments, and challenges identified in the existing literature, Table 13.7 summarizes recommended strategies for further pushing big data for post-disaster recovery.

Table 13.7: Policy Recommendations

Policy Enabler	Recommendation
Synergy and strategic governance	To benefit from innovations and skills available in sectors other than government, authorities should work in partnership with business, academia, and multisector stakeholder groups. Per the study of Kurniawan et al. (2021), it is vital to raise the level of youth participation in order to create a more complete disaster management program that meets regional needs. Kurniawan et al. (2021) found that the amount of youth participation in flood-affected areas was higher than in unaffected areas, which was a clear difference. Governments should also encourage the digital transformation of public services and the use of big data applications in the provision of public services for disaster management, and they should have a concrete strategy, master plan, or governance framework in place to accomplish these goals. The key to successful big data adoption is top management support. The appointed official must have the authority to make decisions in order to properly supervise the use of big data throughout all agencies and ensure the exchange of information among organizations.
Availability and quality of data	To enable practical big data applications, it is essential to increase the relevant data's quality and accessibility of relevant data. This calls for promoting collaborative channels for private industry participation, implementing open data regulations, building a centralized data infrastructure to encourage data exchange between state agencies, and upgrading data gathering procedures. Contreras et al. (2021) points out that third-party vendors like Tweet Binder could collect Twitter data more efficiently, which helped analyzing data historically and in 7-day and 1-month windows. The same study emphasized the quality and importance of tweets from citizens and news agencies, as these are of better quality to assess post-disaster recovery given the accuracy of observed gaps as citizens express the reality they experience (i.e., this is analogous to customers in traditional sentiment analysis). This coincides with a study done by Malawani et al. (2020) that found out how victims used social media to express themselves and communicate. The study determined that several social media accounts that had been active in posting information on Tropical Storm Washi had been formed after the storm had already made landfall. These accounts were also discovered to be from the area that Typhoon Washi had severely affected.
Human capital	Harnessing the potential of big data demands improving the ability of both the citizen and government workers to appreciate and utilize data analysis. To increase the supply of graduates with the requisite experience to enter the job market, governments should ensure that effective curriculums are in place. Also, it is essential to train the general population so that they have the knowledge and abilities needed to make data-driven judgments. On top of this, being technologically adept is essential. A remote sensing study conducted by Lech et al. (2020) noted that a lack of capacity is one of the key limitations in doing advanced geospatial procedures like geo-rectification and mosaicking. In this case, governments can tap GIS experts at universities or research institutions to handle complex methodologies as they develop capacity. Although such collaboration has its own set of potential difficulties (coordination of research interests and assessment objectives, disparities in priorities and timetables, and the need for supervision time), costs may be lower than for hiring a GIS consultant.
Information and communications technology infrastructure	For governments to improve their cloud computing capabilities, it is important to make investments in infrastructural development. This will allow for cost-effective and extensible big data storage as well as efficient cloud-based big data analytics. As highlighted by Soulakellis et al. (2020), big data infrastructures support spatial data analysis that has been proven to be effective in earthquake-induced damage assessment and recovery phase monitoring by demonstrating that capturing high-resolution optical data with a small, unmanned aircraft system at a low altitude over a destroyed area is a very safe, quick, affordable, and efficient method for producing precise 2D and 3D spatial data sets, such as orthophoto maps, digital surface models, and 3D point clouds.
Data-driven culture	Governments should lead in honing an evidence-based norm as a fundamental piece of big data implementation. Promoting data-driven policymaking, partnering with industry on exploring technology applications, and creating regulations based on unbiased, scientific investigation are all necessary. Learning best practices and defining open formats for sharing components and processes are crucial, as underscored by Iglesias, Favenza, and Carrera (2020). A first step in creating a standard framework for describing big data systems in the disaster domain is the reference architecture. This is intended to provide abstract software architectures that compile software components and architectural patterns to aid in the creation of big data systems. Reference architectures can enhance corporate collaboration when it comes to data sharing and data analytics, since standard interfaces make it possible to choose interchangeable components and combine them.

GIS = geographic information system.

References

ADB (Asian Development Bank). 2013. *The Rise of Natural Disasters in Asia and the Pacific*. Manila: ADB. https://www.adb.org/sites/default/files/evaluation-document/36114/files/rise-natural-disasters-asia-pacific.pdf

Ahmad, N., et al. 2020. Big Data Analytics and Government: Opportunities and Challenges. Linnaeus University. https://www.academia.edu/42840274/Big_Data_in_Organizations_Business_and_Society_Big_Data_Analytics_and_E_government_Oppurtunities_and_Challenges

de Albuquerque, J. P., et al. 2015. A Geographic Approach for Combining Social Media and Authoritative Data towards Identifying Useful Information for Disaster Management. *International Journal of Geographic Information Science* 29(4): 667–689. https://www.tandfonline.com/doi/citedby/10.1080/13658816.2014.996567

Altay, N., and W. Green. 2006. OR/MS Research in Disaster Operations Management. *European Journal of Operational Research* 175(1): 475–493. https://www.sciencedirect.com/science/article/abs/pii/S0377221705005047

Akter, S., et al. 2016. How to Improve Firm Performance using Big Data Analytics Capability and Business Strategy Alignment? *International Journal of Production Economics* 182: 113–131. https://ro.uow.edu.au/buspapers/1015/

Akter, S., and S. F. Wamba. 2019. Big Data and Disaster Management: A Systematic Review and Agenda for Future Research. *Annals of Operations Research* 283: 939–959. doi.org/10.1007/s10479-017-2584-2

Asian Disaster Reduction Center. 2019. *Natural Disaster Data Book 2019: An Analytical Overview*. https://www.adrc.asia/publications/databook/ORG/databook_2019/pdf/DataBook2019.pdf

Bazzaz Abkenar, S., et al. 2021. Big Data Analytics Meets Social media: A Systematic Review of Techniques, Open Issues, and Future Directions. *Telematics and Informatics* 57: 101517. doi.org/10.1016/j.tele.2020.101517

Biswas, R. 2022. *The Ascent of APAC in the Global Economy*. S&P Global Market Intelligence Blog. 16 August. https://www.spglobal.com/marketintelligence/en/mi/research-analysis/ascent-of-apac-in-the-global-economy.html

Brereton, P., et al. 2007. Lessons from Applying the Systematic Literature Review Process within the Software Engineering Domain. *Journal of Systems and Software* 80(4): 571–583. https://www.sciencedirect.com/science/article/pii/S016412120600197X

Cabrera, J., and H. S. Lee. 2019 Flood-Prone Area Assessment Using GIS-Based Multi-Criteria Analysis: A Case Study in Davao Oriental, Philippines. *Water* 11(11): 2203. doi.org/10.3390/w11112203

Campaign for Action. 2021. Disaster Cycle. https://campaignforaction.org/next-disaster-ready/disaster-cycle/

Contreras, D., et al. 2021. Assessing Post-Disaster Recovery using Sentiment Analysis: The Case of L'Aquila, Italy. *Earthquake Spectra* 38(1): 81–108. https://journals.sagepub.com/doi/10.1177/87552930211036486

Diaz, A., P. Murren, and S. Walker. 2011. *Preliminary Observations in the Aftermath of the September 19, 2017 Puebla-Morelos Earthquake*. San Francisco: Skidmore, Owings and Merrill LLP. https://www.som.com/wp-content/uploads/2021/08/2018_preliminary-observations-puebla-morelos-earthquake-1632951124.pdf

Dufty, N. 2016. Twitter Turns Ten: Its Use to Date in Disaster Management. *Australian Journal of Emergency Management* 31(2): 50–54. https://knowledge.aidr.org.au/media/1315/ajem-31-02-10.pdf

Durach, C. F, J. Kembro, and A. Wieland. 2017. A New Paradigm for Systematic Literature Reviews in Supply Chain Management. *Journal of Supply Chain Management* 53(4): 67–85.

Dyba, T., V. B. Kampenes, and D. Sjøberg. 2006. A Systematic Review of Statistical Power in Software Engineering Experiments. *Journal of Information and Software Technology* 48(8): 745–755.

Elsotouhy, M., G. Jain, and A. Shrivastava. 2021. Disaster Management during Pandemic: A Big Data-Centric Approach. *International Journal of Innovation and Technology Management* 18(4). https://www.worldscientific.com/doi/full/10.1142/S0219877021400034

The Economic and Social Commission for Asia and the Pacific (ESCAP). 2017. Disaster Resilience for Sustainable Development. https://www.unescap.org/sites/default/files/1_Disaster%20Report%202017%20Low%20res.pdf

Faber, J. W. 2015. Superstorm Sandy and the Demographics of Flood Risk in New York City. *Human Ecology* 43(3): 363–378. https://link.springer.com/article/10.1007/s10745-015-9757-x

FAO (Food and Agriculture Organization of the United Nations). 2021. *The Impact of Disasters and Crises on Agriculture and Food Security: 2021*. Rome. doi.org/10.4060/cb3673en

Galindo, G., et al. 2013. Review of Recent Developments in OR/MS Research in Disaster Operations Management. *European Journal of Operational Research* 230: 201–211.

Government of the Netherlands. Doing Business: Southeast Asia. https://www.netherlandsworldwide.nl/doing-business-in-southeast-asia-asean

Granell, C., and F. Ostermann. 2016. Beyond Data Collection: Objectives and Methods of Research using VGI and Geo-social Media for Disaster Management. *Computers, Environment, and Urban Systems* 59: 231–243. https://www.sciencedirect.com/science/article/abs/pii/S0198971516300060

Himelboim, I., S. McCreery, and M. Smith. 2013. Birds of a Feather Tweet Together: Integrating Network and Content Analyses to Examine Cross-Ideology Exposure on Twitter. *Journal of Computer-Mediated Communication* 18(2): 40–60. doi.org/10.1111/jcc4.12001

Iglesias, C., A. Favenza, and A. Carrera. 2020. A Big Data Reference Architecture for Emergency Management. *Information* 11(12): 569.

Joseph, J. K., K. A. Dev, A. P. Pradeepkumar, and M. Mohan. 2018. Big Data Analytics and Social Media in Disaster Management. In P. Samui, D. Kim, and C. Ghosh, eds. *Integrating Disaster Science and Management*. Elsevier. doi.org/10.1016/B978-0-12-812056-9.00016-6

Kahn, M. E. 2005. The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions. *Review of Economics and Statistics* 87(2): 271–284. doi.org/10.1162/0034653053970339

Kailser, S., F. Armour, J. A. Espinosa, and W. Money. 2013. Big Data: Issues and Challenges Moving Forward. Proceedings of the 46th Annual Hawaii International Conference on System Sciences. https://www.researchgate.net/publication/261226107_Big_Data_Issues_and_Challenges_Moving_Forward

Khan, K. S., R. Kunz, J. Kleijnen, and G. Antes. 2003. Five Steps to Conducting a Systematic Review. *Journal of the Royal Society of Medicine* 96(3): 118–121. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC539417/

Kurniawan, E., et al. 2021.How Far Disaster Management Implemented Toward Flood Preparedness: A Lesson Learn from Youth Participation Assessment in Indonesia. *International Journal of*

Safety and Security Engineering. https://www.researchgate.net/publication/351771178_How_Far_Disaster_Management_Implemented_Toward_Flood_Preparedness_A_Lesson_Learn_from_Youth_Participation_Assessment_in_Indonesia

Landwehr, P., et al. 2016. Using Tweets to Support Disaster Planning, Warning and Response. *Safety Science* 90(3). https://www.researchgate.net/publication/301832617_Using_Tweets_to_Support_Disaster_Planning_Warning_and_Response

Lech, M., et al. 2020. A Proof-of-Concept of Integrating Machine Learning, Remote Sensing, and Survey Data in Evaluations: The Measurement of Disaster Resilience in the Philippines. https://www.researchgate.net/publication/344439698_A_Proof-of-Concept_of_Integrating_Machine_Learning_Remote_Sensing_and_Survey_Data_in_Evaluations_The_Measurement_of_Disaster_Resilience_in_the_Philippines

Letouzé, E. 2012. UN Global Pulse, Big Data for Development: Challenges and Opportunities. https://www.unglobalpulse.org/wp-content/uploads/2012/05/BigDataforDevelopment-UNGlobalPulseMay2012.pdf

Lloyd-Jones, T. 2006. Mind the Gap! Post-Disaster Reconstruction and the Transition from Humanitarian Relief: A Report Produced for RICS by the Max Lock Centre at the University of Westminster. https://www.preventionweb.net/files/9080_MindtheGapFullreport1.pdf

Malawani, A., et al. 2020. Social Media in Aid of Post Disaster Management. *Transforming Government: People, Process and Policy* 14(2): 237–260. https://www.emerald.com/insight/content/doi/10.1108/TG-09-2019-0088/full/html

Matar, S., et al. 2016. Social Media Platforms and Its Applications in Natural Disaster and Crisis Events: The Case of Bosnia and Herzegovina. *Journal of Information and Knowledge Management* 6(5): 50–56.

Mayer-Schönberger, V., and K. Cukier. 2014. Big Data: A Revolution That Will Transform How We Live, Work, and Think. *American Journal of Epidemiology* 179(9): 1143–1144. https://doi.org/10.1093/aje/kwu085

Nagar, S., A. Seth, and A. Joshi. 2012. Characterization of Social Media Response to Natural Disasters. https://www.researchgate.net/publication/241624277_Characterization_of_social_media_response_to_natural_disasters

Nazer, T., et al. 2017. Intelligent Disaster Response via Social Media Analysis. *Social and Information Networks*. https://arxiv.org/abs/1709.02426

OECD (Organisation for Economic Co-operation and Development). 2020. COVID-19 Crisis Response in ASEAN Member States. OECD Policy Responses to Coronavirus (COVID-19). https://www.oecd.org/coronavirus/policy-responses/covid-19-crisis-response-in-asean-member-states-02f828a2/

Pastor-Escuredo, D., et al. 2018. Floods Impact Dynamics Quantified from Big Data Sources. *Computers and Society*. https://arxiv.org/abs/1804.09129

Persson-Fischer, U., and S. Liu. 2021a. What Is Interdisciplinarity in the Study of Sustainable Destination Development? *Sustainability* 13(3639). https://www.diva-portal.org/smash/get/diva2:1547056/FULLTEXT01.pdf

____. 2021b. The Impact of a Global Crisis on Areas and Topics of Tourism Research. *Sustainability* 13(2): 906. https://doi.org/10.3390/su13020906

Pielke, R. 2019. Tracking Progress on the Economic Costs of Disasters under the Indicators of the Sustainable Development Goals. *Environmental Hazards* 18(1): 1–6. doi.org/10.1080/17477891.2018.1540343

Pittway, L. 2008. Systematic Literature Reviews. In R. Thorpe and R. Holt, eds. *The SAGE Dictionary of Qualitative Management Research*. SAGE Publications Ltd. doi.org/10.4135/9780857020109

Pradhan, B., M. S. Tehrany, and M. N. Jebur. 2016. A New Semiautomated Detection Mapping of Flood Extent from TerraSAR-X Satellite Image using Rule-Based Classification and Taguchi Optimization Techniques. *IEEE Transactions on Geoscience and Remote Sensing* 54: 4331–4342.

Qadir, J., A. Ali, R. Rasool, et al. 2016. Crisis Analytics: Big Data-Driven Crisis Response. *Journal of International Humanitarian Action* 1(12). doi.org/10.1186/s41018-016-0013-9

Rahman, M., L. Di, and M. Esraz-Ul-Zannat. 2017. The Role of Big Data in Disaster Management. International Conference on Disaster Risk Mitigation. https://www.researchgate.net/publication/322265557_The_role_of_big_data_in_disaster_management

Rother, E. T. 2007. Revisão sistemática X revisão narrative. *Acta Paulista de Enfermagem* 20: v–vi. http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&src=google&base=LILACS&lang=p&nextAction=lnk&exprSearch=465397&indexSearch=ID

Sackett, D. L. 2000. *Evidence-Based Medicine How to Practice and Teach EBM*. Second edition. Edinburgh: Churchill Livingstone. https://books.google.com.ph/books/about/Evidence_based_Medicine.html?id=oIJrAAAAMAAJ&redir_esc=y

Salihu, A., N. Latiff, and N. S. Ismail. 2016. Exploring the Uses and Gratifications Theory in the Use of Social Media among the Students of Mass Communication in Nigeria. Malaysian Journal of Distance Education 17: 83–95. https://www.researchgate.net/publication/307560253_Exploring_the_Uses_and_Gratifications_Theory_in_the_Use_of_Social_Media_among_the_Students_of_Mass_Communication_in_Nigeria

Shaw, R. 2014. Post Disaster Recovery: Issues and Challenges. In R. Shaw, ed. *Disaster Risk Reduction: Methods, Approaches and Practices*. Tokyo: Springer. doi.org/10.1007/978-4-431-54255-1_1

Sheykhmousa, M., et al. 2019. Post-Disaster Recovery Assessment with Machine Learning-Derived Land Cover and Land Use Information. *Remote Sensing* 11(10): 1174. https://doi.org/10.3390/rs11101174

Soulakellis, N., et al. 2020. Post-Earthquake Recovery Phase Monitoring and Mapping Based on UAS Data. *ISPRS International Journal of Geo-Information* 9(7): 447. doi.org/10.3390/ijgi9070447

Surianto, S., et al. 2019. Regional Policy for Disaster Risk Management in Developing Countries Within the Sendai Framework: A Systematic Review. *Open Access Maced J Med Sci.* 7(13): 2213–2219. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6698101/

Tang, T., et al. 2011. *Understanding User Behavior in a Local Social Media Platform by Social Network Analysis*. MindTrek '11: Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments. doi.org/10.1145/2181037.2181067

Thakur, N., and T. Pitinanondha. 2012. A Concept Development Methodology: Disaster Relief Operations. *IEEE Conference on Technology and Society in Asia (T&SA)*. Singapore. doi.org/10.1109/TSAsia.2012.6397974

United Nations World Conference on Disaster Risk Reduction. 2015. Reconstructing after Disasters: Build Back Better. https://www.wcdrr.org/uploads/Reconstructing-after-disasters-Build-back-better.pdf

____. 2020. Disaster. https://www.undrr.org/terminology/disaster

Velev, D., and P. Zlateva. 2011. An Innovative Approach for Designing an Emergency Risk Management System for Natural Disasters. *International Journal of Innovation Management and Technology* 2(5): 407–413. https://www.researchgate.net/publication/271585968_An_Innovative_Approach_for_Designing_an_Emergency_Risk_Management_System_for_Natural_Disasters

Vu, K. 2020. ASEAN Economic Prospects Amid Emerging Turbulence: Development Challenges and Implications for Reform. Foreign Policy at Brookings. https://www.brookings.edu/wp-content/uploads/2020/07/FP_20200710_asean_economic_prospects_vu.pdf

Wang, C. J., C. Y. Ng, and R. H. Brook. 2020. Response to COVID-19 in [Taipei,China]: Big Data Analytics, New Technology, and Proactive Testing. *JAMA* 323(14): 1341–1342. https://jamanetwork.com/journals/jama/fullarticle/2762689/

WEF (World Economic Forum). 2018. Why Asia-Pacific is Especially Prone to Natural Disasters. https://www.weforum.org/agenda/2018/12/why-asia-pacific-is-especially-prone-to-natural-disasters/

Wu, D., et al. 2018. Disaster Early Warning and Damage Assessment Analysis using Social Media Data and Geo-location Information. https://www.researchgate.net/publication/324916272_Disaster_early_warning_and_damage_assessment_analysis_using_social_media_data_and_geo-location_information

Yang, C., et al. 2017. Disaster Recovery Site Evaluations and Selections for Information Systems of Academic Big Data. *Eurasia Journal of Mathematics, Science and Technology Education* 13(8): 4553–4589. https://www.ejmste.com/article/disaster-recovery-site-evaluations-and-selections-for-information-systems-of-academic-big-data-4893

Yu, M., C. Yang, and Y. Li. 2018. Big Data in Natural Disaster Management. *Geosciences* 8(5): 165. https://doi.org/10.3390/geosciences8050165

Zhan, M. 2017. Big Data in the Public Sector: A Systematic Literature Review. *Scandinavian Journal of Public Administration* 21: 39–61. https://www.researchgate.net/publication/320911071_Big_Data_in_the_Public_Sector_A_Systematic_Literature_Review

Zou, L. 2017. Mining Social Media Data for Improved Understanding of Disaster Resilience. https://repository.lsu.edu/gradschool_dissertations/4274/

Appendix 13

Table A13.1: Studies Identified after Narrow Full Text Review

	Publication Date	Title	Author	Method	Focus
19	2021	How Far Disaster Management Implemented Toward Flood Preparedness: A Lesson Learn from Youth Participation Assessment in Indonesia	Kurniawan et al.	Statistical analysis	Youth, disaster mitigation, participation
2	2021	Assessing Post-Disaster Recovery Using Sentiment Analysis	Contreras et al.	Identification of hashtags, hashtag preference, gathering information, extraction, processing, polarity classification, and mining of keywords per polarity	Earthquakes, Twitter, sentiment analysis, and machine learning
3	2021	Disaster Management during Pandemic: A Big Data-Centric Approach	Elsotouhy, Jain, and Shrivastava	Exploratory research design and qualitative approach with text analytics	Disaster management, big data and innovation
4	2021a	What Is Interdisciplinarity in the Study of Sustainable Destination Development?	Persson-Fischer and Liu	Systematic review	Sustainable destination development, sustainable tourism, interdisciplinarity
5	2021b	The Impact of a Global Crisis on Areas and Topics of Tourism Research	Persson-Fischer and Liu	Content analysis–based literature review	COVID-19, systemic literature review, tourism research, sustainable tourism
6	2020	Social Media in Aid of Post Disaster Management	Malawani et al.	Topic modelling	Social media, big data, post-disaster, typhoon
7	2020	Post-Earthquake Recovery Phase Monitoring and Mapping Based on UAS Data	Soulakellis, et al.	GIS mapping, big data analytics	3D change mapping; building destruction; post-earthquake management
8	2020	A Proof-of-Concept of Integrating Machine Learning, Remote Sensing, and Survey Data in Evaluations: The Measurement of Disaster Resilience in the Philippines	Lech et al.	Statistical and spatial analysis	Risk management, algorithm, socioeconomic factors, climate change, Southeast Asia, data capture, crisis management
9	2020	A Big Data Reference Architecture for Emergency Management	Iglesias, Favenza, and Carrera	Literature review and case study	Emergency supervision, crowdsourcing, big data, crowd working, disaster management

continued on next page

Table A13.1 *continued*

	Publication Date	Title	Author	Method	Focus
11	2019	Post-Disaster Recovery Assessment with Machine Learning-Derived Land Cover and Land Use Information	Sheykhmousa et al.	Remote sensing	Post-disaster recovery assessment, land cover and land use–based recovery maps, machine learning, multi-temporal WorldView-2 imagery, support vector machine, super typhoon
12	2019	Regional Policy for Disaster Risk Management in Developing Countries Within the Sendai Framework	Surianto et al.	Systematic review	Policy, disaster risk management, disaster risk reduction
13	2018	Big Data in Natural Disaster Management	Yu, Yang, and Li	Literature review	Big data, disaster management
14	2018	Floods impact dynamics quantified from big data sources	Pastor-Escuredo, et al.	Image and text analysis	Flood, impact analysis, big data
15	2018	Big Data Analytics and social media in Disaster Management	Joseph et al.	Case study and literature review	Big data, social media analytics, disaster
16	2017	Intelligent Disaster Response via Social Media Analysis	Nazer et al.	Social media analytics, big data	Social media analytics, big data
17	2017	Mining social media Data for Improved Understanding of Disaster Resilience	Zou	Social media analytics, GIS	Disaster, big data, social media
18	2017	Disaster Recovery Site Evaluations and Selections for Information Systems of Academic Big Data	Yang et al.	Hybrid multiple criteria decision making framework	Big data, disaster recovery, site selection, DEMATEL-based network process, VIšekriterijumsko Kompromisno Rangiranje (VIKOR), multiple criteria decision making
19	2016	Crisis analytics: big data-driven crisis response	Qadir et al.	Systematic Review	Big data, Crisis response

COVID-19 = coronavirus disease, DEMATEL = decision-making trial and evaluation laboratory, GIS = geographic information system.

CHAPTER 14

The Way Forward for Resilient Post-Disaster Recovery

Piyush Tiwari, KE Seetha Ram, Dil B. Rahut, and Dwiky Wibowo

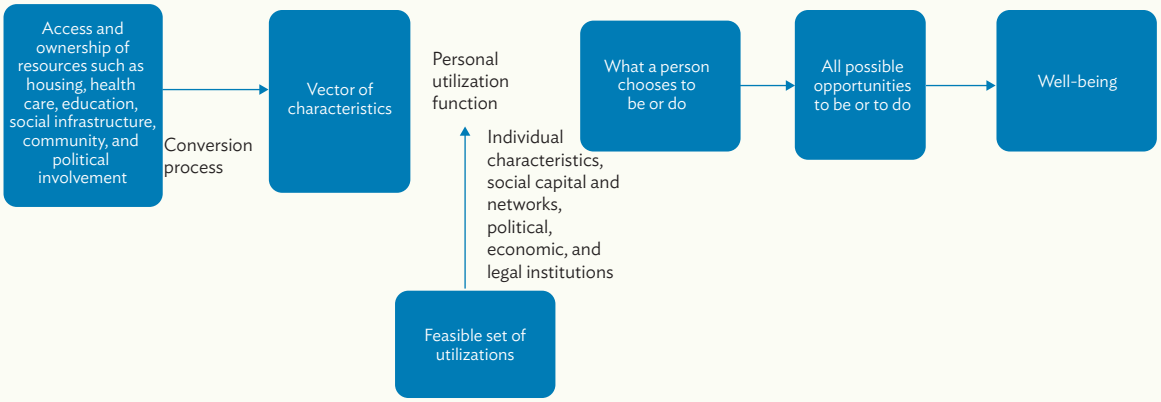
14.1 Resilient Post-Disaster Recovery

Post-disaster recovery entails physical or material reconstruction and the social and economic recovery of the affected communities. Two important aspects of post-disaster reconstruction are building back better and resilient recovery. The Sendai Framework for Disaster Risk Reduction defines the term "build back better" as "the use of the recovery, rehabilitation, and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies, and the environment" (UNDRR 2009). Resilient economic recovery focuses on maintaining well-being, restoring livelihoods, and redeveloping the local economy. Resilient recovery is the nexus between disaster and development. The extent to which resilient recovery succeeds depends on how well the process links disaster recovery to sustainable, resilient, and inclusive economic development.

The devastation that a disaster causes to personal and societal well-being, physical and economic infrastructure, and the environment has long-lasting social, psychological, and economic effects. The personal and societal costs of rebuilding following losses are huge, with effects lasting more than one generation. Some of the deleterious effects of disasters are displacement, loss of life, separation of partners, loss of economic security, loss of education days for youth, deterioration of physical and mental health, stress and anxiety, loss of social bonds (particularly when disasters result in relocation), and fear of recurrence of disasters.

Chapter 2 (Wibowo, Siregar, and Tiwari) proposes a framework that can be applied to post-disaster reconstruction. The authors suggest transforming the tangible and intangible resources that disaster-affected communities possess and can access into actual capabilities. The capability space—broadly seen as the institutional environment (comprising individual characteristics, social capital, and structural, i.e., legal and regulatory, determinants), risks, and vulnerabilities that shape people's choices, abilities, and opportunities—facilitates the transformation of resources into real capabilities. The presence of capability space is important to reinstate disaster-affected persons' lost capabilities or, more importantly, build back better sustainably. The framework emphasizes that resources on their own are not sufficient to reconstruct well-being losses, but these need to be converted into valuable functioning by the involvement of individuals, individual characteristics, social capital, leadership, and institutional environment (Figure 14.1).

Figure 14.1: Graphical Representation of Post-Disaster Reconstruction of Well-Being



Source: Authors.

A conducive institutional environment is necessary for sustainable post-disaster recovery. The current structure with the involvement of domestic and international agencies from private, public, and not-for-profit sectors, each with their own sectoral focus, administrative powers, resources, and assessment of losses due to disasters, makes for challenging efforts in post-disaster reconstruction.

Various chapters of this edited report have examined the various aspects of post-disaster reconstruction. In this concluding chapter, we draw upon the insights gained from these chapters to provide a path forward for post-disaster reconstruction efforts.

14.2 Key Messages

The key messages that emerge from the discussions in this edited report that are relevant for policy are discussed here.

Policy Message 1: Identify Capability Losses and Address the Needs of Vulnerable Groups

The motivation behind this policy message is the recognition of the critical importance of developing resilience and prioritizing the recovery of people's lives and livelihoods during post-disaster recovery efforts. The damage caused by the disaster to resources that contribute to people's functioning, such as the damage to homes, social and economic infrastructure, and loss of livelihoods, would require assessment.

The recommended approach to post-disaster reconstruction efforts is to promptly and accurately assess the abilities and skills affected people have lost, so that reconstruction efforts can effectively and efficiently restore these capabilities. Additionally, the approach to reconstruction must consider the social and cultural dimensions of recovery. The institutional environment must facilitate coordination between disaster management agencies, international organizations, communities, and experts. They must work together with affected persons to ensure that the reconstruction programs have a clear objective focusing on the reconstruction of capabilities.

Additionally, the post-disaster reconstruction efforts must consider the needs of vulnerable groups, such as women, elders, people in low-income countries, and migrants. It is critical to be inclusive in the process of post-disaster recovery efforts because vulnerable groups are often disproportionately affected by disasters and need targeted support to recover.

Governments and reconstruction agencies should recognize their specific losses and needs and prioritize support to ensure that they are not left behind in the reconstruction process. Policymakers should ensure equal access to essential services such as health care, education, clean water, and sanitation facilities. Additionally, policies should adopt a human rights–based approach that recognizes and upholds the rights of affected persons, including their right to participate in decision-making processes that affect their lives.

Policy Message 2: Promote Community Participation

To promote community participation in post-disaster reconstruction, government officials should prioritize the use of local and Indigenous knowledge. This can be done by involving affected communities in decision-making processes and fostering transparency and open communication. Providing opportunities for community members to participate in planning and making decisions, as well as supporting community-based organizations, will also be important. Community participation is essential to post-disaster reconstruction efforts because it ensures that the affected people have a say in rebuilding their lives and environment. The adoption of a strong community-led approach will ensure the reduction of vulnerabilities and increased resilience for the vulnerable communities. Community participation can also help to build trust between the government and affected communities, which can be critical in ensuring that reconstruction efforts are successful.

By working with communities, governments can better understand the specific needs and priorities of the affected population and ensure that their rights are respected and upheld throughout the reconstruction process. By involving communities in decision-making processes, governments can ensure that their unique needs and priorities are considered, and that the reconstruction process is culturally sensitive and appropriate. Community participation will also provide the benefits of local and Indigenous knowledge in reconstruction.

Policy Message 3: Provide Adequate Finance

Adequate finance provided in a timely manner is essential to ensure that no one is left behind in the reconstruction process. Financial delays build dissatisfaction with the government and involved agencies. Providing adequate housing and ensuring property rights and livelihoods as early as possible during the reconstruction process is crucial, as it helps in rebuilding many of the lost capabilities. A wide range of financing sources with varying risk-return profiles and timeliness would need to be utilized.

Governments can establish disaster relief funds and provide low-interest loans to affected persons. Innovative financing mechanisms such as disaster insurance schemes and other financial instruments would also need to be developed, particularly in Asian countries where the insurance penetration rate is low. A mix of mechanisms would help better manage the reconstruction and transfer of risks associated with disasters. In addition, governments in developing countries can work with international organizations and donors to secure funding for reconstruction efforts.

Policy Message 4: Use Data and Technology

Data on affected regions and affected persons, disaggregated by vulnerabilities, is crucial for post-disaster management. The Sendai Framework for Disaster Risk Reduction requires countries to collect data in reports on certain indicators. However, the midterm review of the framework's implementation highlights the gap in data across many reporting countries (UNDRR 2023). The data on the progress of reconstruction can facilitate midcourse correction, if required. Evaluation of programs and the lessons learned can help the future design of reconstruction activities and programs.

A significant contribution of this edited report is the discussion of looking at post-disaster reconstruction through the reconstruction of lost capabilities. The question of capabilities and the indicators that reflect those capabilities is crucial for determining what data could be collected. Tiwari and Shukla (2022) provide a mapping of capabilities with indicators of relevant Sustainable Development Goals, and these indicators could form the basis for the collection of data.

Technology can enable various data to be combined and analyzed, which could be used for facilitating faster action during disaster recovery.

References

Tiwari, P., and J. Shukla. 2022. Post-Disaster Reconstruction, Well-Being and Sustainable Development Goals: A Conceptual Framework. *Environment and Urbanization Asia* 13(2): 323–332.

UNDRR (United Nations Office for Disaster Risk Reduction). 2009. UNISDR Terminology on Disaster Risk Reduction. http://www.unisdr. org/we/inform/terminology

____. 2023. High-Level Meeting of the United Nations General Assembly on the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. 18–19 May. https://sendaiframework-mtr.undrr.org/media/88350/download

Navigating Resilient Post-Disaster Recovery in Asia and the Pacific

Navigating Resilient Post-Disaster Recovery in Asia and the Pacific addresses the importance of resilient recovery in the aftermath of disasters, emphasizing the Asia and Pacific region while holding global relevance. It explores the complex process of post-disaster reconstruction, drawing from various expert analyses and real-world case studies to offer actionable insights for policy makers, practitioners, and academics.

Using global experiences and in-depth research, this edited volume conveys four key messages. First, it underscores the importance of identifying capability losses and addressing the needs of vulnerable groups to foster a people-centric recovery approach. Second, it advocates for robust community participation, emphasizing the value of local and indigenous knowledge in shaping reconstruction efforts. Third, it highlights the need for timely and adequate finance to ensure a well-structured and effective recovery process. Finally, it stresses the crucial role of data and technology in facilitating informed decision-making and accelerating recovery efforts.

The policy insights in this volume are particularly relevant for stakeholders involved in disaster management and reconstruction, offering a well-rounded perspective to navigate the challenges of post-disaster recovery and foster resilient communities.

Piyush Tiwari is a professor of property at the University of Melbourne, Australia.

Dil B. Rahut is vice-chair of research and a senior research fellow at the Asian Development Bank Institute, Japan.

KE Seetha Ram is a senior capacity building and training specialist at the Asian Development Bank Institute and a visiting professor at The University of Tokyo, Japan.

About the Asian Development Bank Institute

The Asian Development Bank Institute (ADBI) is the Tokyo-based think tank of the Asian Development Bank. ADBI provides demand-driven policy research, capacity building and training, and outreach to help developing countries in Asia and the Pacific practically address sustainability challenges, accelerate socioeconomic change, and realize more robust, inclusive, and sustainable growth.

ADBIPress
ASIAN DEVELOPMENT BANK INSTITUTE
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo, 100-6008 Japan
Tel +81 3 3593 5500
www.adbi.org