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EVOLVING NARRATIVES OF HAZARD AND RISK

The Gorkha Earthquake, Nepal, 2015

Edited by
Louise Bracken,
Hanna A. Ruszczyk
and Tom Robinson

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ISBN 978-3-319-65210-8 ISBN 978-3-319-65211-5 (eBook)
https://doi.org/10.1007/978-3-319-65211-5

Library of Congress Control Number: 2018932341

Cover Design: © Melisa Hasan

Printed on acid-free paper

This Palgrave Macmillan imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume was born out of a collaboration of scholars and practitioners connected with Nepal and the Institute of Hazard, Risk and Resilience (IHRR) at Durham University. As editors we are indebted to all of the contributors to this volume; their endeavour and enthusiasm has made this volume possible. Our hearts go out to all those impacted by the Gorkha earthquake and similar events around the world. We hope our contribution can help document the terrible effects, celebrate the amazing strength and capacity of people and organisations who are involved in Nepal and offer a way to view such events in a more comprehensive way.

Publication of this book celebrates the 10th Anniversary of IHRR and is a testament to four key attributes of IHRR: (1) the intellectual scope of the institute and those who collaborate with us, (2) the engagement of practitioners and communities around the world who generously work with us and contribute to our research, (3) the commitment of donors and friends who helped initiate IHRR and continue to support us and (4) the desire of everyone involved with IHRR to support people living with hazard and risk. As we celebrate our 10th anniversary we want to thank you for working with us.

Durham, UK

Louise Bracken
Hanna A. Ruszczyk
Tom Robinson

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Contributors

Kosh Prasad Acharya is former Director-General of Archaeology and Joint Secretary of the Ministry of Culture, Tourism and Civil Aviation, government of Nepal, and has recently retired from his post as Executive Director of the Pashupati Area Development Trust UNESCO World Heritage Site in the Kathmandu Valley. He is a UNESCO Consultant and Co-Director of the Japanese-Funds-in-Trust for the UNESCO project Strengthening the Conservation and Management of Lumbini; the Birthplace of Lord Buddha, World Heritage Property, Phases I and II (2011–17). He is a member of International Council on Monuments and Sites (ICOMOS) (Nepal) and has co-directed two seasons of postdisaster archaeological survey and excavations in the Kathmandu Valley for the government of Nepal and UNESCO.

Surya Prasad Acharya is a civil engineer with more than 21 years of experience in hazard-resilient infrastructure, disaster risk reduction and national-level policy and advocacy. During his professional career he has served for the government, private sector and donor community. He joined NSET as a civil engineer in 2002 and has managed projects funded by Asian Development Bank (ADB), World Bank, UNICEF and others. He has work experience in Nepal and in the South Asian Association for Regional Cooperation (SAARC) countries on school safety. He has participated and presented papers in many national and international conferences.

Sujan Raj Adhikari is a geologist with more than 13 years of local and international experience in the fields of geoengineering and geoenviron-

ment. He started his career working on road and hydropower projects, where he spent most of his time logging boreholes and geological mapping and assessing environmental impacts in addition to landslide mitigation work. After joining NSET in 2011, Sujan has mostly engaged in earthquake risk assessment, urban- and community-based disaster risk reduction activities, with a focus on natural hazard and risk. He has published and presented a range of journal and conference papers on disaster risk management.

Gopi Basyal works with the National Society for Earthquake Technology—Nepal (NSET), with a focus on multihazard mapping, risk assessment and community-based disaster risk reduction initiatives. Gopi is currently a PhD student at the Institute of Hazard, Risk and Resilience in Durham University. He comes from a professional background working in earthquake risk reduction in Nepal, where his responsibilities involved partnering with academic research and government agencies to address the needs of local people.

Ramjee Bhandari holds an MPH degree from Tribhuvan University, Nepal and an MA in Health, Risk and Public Policy from Durham University, UK. He is currently a PhD researcher in the Geography Department of Durham University. Borrowing concepts from public health and from geography, he is currently researching the geographical health inequalities in Stockton-on-Tees, a borough in North East England. Ramjee has interests in austerity, health inequalities and public health issues from Nepal and has been writing in these areas since 2012.

Kapil Bhattarai is a civil engineer by profession and is currently working with NSET. He is assisting 30 municipalities in enhancing their capacities to develop and administer the building permits and control system for ensuring improved seismic performance of buildings. Apart from this, Kapil is also engaged in earthquake risk assessment and community-based disaster risk reduction activities. In addition, he also worked in seismic vulnerability and damage assessment of buildings. Kapil has attended several national and international conferences and training programs on earthquake engineering and disaster risk management. He has more than seven years of professional experience in the field of civil engineering.

Louise Bracken is the Director of the Institute of Hazard, Risk and Resilience (IHRR) at Durham University and the Wilson Chair in Hazard and Risk. Louise leads international networks of researchers and practitio-

ners around hazard, risk and resilience and works closely with policy and practice for resource management in the UK and around the world. Her research involves transdisciplinary investigations on water, including flood risk management and communication, water resource management more widely and building community resilience. She links her physical science understanding of catchment processes to the management and governance of sociophysical landscapes. This encompasses factors such as managing risk, ensuring resilience and analysing the choices facing citizens and policy makers.

Ben Campbell gained his undergraduate degree in Social Anthropology at Cambridge and his PhD from the University of East Anglia in Development Studies. He has lectured at Edinburgh, Keele, Manchester, Hull and Durham (from 2006), where he is the Director of Durham MSc Sustainability, Culture and Development. Ben's PhD dissertation was titled 'The Dynamics of Cooperation: Households and Economy in a Tamang Community of Nepal', and he has continued to undertake research related to this topic ever since. Other research interests include biomass to biogas transition among indigenous communities of Nepal, new directions in UK sustainable food cultures and low carbon energy for development (with colleagues from Loughborough, Sussex and Imperial College). He has secured research funding from a range of sources, including the EU, Engineering and Physical Sciences Research Council (EPSRC) and Department for International Development (DFID).

Robin Coningham is an archaeologist and holds Durham University's 2014 UNESCO Chair in Archaeological Ethics and Practice in Cultural Heritage. He has worked extensively across South Asia and co-directed Japanese-Funds-in-Trust for UNESCO excavations in Nepal at Lumbini, the birthplace of the Buddha, and Tilaurakot between 2011 and 2017. He edited CUP's *Appropriating the Past* with Geoffrey Scarre in 2013 and published *The Archaeology of South Asia* in the Cambridge University Press (CUP) World Archaeology Series with Ruth Young in 2015. He co-directed postdisaster surveys and excavations in Kathmandu on behalf of the government of Nepal, with funding from UNESCO, the Arts and Humanities Research Council's (AHRC's) Global Challenges Research Fund and the National Geographic Society in 2015 and 2016.

Christopher Davis is a UNESCO Chair Research Associate in the Department of Archaeology at Durham University. He studied archaeology at Durham and completed his Arts and Humanities Research Council

(AHRC)–funded PhD on Sri Lankan Buddhist monasticism at the same institution. Dr. Davis is an active field archaeologist, who has excavated in Sri Lanka, Bangladesh, Iran, Cambodia and Nepal. The latter has included participation in the Japanese-Funds-in-Trust for UNESCO project at Lumbini and Tilaurakot as well as two recent seasons of postdisaster archaeological survey and excavations in the Kathmandu Valley, with particular responsibility for the Kasthamandap.

Ranjan Dhungel is a civil engineer and has an MSc in Risk and Environmental Hazards from Durham University. He has been working at NSET since December 2008. Currently, he is a Program Manager for the U.S. Agency for International Development (USAID)–funded Baliyo Ghar Program, which is a housing-reconstruction project for the technical assistance on housing reconstruction to support the government of Nepal. Under his management he has to mobilise more than 173 staff members, including senior experts. This is a special assignment for the earthquake reconstruction after the Gorkha earthquake to support system development, awareness raising and capacity building of the construction workforce.

Amod M. Dixit completed his Doctor of Engineering degree at the Graduate School of Science and Engineering, Ehime University, Japan. His professional experience spans 43 years and covers stints with the government of Nepal, private engineering consultancy and as a visiting professor of engineering geology and disaster risk management with Tribhuwan University and Kathmandu University. In 1994, he founded the National Society for Earthquake Technology—Nepal (NSET) and has since served as its General Secretary and Executive Director. He has worked extensively in Nepal and many Asian countries for disaster risk reduction and for earthquake response.

Lena Dominelli, Professor in Applied Social Sciences and Co-Director of IHRR 2010–2016 at Durham University and qualified social worker, has been involved in community development initiatives in different countries and settings for several decades. She has published extensively in sociology, social policy and social work (defined broadly). Her most relevant book for the chapter included in this volume is *Green Social Work* (Polity Press, 2012), which has inspired researchers, students and practitioners to rethink environmental paradigms in professional social work. Lena has received a number of accolades for her work. She also co-founded the Green/Environmental Social Work Network with Meredith Powers in the United States.

Ramesh Guragain has a PhD in Earthquake Engineering from the University of Tokyo. He joined NSET in 1999 and has been working in the field of earthquake risk management since then. One of the major programme areas Ramesh has led for NSET in recent years is earthquake risk assessment of buildings, infrastructures and urban/rural settlements in Nepal and the South Asian region. He has also led a team of professionals at NSET for development of a range of training curricula and has provided training to different target audiences.

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Shiva Raj Mishra holds an MPH degree with a specialisation in research methods from the University of Western Australia. He is a recipient of the prestigious Australia Award Scholarship from 2015 to 2016. Shiva has interests in global noncommunicable diseases and medicine policies

research in low-income settings, with an emphasis on cardiovascular diseases and diabetes. He also wrote prolifically on the disaster response and recovery in the aftermath of Nepal earthquakes, contributing to several news features. In Nepal, he is affiliated with Nepal Development Society, a community nongovernmental organisation (NGO), as a founding member since 2014.

Sanchita Neupane holds a degree in civil engineering from Pulchowk Campus, Nepal and an MSc in risk and environmental hazards, for which she gained a Distinction from the Department of Geography in Durham University, UK. She has worked as a civil engineer in Nepal on the Rural Access Programme and worked in humanitarian relief. Sanchita is currently the Co-Director for the Centre for Risk Resilience and Recovery in the Nepal School of Social Work, Nepal.

Suman Pradhan is a structural engineer who joined NSET in 2007 to focus on seismic vulnerability assessment of different national and international organisations and their office/residence buildings. Mr. Pradhan did his master's degree in structural engineering from Sapienza University, Rome, Italy. He was then promoted to Program Manager of Building Code Implementation Program of municipalities of Nepal (BCIPN) in NSET. As a Program Manager of BCIPN, his current responsibilities are to mobilise project staff into different municipalities and keep them on track and provide supervision, monitoring and guidance to implement programme activities in 30 selected municipalities of Nepal.

Tom Robinson is a Research Fellow in the Department of Geography and Institute of Hazard, Risk and Resilience at Durham University. Tom's research focusses on emergency response and contingency planning for major earthquakes, and he has worked throughout New Zealand and central Asia. Tom has worked on earthquake risk with a range of stakeholders including the UN, World Food Programme (WFP), and Red Cross as well as international militaries from across Asia-Pacific and Europe. For his work, Tom has won the prestigious Jim Cole Prize and been named a finalist in the Lloyd's Bank Science of Risk Prize.

Hanna A. Ruszczyk is the Post-Doctoral Research Associate at the Institute of Hazard, Risk and Resilience at Durham University. Until October 2017, she was a postgraduate researcher in the Department of Geography and the Institute of Hazard, Risk and Resilience at Durham University. Hanna has been investigating how people perceive risk both in

urban everyday life and when events occur. Through this research, she has engaged with the concept of disaster community resilience and the manner in which the international aid community has framed its work under the rubric of resilience. Before studying at Durham, Hanna's international development work—International Labour Organization (ILO), United Nations Development Programme (UNDP), U.S. Agency for International Development (USAID)—focussed on micro and small enterprise development and led her to work in 10 countries, several in which she lived.

Chandika Shrestha holds an MA in Health, Risk and Public Policy from Durham University, UK. As a recipient of Christopher Moyes Memorial Foundation Scholarship for her PhD, she is currently researching the mental health impacts of the Gorkha earthquake. Her research is devoted to understanding the health impacts of disaster, with a special focus on mental health among the survivors, geographical patterning of vulnerability and resilience factors affecting the health of people in Nepal after the earthquake. Chandika is exploring the relationships of health, vulnerability and resilience factors from a spatial perspective.

Nisha Shrestha is an environmentalist by profession and has more than 10 years of experience in the field of disaster risk reduction. She joined NSET in 2006 and has worked in a range of roles. Currently Ms. Shrestha leads the Monitoring and Evaluation Unit at NSET, and as the team leader she is involved in designing and implementing monitoring and evaluation systems and has conducted project monitoring and evaluations at NSET since 2008. Ms. Shrestha has also been involved in various disaster risk management and emergency response training courses conducted by NSET as an Instructor. Ms. Shrestha has also led the Views from the Frontline as a Regional Coordinator for South Asia and as the National Coordinator for Nepal.

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Ian Simpson is Professor of Geoarchaeology at the University of Stirling and 'reads' soil and sediment stratigraphies in archaeological and historical landscapes to create narratives of relationships between societies and their environments. Reading is achieved through innovative theoretical frameworks of landscape and new techniques in soils and sediments analyses, including thin section micromorphology, soil biomarkers and soils and landscape modelling. Chronological frameworks are provided through new approaches to optically stimulated luminescence, tephrochronlogy and radiocarbon. A member of the UNESCO project at Lumbini and Tilaurakot, he participated in UNESCO and Arts and Humanities Research Council (AHRC)–funded postdisaster excavations in Kathmandu in 2015 and 2016.

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PART I

Earthquake Preparedness and Response

CHAPTER 1

Introduction to the Gorkha Earthquake

Hanna A. Ruszczyk and Tom Robinson

1.1 The Earthquake

On 25 April 2015 at 11:56 a.m., the first jolts of a major earthquake were felt in the small town of Gorkha in central Nepal. Almost 9000 people died, over 22,000 injured, 1 million homes either destroyed or damaged (Government of Nepal, Ministry of Home Affairs and Disaster Preparedness Network-Nepal 2015), thus resulting in a further 2.8 million people homeless across 14 districts of Nepal. Although felt in India, China and as far away as Bangladesh, the Gorkha earthquake, as it became known, and the aftershocks that followed, gave the brunt of its devastation in Nepal. The earthquake, with a magnitude of 7.8 (USGS 2015) and the subsequent magnitude 7.3 aftershock in Sindhupalchok district on 12 May, was the largest earthquake and worst natural hazard to strike the country in 81 years. Not since the devastating 1934 Nepal-Bihar earthquake, estimated to have had a magnitude of 8+, had Nepal suffered such a devastating event (Fig. 1.1).

Yet this was not the *big one* that many scientists, humanitarians, politicians and members of the public had feared and discussed in the years before 2015. This was not the feared mega-quake that would unzip several hundreds of kilometres of the main Himalayan Fault and strike the

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_1

Fig. 1.1 Efforts post-earthquake to help affected people and to assess damage (Source: NSET)

direct hit on Kathmandu (Feldl and Bilham 2006). The Gorkha earthquake was certainly big—not just the worst disaster in Nepal in recent memory but the worst natural disaster of 2015 globally. But the threat of the big one remains, thus not alleviating fear of further destruction.

Disasters do not occur in political, social or economic vacuums. National and local geographies of inequality, ethnicity, caste, gender relations and social and economic marginalisation shape response and long-term recovery for those who remain (Hyndman 2011; Sidaway et al. 2008) to rebuild their lives, communities and country. Only five months after the Gorkha earthquake, the long-discussed but never agreed constitution was unexpectedly approved with a large majority by the constituent assembly. This was greeted with controversy, especially in southern Nepal along the border with India, where protests had already been visible during the summer months and even more so after the signing in September. Within 48 hours of the passage of the constitution, there were sit-ins on the key border crossings, and India ceased all movement of trade into Nepal through these routes, through which 85% of all goods enter Nepal.

The impact of the Gorkha earthquake and subsequent political and economic crisis has thus been felt in many different ways across different

communities throughout Nepal. The World Bank (2016a, 1) appropriately stated that '2015 will be remembered as the year of twin shocks for Nepal'. The impact of the dual disasters will continue to be felt for many years.

1.2 Background

Nepal is a land-locked Himalayan country located between the Asian giants of China and India. Nepal has a population of over 26 million people according to the most recent census (Government of Nepal, National Planning Commission 2012), although difficulties with data collection means the World Bank estimates the population is closer to 30 million (World Bank 2013). Over 80% of Nepal is mountainous, and the remaining 20% is made up of flat, low-lying fertile land along the Indian border, known in Nepal as the Terai. Effectively a closed nation until the mid-twentieth century, this former kingdom has seen significant changes in the past 60 years. In 1950, Nepal had few roads, now 43% of the rural population has access to an all-season road and over 17,000 km of roads exist (World Bank 2017). Adult literacy has increased from 21% in 1980 to 60% in 2010 (Rigg et al. 2016), while the percentage of people living below the national poverty line declined from 42% in 1996 to 25% in 2010 (Government of Nepal, National Planning Commission and the UNDP 2011).

Nepal was governed by royal dynasties until the early 1990s, when several political parties launched a popular prodemocracy movement. The political changes raised expectations of social and economic progress for most Nepalese, in a country highly managed by caste and other hierarchies that left most people very poor. Since democracy was adopted in 1990, Nepal has had over 23 governments. In 1995, the Community Party of Nepal made plans to launch an armed struggle, the People's War, with the goal to better the standard of living for Nepalese people. In 1996, the armed insurgency against the government began. This Maoist-led insurgency lasted a decade, ending in 2006, and resulted in over 13,000 deaths and significantly stifled national socioeconomic development. A Maoist-dominated government was democratically elected in August 2007. Long-term political instability has reigned, and the country is struggling to overcome the legacy of the conflict. As of early 2017, politicians continue to disagree on the new promulgated constitution of September 2015 and discussions leading to a federal state for Nepal continue.

Along with agriculture, which contributes 30% of the gross domestic product (GDP), remittances and the service sector have emerged as major contributors to the economy. Today, Nepal's economy relies on a combination of agriculture (predominantly rice and wheat), tourism and remittances from its young men who work mainly in Malaysia, Qatar, Saudi Arabia, UAE and Kuwait (Government of Nepal, Ministry of Labour and Employment 2014, 6). In 2014, remittances contributed 29% of the GDP (ibid., 36; World Bank databank 2016b) and currently are one of the leading factors behind Nepal's remarkable successes in human development in the last 40 years, contributing significantly to the reduction of poverty since 1995 (United Nations 2011). It is these remittances that are fuelling people's ability to rebuild post-earthquake.

Despite the contribution to the economy and poverty reduction, this reliance on remittances has notable downsides. The number of Nepalese households receiving remittance has increased from 23% in 1995–96 to 56% of all households in 2010–11 (Government of Nepal, Central Bureau of Statistics 2011). Of the households receiving remittances, such monies make up 31% of the household's total income (ibid.), and daily consumption uses 79% of total remittances received. It is clear Nepal's households depend heavily on its young male international migrants rather than on the country's own economy. This leaves many young Nepalese men with a difficult choice: stay and help rebuild after the earthquake or leave and send back their earnings.

1.3 Disaster Risk in Nepal

Over the last five centuries, deaths from earthquake disasters globally have consistently averaged 100,000 per year, with some experts suggesting this rate is increasing (Bilham 2004). With more than 90% of all earthquakes affecting the Asia-Pacific region (hence the colloquial term Pacific 'Ring of Fire'), it is not surprising that the largest number of deaths from earthquakes each year is in Asia (International Federation of Red Cross 2009). Nepal is ranked 11th in the world in terms of vulnerability to earthquakes (UNDP 2004). Situated in the middle portion of the Hindu Kush Himalayan region, a high seismic risk zone, Nepal has a long history of destructive earthquakes (Mugnier et al. 2013; Government of Nepal, Ministry of Home Affairs 2011). It is prone to other natural hazards as well, such as flooding and landslides, both of which occur annually during the summer monsoon, and the latter of which occur in the thousands during a major earthquake (Kargel et al. 2016). This

combination of 'multiple hazard events poses a severe threat to national development processes' (ADPC et al. 2010, xii), and the World Bank (Dilley et al. 2005) considers Nepal one of the global hot spots for natural disasters.

While strong earthquakes in Nepal are infrequent, they almost always result in some level of loss. In 1833, two major earthquakes were experienced in the Kathmandu Valley, causing widespread damage. In 1834, four major earthquakes occurred in just two months. On 16 January 1934, perhaps Nepal's most infamous earthquake occurred: the great Nepal-Bihar earthquake, which, as the name suggests, also affected Bihar, India. This earthquake had an estimated moment magnitude (M_w) of 8.4 and according to Rana (1935, translated into English Lall 2013) killed 8519 people across eastern Nepal. In the recent past, on 18 September 2011, an earthquake of M_w 6.8 struck Nepal's eastern region as well as the capital Kathmandu, in the central region. This resulted in damage to houses, buildings and schools in 13 districts.

1.4 Scope of the Book

Disasters are not natural; they are human made (O'Keefe et al. 1976). Building codes, zoning policies, environmental regulations and enforcement of laws all influence outcomes of major events such as earthquakes (Hyndman 2011). Earthquakes are a particularly special hazard event: There is a rupturing that earthquakes create that is beyond our control and understanding (Simpson 2013; Hyndman 2011). An earthquake is more than the physical shaking. The ramifications are complex and interconnected. The impact of an earthquake is expressed in fits and bursts over a protracted period of time. At one point, the earthquake blends into the everyday but in reality it continues to cause ruptures in different ways over many years.

Disaster studies scholar Kenneth Hewitt suggests 'disaster is a disruption and unravelling of spatial or geographic order' (1997, 41), which is multidimensional and percolates over a long period of time. This book describes the Gorkha earthquake from a multitude of different dimensions and perspectives, taking a deliberate multidisciplinary view to highlight the complex interactions and connections that result from an earthquake. In doing so, it is hoped that this collection can highlight what can be learnt from the Gorkha earthquake before the next big one, whether it occurs in Nepal or elsewhere.

The genealogy of this book is based on two events organised by the Institute of Hazard, Risk and Resilience at Durham University related to the Gorkha earthquake. The following chapters are contributions from researchers who experienced the earthquake or who supported Nepal and its citizen's post-earthquake. Practitioners, both Nepalese and international, have contributed to the book as well, in order to give a more nuanced and grounded view of the earthquake. Clark (2011, 73) suggests 'the disaster is the event so severe that in its tearing away of the foundations, structures and relations that make the world legible, it also deprives those it afflicts of their capacity to absorb and process the event, to render it intelligible'. This book is our collective attempt, two years after the earthquake, to sort through and attempt to process the earthquake and render it and its aftermath intelligible to ourselves and to readers. This volume contains a range of academic research, perspectives and reflections from people who experienced the earthquake, were involved in managing the response and recovery or have a relationship with Nepal.

The ways in which we have been working with disasters has not worked very well in the past, and only by combining our efforts and assessing these events from a multidisciplinary perspective can we attempt to understand more fully and hope to minimise the short- and long-term impacts of earthquakes in the future. Perspectives from geography (human and physical), long-term efforts in disaster risk reduction, cultural heritage protection, anthropology, health, social work and emergency response will be discussed.

1.5 Part 1: Earthquake Preparedness and Response (Chapters 2–6)

Chapter 2 is written by Amod Dixit of the National Society for Earthquake Technology—Nepal (NSET) and several colleagues. They outline NSET's strategy over a period of two decades to increase awareness and preparedness in relation to earthquake risk management within Nepal (Fig. 1.2). They present the most impactful programmes: school earthquake safety programme, the building code implementation programme in Nepal and the enhancement of emergency response capacities at the national and community levels. In this chapter, attention is also given to the effectiveness of the programmes in relation to the Gorkha earthquake. The necessity to consider the long term and to engage with the international, national and local levels is stressed.

Chapter 3 is written by Gopi Basyal, who provides an overview and reflections on the emergency response during the first 100 hours of the

Fig. 1.2 A NSET social mobiliser with community members to help communicate risk (Source: NSET)

earthquake. He outlines Nepal's emergency response structure and looks at how pre-event training of local people in various emergency-response skills influenced the resulting losses. Limitations in the response structure and procedures are identified and potential avenues for improving this structure for future events are briefly discussed.

Chapter 4 is written by Ramjee Bhandari, Chandika Shrestha and Shiva Raj Mishra. They explore the direct and indirect influences of the Gorkha earthquake on the overall health and well-being of people. They suggest this primarily rural-based earthquake devastated the healthcare infrastructure in remote areas and particularly impacted women, the poor and those with pre-existing physical and mental health problems. The event also created a new vulnerable group: people with physical and mental disabilities. They also consider the future and the possibility of universal health coverage in a changing political climate.

Chapter 5 is written by Sanchita Neupane, who discusses traditional methods for estimating the timing and extent of earthquake impacts and compares these with the traditional lay knowledge of many Napalese people. The chapter uses simple mathematical equations along with observations of historic earthquakes in Nepal and the wider Himalaya to shed light on how frequently events like the Gorkha earthquake occur.

Chapter 6 is written by Tom Robinson, who details the ways in which high level planning is used to try to pre-empt future earthquake events and identify issues for emergency response that can be improved and made ready for future earthquakes. He provides an overview of a major

earthquake simulation held in Nepal shortly after the Gorkha earthquake that aimed to identify and improve on flaws in the emergency response to that event. The simulation resulted in myriad findings and recommendations for improvements to Nepal's emergency planning and structure, and several of these are addressed in detail. The chapter also highlights the difficulties facing national governments in the wake of such simulations in regard to investments in disaster risk reduction activities.

1.6 Part 2: Disciplinary Perspectives (Chapters 7–11)

Chapter 7 is written by Ben Campbell, who explores the way in which the impact of the earthquake was felt unequally across districts and communities in Nepal. The earthquake could be considered an ethnic (Tamang) earthquake, in which communities were destroyed and the greatest number of deaths were in the Tamang areas. The Tamang community mechanisms to rebuild are considered, and their inability to access government support (including the national park) is highlighted. Consideration is also given to the significant role of community-based renewable energy systems. Communities were devastated by the loss of electricity and their access to modernity.

Chapter 8 is written by Hanna Ruszczyk, who explores the impact of the earthquake on the lives of residents in a large city (Bharatpur) not directly impacted by the earthquake. Based on her experience of the earthquake and the aftermath of the constitution, she proposes that implementation of urban planning measures as well as the political implications of the constitution and the ensuing economic blockade were as important as the earthquake for large parts of the country.

Chapter 9 is written by Lena Dominelli, who explores how green social work (GSW), a holistic, transdisciplinary model of social work disaster intervention, is applied throughout the disaster cycle from immediate relief to reconstruction. This chapter considers the Nepal School of Social Work's (NSSW's) use of GSW at all stages of a disaster after the earthquake in Nepal's Sindhupalchok area.

Chapter 10 is written by Robin Coningham and colleagues. The authors argue for the necessity to consider heritage impacts in a time of disaster. They discuss postdisaster destruction of subsurface heritage sites and postdisaster rescue archaeology interventions that took place in the Kathmandu Valley. Last, they propose protocols to be used in future events

to safeguard and protect not only UNESCO sites but also local heritage sites while still allowing rapid response during search and rescue efforts.

Chapter 11 provides a synthesis of the book's contributions and is written by Tom Robinson, Hanna Ruszczyk and Louise Bracken. The chapter summarises emerging themes, such as the differences in impact on rural and urban centres, the role of the local, national and international levels in immediate response and long-term recovery from the earthquake as well as the role of science and technology. This collection of perspectives gives visibility to groups and topics often not readily discussed. Response to the earthquake from first responders in the community, by the government, by community groups and by the humanitarian sector are considered. Last, the future is tentatively considered. Written 24 months after the earthquake, the chapter acknowledges that much is still in turmoil and transition due to the earthquake, the constitution and the economic downturn caused by the informal blockade. The rebuilding has yet to take place on a large scale. Reflections from the disaster will, we hope, contribute to considerations for Nepal and other seismically active countries for their future safety and general well-being.

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CHAPTER 2

Earthquake Risk Reduction Efforts in Nepal: NSET's Experience

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2.1 Introduction

2.1.1 General

Nepal faces a multitude of natural hazards. The corresponding risk in terms of human casualty and loss of assets is extremely high because of the high levels of existing physical and social vulnerabilities, the continued building up of vulnerabilities and the lack over the years of any systematic hazard preparedness (MoHA 2011, 2015). Disaster risk management was not a

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_2

priority in Nepal until after the 1988 *M* 6.6 Udayapur earthquake and the 1993 floods. After these events, in 1993 the first National Conference on Disaster Management developed the first national plan for disaster management, and between 1992 and 1994 the government developed the National Building Code. International initiatives, such as the International Decade of Natural Disaster Reduction (IDNDR, 1990–1999), and earthquake events in neighbouring countries have also encouraged Nepal to address disaster risk management seriously. In preparation for the first UN World Conference on Disaster Reduction, the Nepal government developed and later enacted the National Action Plan (NAP) on disaster management.[1]

The National Society for Earthquake Technology—Nepal (2001, 2002) was established in 1993 by a group of Nepalese professionals involved with the development of the building code and in response to the significant global paradigm shift to a proactive approach to disaster risk reduction. NSET's aim was to help the government and people of Nepal in future earthquakes and to help implement the National Building Code. NSET focussed on conceptualising, designing and implementing simple and doable risk reduction initiatives that centred on enhancing earthquake awareness and risk perception of people (NSET 2002). NSET absorbed international knowledge on hazards and risks in Nepal, contextualised global principles to the local conditions; translated scientific terminology into simple everyday language; and disseminated the knowledge using community schools, teachers, students and leaders of society (NSET 2001, 2009). Thus from the very beginning, NSET's works linked people and their aspirations for safety with scientific knowledge on one hand and with the government's policies in disaster risk reduction on the other. For example, NSET simplified the complicated concepts associated with the National Building Code and began to convince people of the benefits of its enforcement. This was an uphill and long-term task.

The usefulness of the initiatives and innovativeness of NSET's long-term efforts were tested by the *M* 7.8 Gorkha earthquake in 2015. Based on results during this immense shock, we are proud of the positive impact of the earthquake risk management efforts implemented by NSET and national and international partners and the efficacy of the approaches, philosophy and methodologies adopted in Nepal in the past 22 years.

This chapter provides a brief history of the earthquake risk management efforts made by NSET in Nepal, thus shedding light on some of the innovative postulations and methodologies used. We describe three of NSET's main programs as cases of successful earthquake risk management in a low-

income country that has suffered protracted insurgency and political instability in the past several decades. This chapter also discusses how the Gorkha earthquake helped us better understand the earthquake vulnerabilities and allow us to look forward to long-term earthquake risk reduction by improved building practices not only in known earthquake-affected districts but also in areas likely to be impacted by future earthquakes.

2.1.2 Understanding Seismic Hazards and Risks in Nepal

J. B. Auden (1937) was the first geologist to talk about Nepal's earthquake risk when he undertook an extensive survey of the effect of the 1934 Bihar-Nepal earthquake (Dunn et al. 1939). Major General Rana, a Nepalese administrator with scientific acumen, also gave detailed accounts of casualty and damage due to the 1934 earthquake and, for the first time, indicated the high seismic risk in Nepal. He suggested ways to minimise this risk, including methods of constructing earthquake-resistant residences (Rana 1935). In 1978 the Department of Mines and Geology (DMG) started a systematic study of earthquake hazards by establishing and conducting seismic monitoring, for which the National Seismological Centre (NSC) is currently responsible. This involved the creation of a nationwide network of short period seismographs, accelerometers and, more recently, GPS instruments as well as conduction of geologic studies such as earthquake intensity surveys and active fault trenching (Sapkota et al. 2012; Pandey et al. 1995, 2002; Sheehan et al. 2008; Dixit et al. 2015; Bettinelli et al. 2008; Lave et al. 2005; Monsalve et al. 2006; Adhikari et al. 2015, 2016; Rajaure et al. 2016; Gualandi et al. 2016).

2.1.2.1 1990s–2000s

Another milestone in understanding seismic hazard of Nepal was the seismic hazard assessment and risk evaluation conducted under the Nepal Building Code Development Project (1994). This assessment prepared a consolidated earthquake catalogue for Nepal, inventoried the reported active faults and analysed their potentials to generate earthquakes. Based on the analysis of the identified point and linear sources, the BCDP developed probabilistic seismic hazard maps (Fig. 2.1), which served as the basis for the formulation of seismic zoning maps and ultimately the National Building Code (NBC) of Nepal. For the first time, the country learned about the high earthquake risk and objectively realised the need for conjunctive efforts towards earthquake risk management.

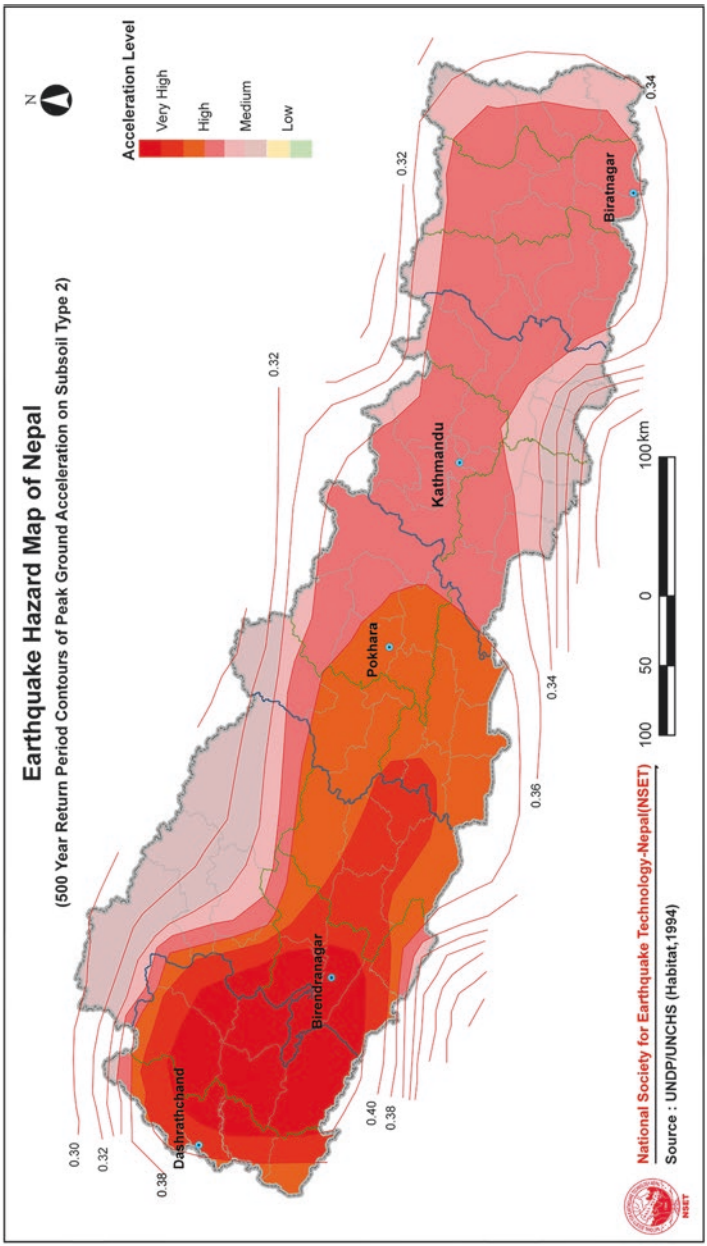

Fig. 2.1 Probabilistic seismic hazard map of Nepal, showing PGA values with 10% probability of exceedance in 50 years (Source: BCDP 1994, recolored and redrawn by NSET)

The NBC (formulated in 1994 and approved in 1998) recognised not only the level of seismic hazard and risks but also the existing practice of building construction, including the prevalence of nonengineered buildings that used traditional construction materials, such as bricks and stones in mud or cement mortar. NBC adopted a unique approach by establishing four different criteria of standards for four different types of buildings—namely:

a. Standards for the construction of modern and large state-of-the-art buildings, mainly in urban areas.
b. Standards for engineered building design and construction in urban and urbanising areas.
c. Mandatory rules of thumbs for low-rise residential buildings, in urban and urbanising rural areas.
d. Guidelines for rural construction.

By adopting these criteria, NBC aimed to improve seismic performance standards for 100% of the building stock of Nepal, including the majority of private residential buildings less than three stories high or less than 1000 square feet of plinth area and the rural one- to two-storey mud-based or timber-based constructions. In a context in which there had been no implementation of the NBC, a cautious initiation of the code was initiated, thus moving from *nothing to something*. The NBC was the beginning of a process to gradually move from a nonengineered level in Nepal to a pre-engineered or semi-engineered level and then finally to a 100% engineered level for significant structures, at least in the metropolitan areas (Parajuli et al. 2000).

The other milestone programme was the Kathmandu Valley Earthquake Risk Management Project (KVERMP); implemented by NSET in 1997–99 in close collaboration with GeoHazards International (GHI) and the Asian Disaster Preparedness Centre (ADPC) and in partnership with the U.S. Office of Foreign Disaster Assistance (OFDA) (Dixit et al. 2000). KVERMP components included (1) development of an earthquake scenario and an action plan for earthquake risk management in the Kathmandu Valley, (2) a school earthquake safety programme and (3) awareness raising and institutional strengthening. The project was implemented with significant engagement with central government agencies, municipal governments, professional societies, academic institutions, schools and international agencies present in Kathmandu Valley in advisory committees and various workshops, seminars and interviews.

The earthquake scenario simulated a repeat of the 1934 level of shaking in Kathmandu Valley. This scenario estimated that approximately 60% of all buildings in Kathmandu Valley would likely be damaged heavily, almost half of the bridges in the valley would be rendered as impassable, and 10% of paved roads would have moderate damage, such as deep cracks or subsidence. The prevalence of extremely narrow roads, which could easily be blocked by debris, would exacerbate the problem. Approximately 95% of water pipes and 50% of other water system components (pumping stations, treatment plants, and so on) could be seriously damaged. Almost all telephone exchange buildings and 60% of telephone lines would likely be damaged, requiring significant to moderate repair to be operational. Approximately 40% of electric lines and all electric substations were found likely to be damaged. Comparison of recent earthquake casualty figures from cities comparable to Kathmandu Valley, such as that due to the 1980 earthquake in El Asnam, resulted in an estimate of 40,000 deaths and 95,000 injuries for this scenario (Dixit et al. 2000).

2.1.3 Earthquake Risk Management Efforts in the Past Two Decades

KVERMP provided the necessary stimulus for NSET to implement several milestone programs such as the School Earthquake Safety Program (SESP), annual Earthquake Safety Days (ESDs), mason training (MT) for earthquake-resistant construction, a Program for Enhancement of Emergency Response (PEER), Community-Based Disaster Risk Management Program (CBDRM), Municipality Earthquake Safety Program (MERMP), Public Private Partnership for Earthquake Risk Management (3PERM), community-level disaster preparedness and planning and collaboration with the dense network of community and private FM radio stations to propagate earthquake safety messages. These works were acknowledged positively nationally and globally. Figure 2.2 provides a glimpse of the various innovative initiatives implemented by NSET and the outputs achieved. There is an accelerated growth in implementation—the outcome in the year 2016 is significant in many cases as compared to the cumulative output achieved in the past two decades. More on NSET's works since 1997 can be learned from the publication *Safer Society* 2014, and its website (www.nset.org.np).

The following sections describe three of the initiatives that have provided significant support to the people and government of Nepal in the response, recovery and reconstruction phases of the Gorkha earthquake.

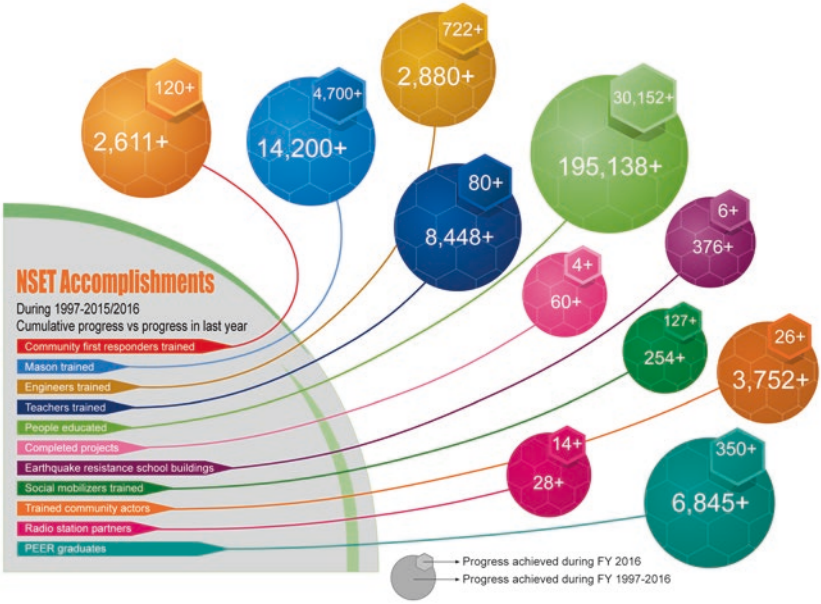

Fig. 2.2 Earthquake risk management efforts and achievements by NSET in Nepal in the past two decades.

2.2 School Earthquake Safety Program

2.2.1 General

The School Earthquake Safety Program of NSET started with seismic retrofitting of a school building in the Nangkhel village of Bhaktapur in 1998 under KVERMP. It has become NSET's most successful programme, not only for making the schools safer but also for triggering a sustainable process of earthquake awareness and earthquake disaster risk reduction in Nepal. It proved the social, economic and technical feasibility of enhancing seismic performance of nonengineered, mostly brick masonry buildings of community schools and fostered positive changes in the mind-set of people. Even those donors and government officials who were initially sceptical towards investing in school disaster risk reduction have agreed that, two decades later, SESP is one of the most attractive programs for funding by

the government as well as by small or large funding agencies and international development partners (NSET-KVERMP 2010). The programme itself has evolved over the years to encompass the following components:

a. Seismic retrofitting and or earthquake-resistant reconstruction of the physical structures.
b. Seismic retrofitting of the nonstructural elements.
c. Training to masons, carpenters, contractors, supervisors, engineering technicians and building design engineers/architects on earthquake-resistant design and code-compliance construction technology and seismic retrofitting.
d. Earthquake awareness programs targeting teachers, students, community members and government officials working in the educational system.
e. School disaster emergency preparedness and response planning, safe evacuation drill, first aid and extension of earthquake awareness to the community.

We believe that the following approaches and operational principles additionally helped enhance stakeholders' engagement in and ownership of the programme:

a. Preferential use of local resources, masons, contractors, construction materials and building typologies.
b. Fostering collaboration among government agencies, nongovernmental organisations (NGOs), community-based organisations (CBOs) and the business community by involving them in the decision-making process at all stages.
c. Following strict technical and financial transparency and being always ready to answer the following questions: What is being done? How and who is doing this? Why it is being done? What time, technology and resources are required? How many resources and for what aspect are being used?

2.2.2 Institutionalisation of SESP

The Ministry of Education made a decision to incorporate a programme of seismic retrofitting of school buildings in its annual national plan, starting from the fiscal year 2011–12, and allocated a significant budget for seismic

retrofitting of 15 buildings. This decision immediately received support from the development partners and international financial institutions. The Nepal Risk Reduction Consortium, which draws in membership of various international development partners based in Nepal, included SESP as one of the five flagship programs with the Asian Development Bank serving as the coordinator leader of the Flagship 1: School. NSET continued to serve as the national consultant to provide technical assistance to the Department of Education and Ministry of Education. The number of school buildings retrofitted annually grew gradually from 3 per year by NSET to more than 150 per year after 2010 (ADB/GON 2010). Subsequently, a national strategy for school earthquake safety was developed and enacted.

The following provide evidence of sustainability and institutionalisation of school safety in Nepal:

1. School safety has become business as usual for the Ministry of Education. Currently the school building retrofitting is running in 23 districts outside of Kathmandu Valley. There is a remarkable improvement in institutional capacity of the Ministry of Education's Department of Education (DOE) and the District Education Offices (DEOs) for implementing SESP and for scaling up the programme to the whole country. Almost all the pertinent staff have received training. A unit to deal with issues of disaster risk management has been established in the Department of Education of the Nepal government. The following types of activities have become embedded into schools: earthquake drills, teacher training on school safety in a time of disaster, school emergency preparedness plans and retrofitting (as mentioned earlier).
2. There is significant increase in the number of agencies and institutions, both public and private, working in aspects of school safety. Similarly, the number of supporting partners, nationally and internationally, is on the increase. Many institutions have made school safety their priority; many others have incorporated mason training as an integral component of their programs.
3. About 300 school buildings have been retrofitted since 2010 as part of the government-led programme. Approximately 10,000 teachers and 2000 masons have been trained on aspects of school retrofitting and disaster preparedness, and around 500,000 students have been sensitised on methods of disaster safety. SESP has thus been firmly institutionalised in Nepal (NSET/GFDRR 2010).

2.2.3 Performance of Retrofitted Buildings in April 2015 Gorkha Earthquake

Although NSET's programme of seismic retrofitting school buildings has been implemented for two decades, there was little research confirming scientifically the many assumptions made for the methodology adopted while implementing the retrofitting programs. The Gorkha earthquake of 2015 provided the much-awaited opportunity to study the behaviour of the retrofitted school buildings to seismic loading.

Of the approximately 300 school buildings retrofitted in Nepal, nearly 70% are located in the areas impacted by the Gorkha earthquake. No collapse or serious damage was reported for these schools. Even those schools located near the epicentre remained in a condition that allowed them to be immediately used after the earthquake. Almost all of the retrofitted school buildings were utilised during the earthquake response as emergency shelter, warehouse, health posts or safe offices.

This contrasts sharply with poor performance of the unretrofitted schools, including those located close to retrofitted ones. During the Gorkha earthquake, about 80% of the unretrofitted schools were damaged beyond repair. Although detailed studies on each of the schools are yet to be completed, it can be simply said that retrofitting did enhance the building resilience significantly and the retrofitting technology successfully passed the test posed by the Gorkha earthquake.

2.3 Building Code Implementation Program Nepal

2.3.1 Experience of NBC Implementation in Nepal during 1998–2011

Lalitpur Metropolitan City (LMC) became the first municipality in Nepal to announce the mandatory enforcement of NBC into the building permit process in 2003. NSET and other professional groups supported this initiative. In 2007, Dharan (devastated by the 1988 *M* 6.6 Udayapur earthquake) became the second municipality that officially announced its commitment to implement the building code. After learning lessons from LMC, Dharan introduced formal organisational procedures and included supporting programs, such as the training of masons and engineers. Dharan also implemented a comprehensive awareness programme targeting

various stakeholders involved in the building production process, from the designers and architects to the masons, traders in construction materials, quality control offices, officials of the building permit system and others. Dharan became the most respected leader among municipalities for its efforts in building code implementation because it was seen as adopting a comprehensive approach that included earthquake awareness programs, systematic training of masons and engineers in earthquake-resistant construction and allocation of annual budget for Building Code Implementation Program (BCIP; Shrestha 2012).

Kathmandu Metropolitan City (KMC) followed suit. Utilising the provisions of the Local Self-Governance Act, KMC relaxed to a certain extent the provisions of NBC due to political reasons and included most aspects of the NBC into its building permit process. The municipal areas of Panauti, Banepa, Ilam, Vyas and Hetauda also started implementing the NBC. Despite efforts by many, only a few municipalities were implementing the building code effectively by the end of 2011. NSET was involved directly or indirectly in most of these municipal efforts of building code implementation between 1994 and 2011, and we can identify the following as the main impediments and problems for NBC implementation by municipalities and urbanising settlements of Nepal:

1. Urban and urbanising settlements in Nepal vary in terms of their size, use of building construction materials and building construction process. It is necessary to develop a unique implementation strategy for each municipal or urbanising settlement for incorporating provisions of the NBC into the building permit process based on prevalent ground realities related to the construction process, such as the number of buildings constructed each year, availability of traditional and modern construction materials, construction trends and the level of earthquake awareness among the residents.
2. Lack of institutional capacity and human resources is another hindrance at the national and local levels. Some municipalities have just one or few technical professionals, and some have many technical professionals, including qualified engineers to review and check the submitted drawings and designs for building permits. A radically new approach needs to be implemented for developing such capacities in all target areas simultaneously.

3. A national consensus should be developed on the urgency of improving seismic performance of existing and new buildings and the need to develop a consensus building standard commensurate with the current international level of knowledge of science and technology. Simultaneously, a certain flexibility corresponding to the local contexts should be agreed on at the national level—for example, unavailability of good timber at higher Himalayan regions or high costs of cement and iron in remote areas should allow use of alternate materials and designs that are not included in the current version of the National Building Code.

2.3.2 Building Code Implementation in Nepal after 2011

Based on the past experiences and considering the urgency to scale up the successes of several municipalities, NSET worked in close collaboration with such municipalities and under the direction of the Ministry of Urban Development (MOUD) and Ministry of Federal Affairs and Local Development (MoFALD) and the supervision of the government Department of Urban Development and Building Construction (DUDBC). NSET has put the Building Code Implementation Program in Nepal (BCIPN) into operation. The U.S. Agency for International Development (USAID)/U.S. Foreign Disaster Assistance (OFDA) programs has been providing financial support to NSET for the BCIPN, which entails technical support to 24 municipalities in their efforts to establish the National Building Code.

2.3.2.1 Situation of Building Permits and Building Construction Practices

In addition to the general experiences gathered between 1998 and 2011, NSET conducted a baseline survey in all the 58 municipalities in 2012 to gather basic information on building construction practices, municipal capacities and the status of building code implementation in Nepal. The majority of municipalities were rural, with the average number of building permits issued ranging from a few hundred to a thousand annually. Only 3 municipalities—namely Dharan, Vyas and Lalitpur Metropolitan City—were found to be implementing the National Building Code using a comprehensive approach consisting of combined efforts in risk awareness, capacity enhancement and strengthening the policy and legal

environment. Nine of the 58 municipalities did not have even a single engineer; 23 municipalities had two or more engineers. Thus the majority of new buildings in most urban and urbanising areas of Nepal continued to be built without compliance to the building code, despite the building act making code compliance mandatory since 1998. Many new buildings were built without the building permits. This resulted in many structures not having any plan at all. Adding stories or making alterations to buildings without permits was prevalent, even for public buildings. The building permit system was geared towards generating significant revenue for the municipality in the form of permit fees and not in generating disaster safety. Building permits are important for homeowners seeking bank loans or connections to municipal utilities (such as electricity, water supply and, in some locations, solid waste management). Sometimes homeowners could unduly influence or bribe the relevant clerk to get false permit papers, even without inspection of the plan or the building site.

2.3.2.2 NSET Strategy for Building Code Implementation

NSET developed its strategy for building code implementation based on the earlier experience of assisting a few municipalities such as Dharan and Vyas and based on the findings of a detailed survey of existing building typologies and building construction processes; urbanisation intensity and demand for engineering services; human resources available with the municipalities and their institutional capacity; status of earthquake risk perception; and knowledge, attitude and practice among the municipal population. After reflecting on the problems identified, gaps to be bridged and potentials for future success, NSET developed a three-pronged strategy for building code implementation that focussed on assisting municipalities enhance capacities in awareness and risk communication, technical and institutional services and policy improvements for institutionalising the process. The target stakeholders and appropriate resources were also identified and the indicators to gauge the effectiveness of the strategy were defined and adopted.

Three concrete activities were established: (1) development of a system of improved building permit process, (2) a mechanism for code compliance check in the permit process and (3) development of a building code implementation guideline and a checklist. Earthquake awareness initiatives and methods were developed and implemented differently for the various specific target groups, such as social leaders, community groups, homeowners and mothers' groups. Different training programs were

Fig. 2.3 NSET training local masons (Source: NSET)

developed for the different actors of building production, such as engineers, technicians and masons (Fig. 2.3). As a part of the strategy, clear outcome and impact level achievement indicators were set to make the monitoring and evaluation system more objective, and an overarching target of full code compliance in a minimum of 70% of new buildings in programme municipalities was established.

Together, NSET and several leading municipalities championed three directions: awareness raising among residents for creating a demand for increased safety, a focus on building both human resources and institutional structure and the development of municipal procedures and related policies. These created an enabling environment for engaging different stakeholders in discourse on implementation of the code. Once the stakeholder engagement was ensured, pilot implementation in four municipalities triggered a diffusion process, which now has become widespread. This was possible largely due to the positive policy changes enunciated by MoFALD: building code compliance and improvement of seismic safety

of new buildings were included as a part of the performance evaluation of the municipal chief executive officer (CEO) and as a criterion for municipal performance monitoring, which in turn thus impacted budgetary allocation from the MoFALD to the municipality.

Meanwhile, during 2014–16, the government defined many more settlements as municipal areas (see Chap. 8 for more details). It is important to note that after the Gorkha earthquake of 2015, the government made the National Building Code mandatory for all buildings throughout Nepal, both rural and urban. This has created a huge demand for successful implementation of the building code.

2.3.2.3 Changes in Risk Perception over the Years

As a part of monitoring and evaluation (M&E), NSET conducted a very detailed baseline risk perception survey in 2012 in 23 BCIPN program municipalities using the Knowledge, Attitude and Practice (KAP) Survey at the start of the programme. The sample size was of 1–5% of the total population in each municipality, amounting to a total of 40,000 respondents. The results show the scores on knowledge and attitude are relatively high due to the continuous and persistent efforts in earthquake awareness and education of the population in the past two decades, including those by the community FM radio stations, with almost 75% coverage of the country's territory. But the score for practice is rather low, largely because people did not have adequate technical knowledge or the required policy and legal environment for making new buildings safe against earthquakes. Figure 2.4 shows a significant change in the knowledge level of safety intervention for making buildings safe against earthquake shaking during the period of the BCIPN (2013–16).

2.3.2.4 Success in Code Compliance

For the past three years, the BCIPN focussed on applying the building code, a process of enhancing municipalities' capacity in checking submitted drawings and conducting field inspections. After three years in this pursuit, NSET is revisiting the process as part of its M&E plan to measure the success in achieving building code compliance. The compliance check methodology is an adapted version of what is used in the United States and India and uses three attributes of vulnerability—namely, building configuration in plan and elevation, strength of the building elements and materials and the ductility of the structural elements. Weights were assigned to the individual criteria to make a cumulative total of 100.

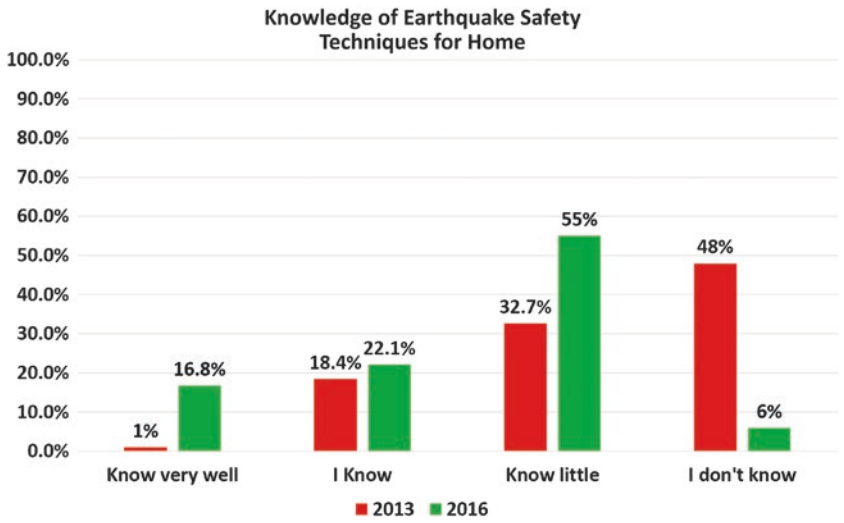

Fig. 2.4 Change in knowledge level on earthquake safety techniques during 2013–16 in Bharatpur Municipality (Sources: Baseline Study Report on Risk Perception Survey in the municipalities; Building Code Implementation Program in Nepal (BCIPN), September 2015; and an in-house report of NSET/BCIPN)

A total score of 20 or less is considered code compliant, scores greater than 20 and less than or equal to 30 are partially compliant or close to compliant and scores greater than 30 are considered noncompliant. Buildings designed and constructed in three time periods—2012, 2014 and 2016—were analysed separately. Although this survey is still in progress in all 30 programme municipalities, initial results in 10 municipalities show encouraging results. For example, Fig. 2.5, pertaining to Bharatpur Municipality, shows a significant improvement in code compliance expressed in the quality of the drawings submitted, building permit applications and, more significant, in the way the building is actually constructed on site.

The average compliance rate in 30 BCIPN municipalties improved in drawings submitted from 4% to 61% and actual construction compliance from 5% to 47%. This is a real success. These results indicate that Nepal's municipalities can actually enhance the seismic performance of new

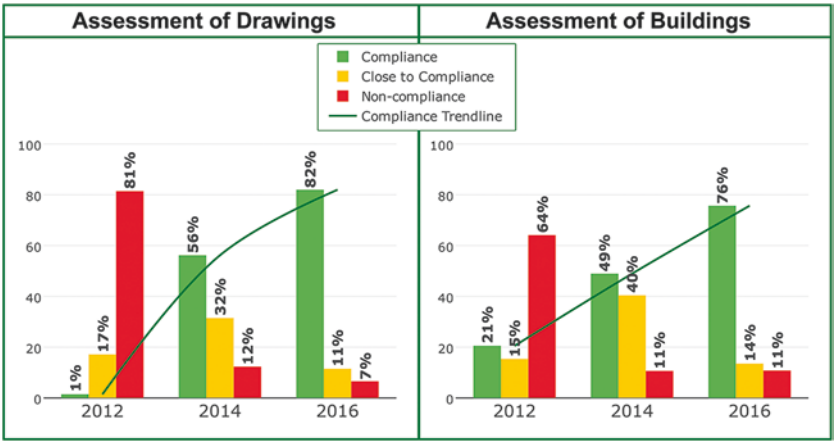

Fig. 2.5 Building code compliance—the change in Bharatpur Municipality in the period 2012–16 (Source: Building Code Compliance Assessment Report, 2017, an in-house report of the NSET/BCIPN)

buildings. Municipalities can achieve results if they are provided with technical assistance for capacity enhancement and for improvements in municipal institutional structure as well as in municipal policy and legal environments.

Similar positive results are emerging for most of the municipalities involved in the BCIPN. NSET believes the following have made the difference in building code implementation:

1. Gaining peoples' trust (positive attitude). The mason-training programme instilled a confidence in local workers in the new ways of construction using familiar materials, and the confidence of the local masons convinced homeowners to spend the extra money to enhance the seismic strength of their houses.
2. Acceptance and enthusiasm of the municipality. First, the municipal engineers or the engineering technicians became convinced of the possibility of making a difference after they participated in training under the BCIPN. In turn, they could convince the municipal CEO to agree to introduce positive changes in the building permit process and in-house capacity enhancement for ensuring code enforcement. Municipalities started allocating budgets for training in and awareness

of the building code and recruiting additional technical hands and creating building sections for monitoring code compliance in new construction of buildings.
3. Sincere and transparent intervention. The BCIPN adopted financial and programme transparency right from the very start, inviting all stakeholders to get involved in all discourses on programme implementation. Community-based organisations, such as mothers' groups and Tole Lane Organisations, were happy to discuss problems of programme implementation.

2.3.2.5 Key Lessons Learned from Building Code Implementation

The following are the key lessons learned from building code implementation at the municipal level in Nepal from 1998 to 2015:

a. **Awareness raising, capacity building and enabling municipal policies are the keys to success.** In the situation in which most buildings are traditionally nonengineered and owner built, people's individual risk and safety perceptions significantly influence the decision to follow the safety standards in construction of buildings. The tipping point for 'to be' from 'not to be' safe depends on many factors, including perception of risk and the understanding of benefits from risk reduction. Earthquake awareness creates the foundation for understanding the building as the potential source of risk and for the internalisation of the risk, leading to a demand for safety. The growing demand for earthquake safety can be met only by a combination of the enhanced technical capacity of municipal engineers, private sector designers, field supervisors, masons and contractors as well as an enabling policy environment in the municipal system. If there is sufficient awareness among homeowners and the construction workforce is trained in an enabling environment of the municipal system, most of the buildings would be constructed in compliance to the National Building Code. This is the most important lesson. Contrary to the earlier belief, BCIPN has demonstrated that municipalities can encourage people to construct code-compliant buildings, even in a less developed country like Nepal.
b. **Institutionalisation of building code implementation was a long-term undertaking in Nepal.** Nepal developed the NBC in 1994 and promulgated it as mandatory via the Building Act in 1998, and yet enforcement of the code remained a serious challenge. It required almost two decades for developing confidence in its implementation.

Dharan municipality in Nepal took approximately eight years of consistent efforts to achieve code compliance in the majority of new buildings. A continuous effort by the local government and continuous backup by an organisation such as NSET were crucial for Dharan. What encouraged the shift in people's mind-set were the persistent efforts of the municipality in earthquake awareness, enhancing capacities of design engineers and the construction industry in building code compliance and in improving the municipal process for encouraging earthquake-resistant construction in compliance to the code.

c. **Working with champions helps institutionalise the process.** NSET is convinced that changes in people's mind-set are not possible without the support of the change agents that exist in all societies—in government offices, in private sector businesses and in civil society organisations that influence people to change. The BCIPN was lucky to get support from such change agents within the municipal system, among the local media and civil society organisations, among community-based organisations and among private-sector businesses. A close and transparent association with such champions persistently for three to five years helped develop the confidence to carry out all the activities competently and helped establish a proper system within the municipality. At this point, the municipality could manage the process without external support from NSET.

2.3.2.6 Institutionalisation of Building Code Implementation at Municipal Level

Although implementation of the NBC has taken a long time to gain traction, there is now evidence of growing success at the municipal level in Nepal since 2013 and most especially after the Gorkha earthquake.

1. Following the Gorkha earthquake, the government of Nepal made the National Building Code mandatory for both rural and urban building constructions. Naturally, the focus at present is earthquake-resistant reconstruction in the 14 severely affected districts. The National Reconstruction Authority (NRA) has mobilised engineers and technicians to ensure earthquake-resistant reconstruction. This decision indicates the level of confidence the government has developed in the building code and its usefulness. Earthquake reconstruction will surely have a long-term influence in enforcement of the National Building Code in the country.

2. More and more municipalities of Nepal have made commitments to improve the building permit process by publicly declaring mandatory enforcement of the building code. The governing councils of more than 50 out of 217 municipalities (see Chap. 8) accepted as a policy the enforcement of the National Building Code in 2015–16 (after the earthquake). Most of the municipalities have, to varying degree of success:

   - Incorporated BCI as an important aspect of annual municipal planning with an allocated budget.
   - Established a separate BCI unit within the municipal organisational structure, allowing for recruitment of more building code technicians.
   - Started an education programme targeting the general population, especially prospective homeowners who are considering constructing a house or repairing an old one. The programme focusses on the benefits and process of the National Building Code and building permits process.
   - Started a registration and licencing system for local builders and masons.

This contrasts sharply with the level of indifference of many municipalities to the building code in previous years.

2.3.3 Challenges for the Future

As a consequence of the Gorkha earthquake, there has been high demand on BCI: building back better for the more than 800,000 residential buildings within a time span of five years. This equates to building more than 100,000 earthquake-resilient houses per year in the 31 earthquake-affected districts. This is on top of the national target of building code enforcement, affecting about 25,000 new buildings per year in all urban settlements of Nepal. This demand has further increased because the government has made compliance to the building code mandatory, even in rural settlements.

The surge in the need of constructing earthquake-resistant buildings in compliance to the National Building Code demands increased national capacity in design, construction, supervision and compliance checking. This in turn demands improving the policy and legal environments, increased efforts in formal and informal education and enhanced capacity

to learn from the on-going construction process to create the scientific basis for updating the building code. The need for scientific research in building construction materials, design and construction processes has become obvious.

The NRA has developed a system that prescribes standards for reconstruction for ensuring compliance to its directions for earthquake-resilient building. This provides detailed procedures for the design, construction and field checking for compliance; in addition, the system is tied with the procedures for the disbursement of the financial assistance the government is providing to the earthquake-affected families. This experience needs to be consolidated to develop a national system for ensuring building code enforcement in other districts that are certain to be impacted by future earthquakes. There is also the need to develop national standards and guidelines for seismic retrofitting of existing vulnerable buildings, including newly constructed structures that are found to not be in compliance with certain provisions of the code.

The government and all stakeholders have accepted the challenge and focussed on reconstruction despite unfavourable physical and/or economic conditions. Such levels of confidence would not have been possible had the leading municipalities not started enforcement of the code two decades earlier or the government promulgated national standards on training curricula, methods and procedures.

2.4 Enhancement of Emergency Response Capacities

2.4.1 General

Although earthquake risk reduction programs such as SESP were attractive for people, NSET also strived to work towards enhancing national and local capacities in emergency response. To further this aim, NSET implemented two programs: the Program for Enhancement of Emergency Response (PEER) and a community-based disaster preparedness programme.

PEER is a regional training programme that was introduced to Asia in 1998 by the USAID/OFDA. PEER seeks to enhance the capacities of countries by imparting a system of training programs on medical first responder (MFR), collapsed structure search and rescue (CSSR), community action for disaster response and hospital preparedness for emergencies. PEER is geared towards the development of a training system

(curricula and training equipment), with the aim of developing national instructors who will be able to continue the training programs in national training institutions for formal national level emergency responders (Tandingan and Dixit 2012).

NSET works in collaboration with the Ministry of Home Affairs (2013) to implement the programme. To date, PEER has trained more than 1100 MFR-CSSR professionals in Asia (NSET 2015). Of these, approximately 245 are from the Nepalese Army, Nepal police, Nepal armed police force and the Nepal Red Cross Society; all mandated with emergency first response tasks. Most of the PEER graduates/instructors have become catalysts in promoting PEER, have designed similar training curricula for their organisations and have delivered similar emergency response training for their personnel.

In addition to implementing the PEER training programs, NSET has also been conducting training programs on emergency preparedness at the grass-roots level, imparting training in basic emergency response (BEMR), community search and rescue (CSAR), damage assessment training (DAT), vulnerability and capacity assessment and community fire response trainings as well as developing and testing emergency response plans and prepositioning emergency supplies at different levels (Jimee et al. 2012). So far NSET has provided earthquake preparedness orientation programs for more than 37,000 people and has trained more than 1400 CSAR responders, more than 300 BEMR responders and more than 100 DAT graduates.

2.4.2 PEER Reflections in Gorkha Earthquake

The Gorkha earthquake inflicted huge damage, prompting the government to declare a state of emergency in a third of the country. The 15 years of PEER investment in Asia was put to the test during this challenging episode in Nepal's history. We are proud that the national capacity developed in the past two decades and the national discourse and actions on emergency preparedness were crucial, albeit not enough, for responding to the dire situation. Nepal PEER partner (NSET 2015) organisations mobilised response teams for search and rescue (SAR) (Fig. 2.6) as commanded by the government. PEER-trained professionals provided leadership to the trained or yet-to-be-trained security personnel to undertake such operations. Primary PEER partners in Nepal—namely, the Nepalese Army (2015a, b), Nepal police, armed police force (2015), Nepal Red Cross Society and NSET—were all in full action thanks to years

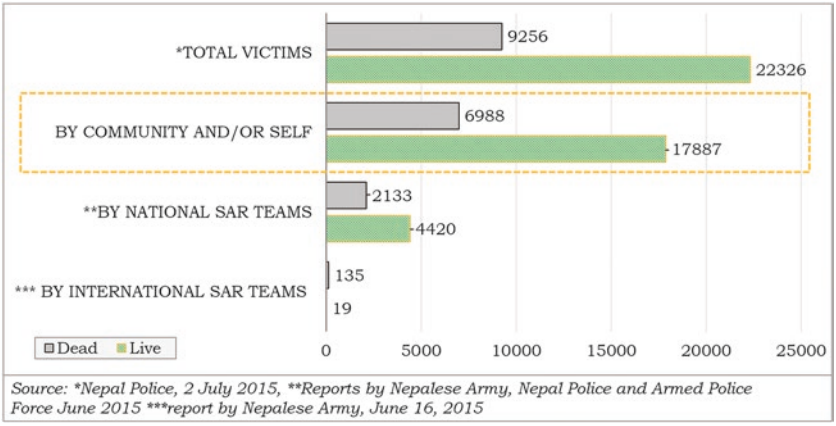

Fig. 2.6 Extricated victims and recovered dead bodies by different SAR teams (Source: Bret Lizundia et al. 2016)

of preparedness during which PEER helped embed the basic SAR skills in local and national responders.

Due to this foundation, national responders were able to assist the international urban search and rescue (USAR) teams because they understood international practices, guidelines, techniques and goals of searching for and rescuing victims using the safest techniques. It was obvious that the main difference in the work of the national teams and the international teams was the difference in access to equipment, mainly the heavy-duty and more sophisticated SAR equipment used by the international teams. Some national response teams worked independently on site and assisted the international USAR teams with their understanding of the context and environment. The performance of the national responders, notwithstanding the problems of logistics, was commendable (Fig. 2.6). Had the Gorkha earthquake occurred a decade earlier, the SAR efforts would almost certainly have been much less effective.

The Gorkha earthquake once again revealed the importance and usefulness of community SAR volunteer responders. It was clear that community volunteers are in fact the first responders and that they need to be trained in the programs listed earlier as well as in first aid. In addition, the earthquake revealed the need to train security forces from the private sector, including from tourism and business travel, industry, hotels, river rafting and so on, a lesson NSET has been propagating for two decades.

2.5 Conclusions

Throughout this chapter there has been an undercurrent of the painstaking and conscientious process to raise earthquake awareness, preparation and mitigation in Nepal. There have been a variety of actors involved on a national and international levels. All were necessary and helped Nepal be prepared. Much work remains to be addressed. Our message is that we will continue to work conscientiously in this manner, engaging with all actors who will help Nepal be a country that is aware of its hazard risks and the implications for its people, economy and social life.

Organised approaches in earthquake risk management in Nepal were triggered by the *M* 6.6 Udayapur earthquake and by the hazard and risk assessments undertaken for the formulation of the National Building Code. Subsequent assessment of the potential loss from a simulated earthquake in Kathmandu Valley and subsequent action planning to manage the losses identified helped raise earthquake awareness at the policy level. Initial efforts towards vulnerability reduction, such as the school retrofitting programme, demonstrated social and technical feasibilities that helped the gradual engagement of people and neighbourhoods in risk reduction initiatives. These initiatives were initially centred in Kathmandu Valley, but soon interest grew to other parts of the country.

Earthquake awareness increased significantly, especially at the community level in the past two decades. More and more municipalities and rural settlements started enforcing the National Building Code using incremental approaches for safety and guided by the policy and regulations that the central government promulgated over the years. An initial effort and success in the Kathmandu Valley in the late 1990s and early 2000s thus reverberated steadily throughout the country at varying levels of acceptance and action since that time.

These experiences greatly helped Nepal face the 2015 Gorkha earthquake sequence in the way it did: Communities provided neighbourhood-level support, and the government was prepared to handle international support in search and rescue and early recovery. In developing institutional and policy structures for reconstruction, and despite numerous economic and political problems, the country is trying to implement earthquake reconstruction and rehabilitation using internationally accepted approaches.

Working on a central level is essential. Working with the Ministry of Education and institutionalising a range of initiatives targeting schools and students will support Nepal long term. For example, the earthquake sequence showed the effectiveness of retrofitting school buildings in

Nepal. Almost all of the retrofitted school buildings were utilised during the earthquake response as emergency shelters, warehouses, health posts or as safe offices. This contrasts sharply with poor performance of the unretrofitted schools, including those located nearby to retrofitted ones. During the Gorkha earthquake, about 80% of the unretrofitted schools were damaged beyond repair.

Working on a municipal level is essential to implement the NBC. Through long-term engagement with some municipalities, NSET has been able to document substantive improvement in the number of plans approved that meet ERC guidelines, but more important, these plans have been implemented. This is a real success and indicates Nepal's municipalities can actually bolster the seismic performance of new buildings if they are provided with technical assistance for capacity enhancement, make improvements in municipal institutional structures and lastly, received support in policy and in the legal environment. In some cases, as of 2016, 75% of new residential construction is in compliance with the building code (up from 21% in 2012). The key lessons learned from 1998–2015 include (1) awareness raising, capacity building and enabling municipal policies are keys to success; (2) the institutionalisation of the building code implementation is a long-term undertaking in Nepal; and (3) working with champions at all levels of government and society helps institutionalise the process.

The government has recognised the value of earthquake preparedness and risk reduction and has declared mandatory compliance of the National Building Code for all construction in the country, rural or urban. This is a tall order and demands lots of effort in earthquake risk management and building code implementation in areas beyond the 31 districts affected by the Gorkha earthquake. It demands careful documentation of the lessons learned on the successes of the past and their usefulness as demonstrated by the Gorkha earthquake. It also requires policy and legal practices, including the National Building Code and working practices at the local level for smooth integration of earthquake risk management in governance and citizens' actions.

Following the earthquake, the central government made institutionalisation of the building code implementation at the municipal level mandatory and the governing councils of more than 50 of the 217 municipalities have accepted the necessity to enforce the NBC. In other locations, the local authorities are deciding how to interpret the NBC and how to manage implementation. Because most of the 217 municipalities are new entities as of 2015, they face a difficult task to implement the NBC with limited

financial, technical and human resources. External support is necessary to provide more support to a larger number of municipalities.

Nepal has gathered much experience and developed capacities as well as methodologies to face this challenge. The 2015 Gorkha earthquake sequence and the process of proper reconstruction will help internalise Disaster risk reduction (DRR) into the lives of the people, not only in earthquake-affected areas but also in areas vulnerable to the next earthquake.

Note

1. Nepal developed the NAP for disaster management based on a series of expert consultations, and the Nepal government presented the NAP to the UN World Conference on Disaster Reduction in Yokohama in 1994. The government of Nepal formally adopted the NAP in 1996.

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CHAPTER 3

The First 100 Hours: Emergency Response to the Gorkha Earthquake

Gopi Krishna Basyal

3.1 Context and Overview

On Saturday, 25 April 2015 at 11:56 a.m. local time, a magnitude (M_w) 7.8 earthquake struck near the village of Barpak in Gorkha some 80 km northwest of Nepal's capital, Kathmandu. Nepal had not faced a natural shock of comparable magnitude since the 1934 Bihar-Nepal earthquake 80 years earlier (NPC 2015). The main shock was followed by about 500 aftershocks with $M_w \geq 4.0$, of which four were greater than M_w 6.0, including one measuring M_w 7.3, which struck 17 days later on 12 May 2015 (NSC 2017).

The official records (NEOC 2015) show that over 8,790 people died and 22,300 people were injured as a result. The damage assessments after the earthquake showed that at least 498,852 private houses and 2,656 government buildings were completely destroyed; another 256,697 private houses and 3,622 government buildings were partially damaged (Fig. 3.1). In addition, more than 19,000 school classrooms were completely

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_3

Fig. 3.1 An example of the devastation in Kathmandu (Source: NSET)

destroyed and 11,000 were partially damaged (NRA 2016). It is estimated the lives of 8 million people, almost one third of the population of Nepal, have been impacted by this earthquake sequence. Out of 75 districts, 31 were declared affected and 14 were declared 'crisis hit' (Fig. 3.2) for the purpose of prioritising emergency rescue and relief operations (NPC 2015). The spatial distribution of building damage shows the devastation was more seriously concentrated in the northern mountainous districts of Gorkha, Nuwakot, Rasuwa, Sindhupalchok and Dolakha (Fig. 3.2).

As well, residential properties, historical buildings and settlements were also destroyed by the quake and aftershock sequences. The Department of Archaeology (DOA/GoN 2015) has listed a total of 743 historical buildings, including temples, gumbas, historic neighbourhoods and heritage sites, in the Kathmandu Valley and surrounding districts as destroyed or heavily damaged. The earthquake also had dramatic effects for the manufacturing, production and trade; agriculture; and tourism sectors. The initial estimates (NRA 2016) suggest reconstruction of damaged properties and infrastructure would require more than 669 billion rupees (US$6.7 billion).

More than 56% of fatalities from the earthquake were female, and there was a significantly higher percentage of the elderly and children killed, accounting for 17% and 28%, respectively (Fig. 3.3). This is similar to

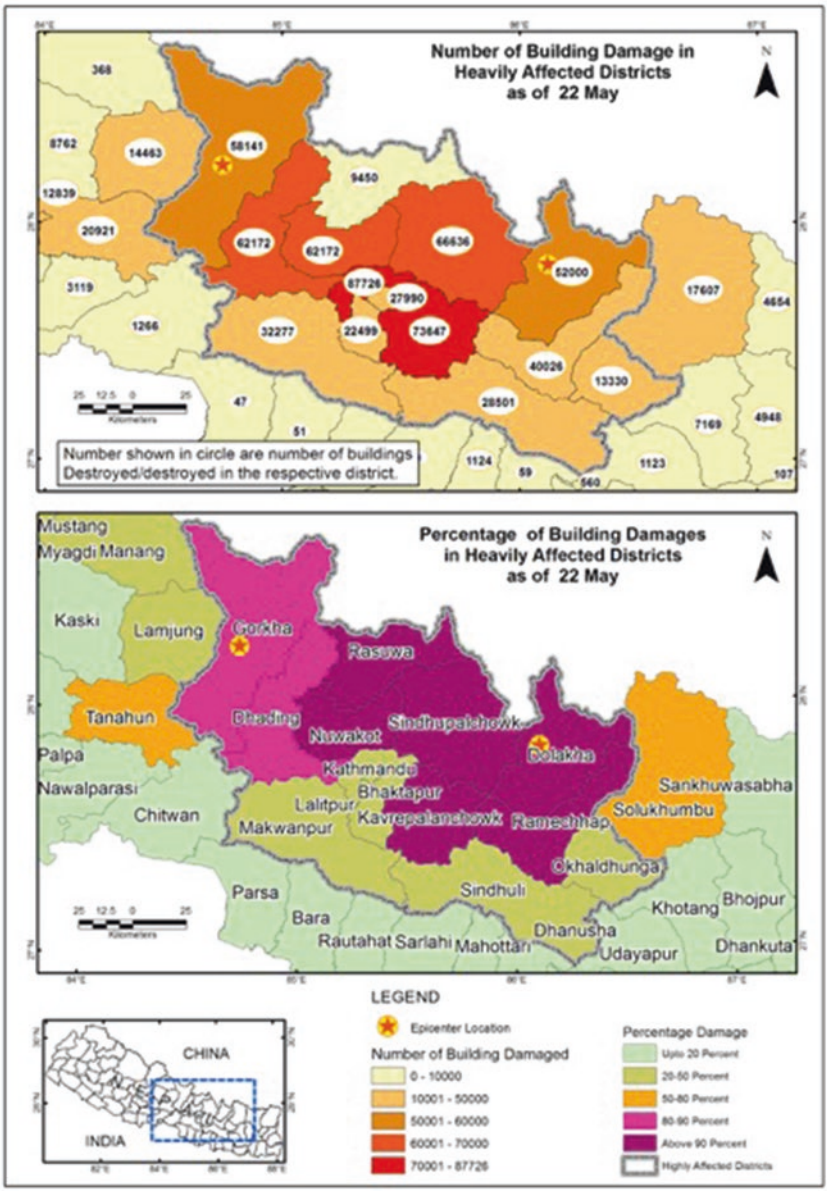

Fig. 3.2 Distribution of building damage in the 2015 Gorkha earthquake

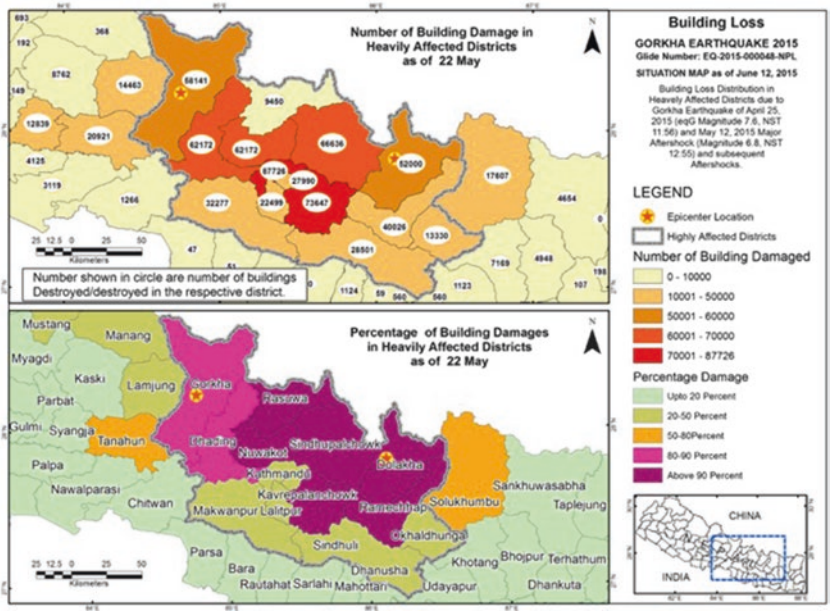

Fig. 3.2 (continued)

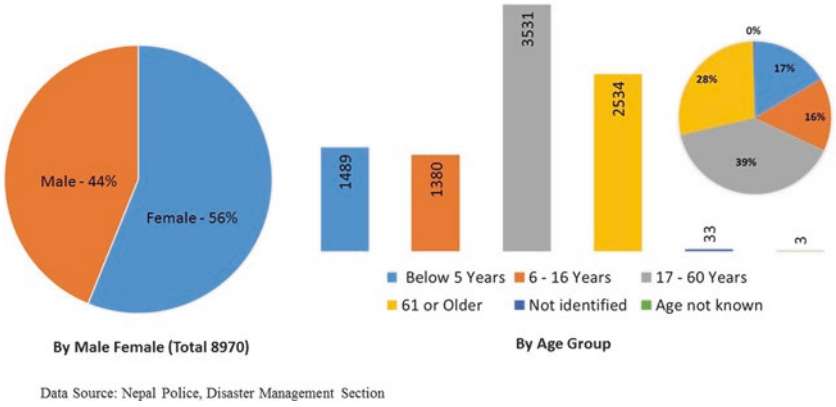

Fig. 3.3 Fatalities due to 2015 Gorkha earthquake disaggregated by gender (*left*) and age group (*right*)

reports from earthquakes elsewhere and highlights the extreme vulnerability of these sections of society and the special consideration required in search and rescue operations.

Besides large numbers of casualties, the earthquake resulted in a substantial amount of earthquake-triggered landslides and avalanches. Settlements and villages in Langtang Valley and the Mount Everest region were badly destroyed, and most of the heavily affected hill districts were also badly damaged by landslides (EwF 2015). Villagers from the worst hit districts suffered the highest impact from landslides and avalanches (NRA 2016), compelling people to evacuate temporarily to what in many cases were still unsafe locations.

Intensity maps for the earthquake (Fig. 3.4) show that the strength of shaking was quite variable throughout the affected area, with the most intense shaking occurring near the epicentre, where Barpak village was completely destroyed. Similarly strong shaking was experienced in northern Sindhupalchok district near the Chinese border, resulting in

Fig. 3.4 Intensity map of 2015 Gorkha earthquake based on ground surveys carried out by NSET (2016)

substantial damage and casualties in the villages of Tatopani and Dugnagadi (Murakami et al. 2015). In the Kathmandu Valley, shaking was strongest in the east, resulting in relatively greater damage in Bhaktapur than in Kathmandu itself. Nevertheless, the shaking in Kathmandu was still strong enough to cause substantial damage across the city.

3.2 Governance Structure for Emergency Response in Nepal

The Natural Calamity Relief Act 1982 (NCRA 1982) defines the role of Ministry of Home Affairs (MoHA) as the apex body for disaster management in Nepal. Under the Act, the Central Natural Disaster Relief Committee (CNDRC) forms the highest government response body under the chairmanship of the Home Minister and is made up of several representatives from various other ministries. Its ultimate goal is to formulate policies and programs related to disaster response and relief activities. The CNDRC is replicated at the regional, district and local levels, with the District Disaster Relief Committee (DDRC) being the most actively functional of the three; in practice, regional and local committees are rarely functional. The NCRA focusses primarily on response and relief activities after disasters happen rather preparedness activities before such events.

Several initiatives have been developed in Nepal regarding disaster risk management, response and preparedness in recent years, including the development of a national strategy, establishment of emergency operation centres at national and district levels, development of guidelines for district and local level disaster management plans and strengthening the preparedness and response within government, security forces and other institutional and community capacities. Among them, the 'National Strategy for Disaster Risk Management' (NSDRM), published by MoHA (2009), is the guideline for disaster management approved by the Government of Nepal (GoN). This provides strategic guidance for the different phases of disaster risk management in Nepal. Based on the NSDRM 2009, the GoN published the 'National Disaster Response Framework' (NDRF) in 2013 (MoHA 2013), which identifies the role and responsibilities of both governmental and nongovernmental stakeholders in disaster management and response. The NDRF developed the

coordination mechanism between national and international actors during the post-disaster emergency operations (Jimee and Lizundia 2016).

The National Emergency Operation Centre (NEOC) was established with responsibilities for coordination and mobilisation of emergency activities at the national level under MoHA in 2009. The NEOC has developed a standard operating procedure (SOP) and has a provision for periodical testing of the system. It is important that all security forces of Nepal—namely the Nepalese Army, Nepal police and Armed Police Force—have established separate disaster management sections with on-call responders within their organisations (NEOC 2016). The NEOC is also replicated in districts as the District Emergency Operation Centres (DEOCs). The DEOC coordinates among district-level stakeholders in disaster management, including representatives from the governmental district lead offices, Nepalese Army, Nepal police, Armed Police Force, nongovernmental organisations (NGOs) and the private sector.

Regarding local governance disaster management, the Local Self Governance Act (LSGA 1999) has established three levels of local government—district, village/municipal and ward. The act aims to empower local governments in undertaking disaster management activities at local levels (Dixit et al. 2013). The act envisions the institutional provisions for disaster risk management at the local level operating in conjunction with local stakeholders, including community organisations, local authorities and the general public. The LSGA has conceptualised the key role of communities in different phases of disaster management at the local level. Despite this, the resources required for the implementation of developing capacities at the local level has always been a concern. The lack of resources was quite visible and key during the response by the local authorities after the 2015 Gorkha earthquake. The local authorities were the first point of contact for local communities, who expected sufficient support from the governmental system, but in reality the capacity to respond was severely lacking. The lack of proper equipment for search and rescue was widely realised during the operation. The police force had only half a dozen drilling machines available (Adhikari 2015), and much equipment had to be borrowed from local private contractors. The DDRC had to request local farmers to provide agriculture tools to the police.

Broadly speaking, several stakeholders are active in disaster management in Nepal simultaneously within and outside the government framework. Key actors during the disaster response are the three security forces

who are coordinated by the NEOC. Each force has their own guidelines and frameworks for disaster response in the country. The composition of the CNDRC is mandated to include representation by security forces representatives, and further provisions are laid down in the act to form subcommittees for search, rescue and relief operations from central and district levels, where representation from security forces are also mandatory. The Nepal Red Cross Society (NRCS) and other local stakeholders are members of the committees from national to local level.

Despite the organised structure of the response system, there are several actors who do not represent any institutional affiliation, such as volunteer-based organisations, local volunteers and community members. Although not part of the government structure, these groups self-mobilised extensively after the Gorkha earthquake, particularly engaging in search and rescue (SAR). Hence the response activities after Gorkha earthquake involved a combination of national and international governments, nongovernmental organisations, communities and individuals.

3.3 Emergency Response to the Gorkha Earthquake

3.3.1 The Search and Rescue Operation

Under the framework as indicated in the NDRF (2013) and SOPs (MoHA 2015), the NEOC was immediately activated at the highest level following the earthquake. All concerned central authorities— including the acting prime minister, home minister, chief secretary, secretary of MOHA and security heads—were called for the first emergency meeting at the NEOC a few hours after the event. The central command post was established, and all the security forces were mobilised for SAR operations. In a following meeting with the CNDRC and the cabinet, the GoN decided to declare a state of emergency in all districts hit heavily by the quake. All chief district officers (CDOs) were instructed to call emergency meetings and mobilise for emergency response in their respective districts (Jimee and Lizundia 2016). In addition, an appeal was made for international assistance by the cabinet meeting in the same day.

Overall the response benefitted from the extensive preparedness and planning efforts undertaken in Nepal over the past few years (Sanderson et al. 2015). Within the central government, the CNDRC met two hours

after the earthquake with support from the NEOC. At the district level, clusters were activated quickly, and early efficiency was achieved through geographical divisions between relief agencies, supported by the DDRCs and implemented in collaboration with VDCs and ward-level citizen forums. Clarity on geographical divisions was intended to ensure extensive coverage of affected areas and to prevent duplication and gaps (Sanderson et al. 2015).

All security forces mobilised responders trained in medical first response (MFR), collapsed structure search and rescue (CSSR), water rescue and firefighting with some SAR equipment within two hours of the earthquake occurring (Jimee and Lizundia 2016). By 26 May, the Nepalese Army had mobilised 66,000 responders, the Nepal Police had mobilised 41,776 responders and the Armed Police Force had mobilised 24,775 responders (MoHA 2015). Despite the response, the immediate reach of these official SAR efforts by the government was limited to places nearby their operation centres and primarily focussed in urban areas (Jimee and Lizundia 2016).

In remote rural areas, the role of volunteer community responders became crucial in saving lives by mobilising SAR operations at the local level. However, in more urban areas and especially in Kathmandu Valley, there have been initiatives taken by different organisations such as NRCS and National Society for Earthquake Technology—Nepal (NSET) to train community members as first responders, but these activities are limited to particular areas and institutions (Jimee and Lizundia 2016), notably in the cities and locales with easy access to the road network. Hence, where the presence of trained SAR operators is minimal, such as in rural areas, community volunteer responders were the only actors, unless the security forces were able to reach the area. Such villages have no trained responders or prepositioned equipment; therefore, community members spontaneously worked to rescue victims using locally available tools and equipment (Jimee and Lizundia 2016). These untrained community members played vital roles by helping when the professional responders arrived at the scene, providing information, assisting in SAR and supporting logistical arrangements appropriate to the local context (Jimee and Lizundia 2016).

The only international airport in Nepal (Tribhuvan International Airport; TIA) was, fortunately, functional, so international SAR teams were able to arrive directly. The major road bridges into Kathmandu Valley had limited damage and remained functional, allowing SAR teams access areas throughout the valley. On the other hand, severe damage to roads in

hill areas were observed and resulted in limited access to the victims and communities outside of Kathmandu. Consequently, the majority of international SAR teams were focussed solely in the Kathmandu Valley.

The largest aftershock (12 May) caused substantial damage in the Sindhupalchok district, with the road connection to Kodari (the border crossing with China) seeing further damage. The district therefore faced a major obstacle in SAR operations and evacuation. Mobilisation of SAR teams and relief materials to the district by road was almost impossible. People self-evacuated to nearby safer places in the immediate aftermath and later to Kathmandu once access had been achieved. Many people fled to Kathmandu by walking along dangerous foot trails for many hours. In Chaku, for example, almost all of the houses were left abandoned until October 2015, and very few people returned until the following year. The internal displacement left the district almost entirely evacuated for several months, and the regaining of livelihoods has so far been slow.

Transportation has always been the key to success of SAR operations in any disaster. Because road networks into the Kathmandu Valley pass through landslide-prone mountain slopes, there are numerous chances for disruption of these routes, which could last for days or weeks. This has resulted in an acute storage of daily commodities within the valley (Dixit et al. 2013). Fortunately, the road to the Kathmandu Valley from the south remained functional; suffering only minor damage it remained a key access route into Kathmandu. However, north of Kathmandu, where the damage was concentrated, the remoteness, difficult terrain and poor weather conditions in addition to substantial road damage severely impeded the timely arrival of SAR responders. This delayed SAR response was visible in the success rate of lives saved (Jimee and Lizundia 2016). Consequently, evacuation and aid distribution in the worst hit areas of the Sindhupalchok, Dolakha, Dhading, Gorkha and Nuwakot districts was possible only by air, even for locations close to the main highways.

Over 41% of all lives saved occurred in the first 72 hours, before most of the foreign SAR teams arrived and became effective (NA 2015). Out of 22,326 injured people, just 19 victims were rescued by international SAR teams, and 4420 victims were rescued by national teams; the remaining 17,887 victims were rescued by either community responders and/or by self-rescue. Similarly, in terms of dead body recoveries, only 135 were recovered by international teams, compared with 2,133 by national teams, and the rest by community members (Jimee and Lizundia 2016). These statistics clearly demonstrate the importance of community members hav-

ing local tools and equipment available for undertaking effective SAR operations. International SAR team's response was primarily focussed on the heavy buildings, where modern equipment and skills are required for rescue operations.

These figures indicate the need for increasing the capacity of community responders by ensuring that community members have minimum SAR skills and that vital SAR equipment is prepositioned in strategic locations. The need for the comprehensive development of skilled volunteers—professional responders with skills and equipment—was widely noted after the Gorkha earthquake (Jimee and Lizundia 2016). The development of skilled responders should be aimed at the community level so the first responders can save the lives of people locally.

3.3.2 Relief Distribution

In terms of relief distribution in the aftermath of the earthquake, DDRCs, and thereby local-level municipalities/VDCs, assumed responsibility for coordinating and overseeing the distribution of relief materials in their respective administrative divisions. The responsibility of distribution of relief materials at the district level is assigned to the DDRC by default. However, because there are fewer local-level committees (Municipal and VDC level), the overall relief distribution coordination was led by the DDRC in the district as the 1982 Act outlines.

In early May 2015, the MoHA issued a direction that all humanitarian responders should follow a 'one door policy' for distribution of relief materials, reporting first to the district authorities as an entry point and then taking direction from them regarding where to work and whom to assist (Jimee and Lizundia 2016). As heads of the DDRCs, it is the CDOs responsibility to coordinate the distribution of these response and relief materials while also maintaining law and order in the district. In this way, the mechanism of the distribution of relief on the local level was mechanised. Fundamentally, local authorities played a vital role in the coordination of the earthquake response at this level.

In practice, it was almost impossible for the DDRCs to fulfil the gap at local level with the required resources. On the ground, volunteers distributing aid were common but were unaccounted for in the government mechanism. In addition, most aid and relief materials were distributed in roadside settlements, whereas villages far from road access were almost unreached, resulting in many people self-evacuating.

3.3.3 Shelters, Evacuation Sites and Relief Distribution

The earthquake was estimated to have displaced 2.8 million people (MoHA 2016). Following the earthquake, an immediate need in the most impacted areas was shelter (Khazai et al. 2015; Jimee and Lizundia 2016). Because of the effect on buildings, many people were unable to reoccupy the buildings in which they were living. Continuing strong aftershocks resulted in many people self-evacuating from their homes, even if the building had only minor or unnoticeable damage. This led to a high demand for temporary shelter. Tents and tarpaulins were scarce in the local markets from the very first night after the earthquake. Initially, the majority of evacuees moved to nearby open spaces and spent the night in open-sky shelters. Generally, people preferred to remain close to their houses because of security concerns and a desire to be close to their belongings. Numerous temporary shelters were visible in many neighbourhoods throughout the Kathmandu Valley as well as outside the valley.

On the second day after the earthquake, the GoN and NGOs started to distribute tents and tarpaulins as emergency shelters in affected areas (Jimee and Lizundia 2016). The demand was very high, resulting in even basic plastic sheets becoming scarce in local markets. Increased demand for materials, including bamboo poles and plastic sheets continued throughout the first week. With the continuous aftershocks, the demand shifted towards more durable semipermanent materials like corrugated galvanised iron (CGI) sheets for shelter construction. The efforts made from both the central government and the local market were not very organised and were insufficient to fulfil the demand. Only a very limited number of individuals were able to obtain some temporary shelter structures provided by local organisations (Jimee and Lizundia 2016; Khazai et al. 2015). The local government has very limited resources for such situations, and the local market cannot supply those demands even in the Kathmandu Valley. In rural areas the reuse of debris materials was repeatedly observed within a few weeks of the earthquake.

The UN Office for Coordination of Humanitarian Affairs (UN-OCHA) estimated that about 2.33 million people required temporary shelter immediately following the earthquake (UN-OCHA 2015). Three types of temporary shelters were observed: 1.58 million people were estimated to be located in ‘scattered sites’, consisting of fewer than 5 households on the land of their damaged house(s) or nearby in open spaces; 117,700 were in ‘spontaneous sites’, consisting of 5–50 households on public or privately

owned land without official support; and 636,000 were in 'hosted sites', with 50 or more households with official support in designated public spaces (UN-OCHA 2015). Consequently, the vast majority of evacuated people did not have direct access to organised and designated shelters.

Within these shelters, internal tensions began emerging in two ways. First, people initially were grateful for whatever help could be provided, but over time resources became scarce and continuous aftershocks restricted people's ability to move back to their original houses. This led to people becoming increasingly frustrated with the amount of support they were being afforded. Second, aid distribution was concentrated primarily on roadside locations, leaving people in remote areas increasingly dissatisfied with the response. In this way, many internally displaced people had issues with the lack of uniformity in shelter facilities and the seemingly preferential treatment of easy-to-access roadside communities at the expense of more remote communities.

Before the earthquake, in 2013, the GoN identified and declared 83 open spaces for evacuation sites and shelter purposes (GoN 2013) in the Kathmandu Valley. This declaration of open spaces was focussed on the need of evacuation sites to provide humanitarian assistance to the victims during the response. In addition, there were more than 887 public open spaces identified and mapped within Kathmandu Valley that could potentially be used as evacuation sites in case of a major earthquake (KVDA 2015). However, the evaluation of usage of such places had yet to take place at the time of the 2015 earthquake. In general, it has been observed that most of these areas were used by locals and managed by different stakeholders to help victims.

During the response phase, the UN Shelter Cluster system was activated and coordinated through the relevant DDRC agent. As an immediate support, the GoN decided to provide 5,000 Nepalese Rupees (about US$500) per family to those whose house had been completely destroyed, and 3,000 Rupees (US$300) per family to those with partially damaged homes. However, for distribution of relief materials, the GoN, instituted a one door policy through the DDRC, but the effectiveness of such initiatives were rarely fulfilled. Many organisations, individual donors and volunteer groups independently provided shelter materials and supported displaced people directly in many cases (Jimee and Lizundia 2016). Many families preferred living in individual shelters rather than staying in formal group shelters, where basic facilities such as water, food and sanitation were essentially lacking. Individual shelters made by families were often

constructed using materials salvaged from the damaged buildings and properties in rural areas, primarily wood and CGI sheets. There was far less use of salvaged materials in urban areas, where the primary building materials are brick and stone.

For individual support, the GoN provided 40,000 Rupees (US$4,000) per fatality for each family and 2,000 rupees (US$200) per person per family for immediate food support (MoHA 2015). In some locations, food stores were buried under rubble, resulting in scarcity in many areas. Due to road blockages, many villages were disconnected from the rest of the country, and worries about food security and other basic supplies were quite visible. The Earthquake Engineering Research Institute (EERI 2016) rapid response team discovered the use of 'earthquake go bags', containing some food and other emergency supplies, in Kathmandu Valley were very helpful in survival for first two days (Jimee and Lizundia 2016). Outside the valley few people had such emergency supplies ready.

3.4 From Response to Preparedness

Despite many difficulties, the GoN had taken steps before the earthquake to prepare the country for an expected event. While the NCRA 1982 provided grounds for the formation of disaster relief committees at different levels of the government, the NSDRM 2009 was developed to help reduce risk arising from such disasters. This new strategy identifies and prioritises preparedness as the key activity, whereas previous legislation was more focussed on response. In connection with this, the Nepal Risk Reduction Consortium (NRRC) was launched by the Government of Nepal (GoN) in 2011 as envisioned in the NSDRM. The consortium brought national and international actors together in conjunction with the GoN in supporting Nepal's disaster preparedness efforts. Among the Flagship programs under NRRC priorities, Flagship 2 has been focussed on increasing the GoN's emergency preparedness and response capacity to the devastating effects of disasters at different levels. In such a way, Nepal's priorities have changed focus from response after an earthquake to preparedness initiatives before such an event.

3.5 Conclusions and Recommendations

In recent years, several initiatives in Nepal regarding earthquake preparedness and response have been undertaken that have resulted in significantly increased earthquake preparedness and capacity building in Nepal

(Jimee and Lizundia 2016). Within the security forces, this has been significantly enhanced by focussing on training medical first responders (MFR), collapsed structure search and rescue (CSSR), community search and rescue (CSAR) and basic emergency medical response (BEMR). In addition to these efforts, similar capacities have also been enhanced at the community level, though the organised mobilisation of these groups has yet to be framed. The current initiatives—disaster preparedness and response plan (DPRP) and local disaster risk management plan (LDRMP) guidelines focus on community preparedness by developing search and rescue capacities and developing local responders and evacuation plans from local to district levels.

The primary difficulty faced in response to the Gorkha earthquake was coordination among different actors, including multinational teams and various authorities within the Nepalese government. Under the existing disaster management system, the MoHA assumes overall control of all the rescue and relief operations after a major disaster; however, experience has shown that this may not always be the best practice. At times of major disasters, when several ministries and government departments must be involved, this can lead to confusion in terms of leadership and coordination. Based on lessons from the 2015 earthquake, the current institutional system of disaster response requires urgent reformation to avoid such problems in the future.

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CHAPTER 4

Health and the Nepal Earthquake: Ways Forward

Ramjee Bhandari, Chandika Shrestha, and Shiva Raj Mishra

4.1 Introduction

Chapter 1 highlights the multidimensional nature of disasters such as earthquakes; in particular, the health sector receives pressure from the time of the incident and continues for a relatively longer period of time during the aftermath. Acute and long-standing health impacts are common occurrences after an earthquake and require robust preparedness and timely management. In this chapter, we explore the direct and indirect influences of the Gorkha earthquake in the overall health and well-being of the population and the challenges faced by the health system in the post-earthquake period. The chapter further proposes a multivariate spatiotemporal risk factors model that explores the different determinants of health and well-being from a health geographers' (public health) perspective. We also provide a brief account on the possibilities in Nepal's healthcare system following the three major events: the earthquake, newly adopted political system and the wider global commitments.

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_4

4.2 The Acute Health Impacts: Damages and Losses

Health was the most severely impacted sector, as evident from the number of fatalities, injuries and, on top of it all, the devastation of the healthcare infrastructure. The earthquakes caused 8702 deaths and 22,000 injuries. Meanwhile, 462 healthcare facilities were completely destroyed and another 765 health institutions were partially damaged (National Planning Commission 2015). The vulnerable populations in resource poor setting experienced heightened risk of both acute and chronic health complications.

The relief and recovery operations were initially concentrated in and around the capital city (The Guardian 2015). The hard-to-reach areas in the mountains and the hills had to wait a longer period of time before they received the first round of basic supplies, including healthcare. The delay in rescue and emergency healthcare was partly the reason for higher reported deaths and fewer injuries in remote districts compared to more accessible urban districts. More than two thirds of the total deaths and one fifth of total injuries were in four remote districts—namely Rasuwa, Nuwakot, Dhading and Sindhupalchok. These districts have difficult geographical terrain and poor or almost nonexistent road networks. The figures are almost opposite for the three districts in the Kathmandu Valley (Kathmandu, Bhaktapur and Lalitpur), which have easier access to all kinds of health facilities, including tertiary care units (see Table 4.1).

Table 4.1 Deaths and Injuries in the Severely Affected Districts

Districts	*Total Households*	*Total Population*	*Deaths*			*Total Injured*	*Health Facilities Damaged*	
			Male	*Female*	*Death*		*Fully*	*Partially*
Sindhupalchok	66,688	287,798	1557	1996	3553	1569	74	23
Kathmandu	436,344	1,744,240	623	605	1228	7950	11	52
Nuwakot	59,215	277,471	466	643	1109	1050	55	44
Dhading	73,851	336,067	293	386	679	1218	69	37
Rasuwa	9778	43,300	312	344	656	771	21	6
Gorkha	66,506	271,061	215	234	449	952	40	39
Bhaktapur	68,636	304,651	119	214	333	2101	5	20
Kavrepalanchok	80,720	381,937	129	189	318	1179	55	76
Lalitpur	109,797	468,132	71	109	180	3051	19	20
Dolakha	45,688	186,557	90	86	176	662	52	31
Ramechhap	43,910	202,646	18	24	42	134	33	33
Makwanpur	86,127	420,477	16	17	33	229	39	20
Sindhuli	57,581	296,192	5	10	15	230	15	44

Source: Nepal Earthquake 2015: Disaster Relief and Recovery Information Platform

Immediately following the disaster, there was an increased risk and threat of a major epidemic outbreak. Disrupted disease control programs, population displacement, appropriate environmental conditions for the vectors to breed and inadequate hygiene and sanitation-related provisions were all favourable factors contributing to a possible epidemic outbreak (Basnyat et al. 2015; Asokan and Vanitha 2016). Fortunately, Nepal did not witness any major disease outbreak during the post-earthquake period (Basnyat et al. 2015; Regmi et al. 2016). This can be linked to the government's initiative of establishing an early warning response and alert system and strengthening the disease surveillance system to check for any communicable disease outbreaks in the most affected districts.

4.3 The Long-Term Health Impacts

The long-term health and well-being of human society have always been susceptible to natural events. A number of studies have documented the wide range of substantial and prolonged psychological and physical health impacts of disasters (natural or man-made) (Adams et al. 2002; Norris et al. 2002; Kokai et al. 2004; Novick 2005; Adams and Boscarino 2005; Dirkzwager et al. 2007; Bich et al. 2011). As Landry et al. (2015) argue, access to tertiary care and advanced medical care after the Gorkha earthquake helped save many, but in the meantime, a population group with complex and long-standing health conditions was created: people with physical and mental health disabilities. Such patients need special care for an extended period of time, in most cases life long. A report published by Handicap International (an international nongovernmental organisation; INGO) shows that more than 6000 injured survivors received rehabilitation and almost 4000 assistive devices and mobility aids, including crutches and wheelchairs, were distributed (Handicap International 2016). When contrasting these numbers with the total injured cases throughout the country, a relatively high proportion of long-term physical disabilities can be noticed. In addition, it is highly likely there is an unequal distribution of the physical disabilities, with the remote districts bearing the higher shares.

Apart from physical disabilities, exacerbation of pre-existing or development of new mental health conditions (such as anxiety and depression) are the usual phenomena after a disaster of this extent. Considering the sociocultural and healthcare settings of Nepal, Thapa (2015) argues that these mental health problems are going to last for a longer period than usual. Management of long-standing mental health issues is a grave challenge for a country like Nepal, where integration of mental healthcare into

the existing primary healthcare network has not so far been completed (Luitel et al. 2015). A study conducted in three of the most affected districts of Kathmandu, Gorkha and Sindhupalchok revealed a third of the general members of the community had developed depressive symptoms and almost the same proportion had issues of anxiety in the aftermath (Antigua et al. 2015). The same study found people living in remote and rural areas, those belonging to lower caste/ethnic groups, females and the elderly were more vulnerable to poor mental health outcomes.

4.4 Earthquake and the Risk Factors Theory

In this section, we explore the geography of health and well-being in the Gorkha earthquake scenario. In doing so, we propose a multivariate risk factor model to explain why a certain segment of the population is more at risk of developing poor health outcomes. We will shed light on these risk factors by dividing them into three time frames—pre-earthquake, during earthquake and post-earthquake. The proposed risk factors model can help develop necessary interventions to address postdisaster health and well-being needs. The model is process based and highlights that health and well-being can be more contextualised than individualised. It further signifies the spatiotemporal variations of the risk factors.

4.4.1 Pre-Earthquake Factors

The individual-level and environmental pre-existing factors are crucial in determining the health outcomes following a disaster. These factors can be theorised as compositional and contextual determinants of health inequalities (Cummins et al. 2005). We believe the pre-existing compositional and contextual factors may predict the physical and mental health outcomes of the population.

Compositional Factors Factors such as sociodemographic characteristics, pre-existing health conditions and prior life events can be linked to the postdisaster health outcomes. Several studies have explained that women, the elderly, the disabled and children are the most vulnerable groups during the time of disasters (Lewin et al. 1998; Mason et al. 2010). When we look at the mortality statistics, in almost all districts death counts of females were higher than their male counterparts (see Table 4.1). Household economic status is another key determinant of health and well-being after a

disaster. In Nepal, people with better incomes have access to better housing facilities compared to lower-income citizens who are forced to live in mud and brick houses. (See Chap. 7 for demographic distinctions of risk factors and impacts from an anthropological perspective.)

Also, people with pre-existing physical and mental health problems are more at risk of being adversely affected by earthquakes. For example, people with reduced mobility could face life-threatening circumstances, which can get worse when building codes and accessibility arrangements are not the priority. There is a clear intersection of disability and social exclusion in Nepal, where people with disabilities are more likely to be socially excluded. This in turn puts them at a higher risk of developing poor mental health outcomes, compared to the general community and those without disabilities (Lord et al. 2016). Apart from this, pre-existing mental health problems can exacerbate existing illnesses due to decline in health-seeking behaviour and self-care during the time of emergencies.

Contextual Factors The pre-existing contextual factors are again key to the losses and damages after a disaster. It is evident that earthquakes don't kill people, the collapse of buildings does, which highlights the significance of the physical and sociopolitical environments. Inadequate attention given to building codes and earthquake preparedness is a key contextual factor in Nepal that can be linked with the excess damage. The presence of a hazardous environment, such as unsafe buildings/structures (unplanned urbanisation and crowded households), increases the risk and vulnerability of people who could be exposed during the time of disaster. Likewise, in the sociopolitical sphere, policies, plans and strategies related to disaster preparedness play crucial roles. The pre-existing earthquake preparedness activities were mostly targeted to urban areas, and little was done in the rural parts of the country, though this may not be the only reason rural areas suffered more damage than urban areas in terms of lives lost and the per capita disaster effects (Nepalese rupees/person) (National Planning Commission 2015).

4.4.2 During Earthquake Factors

We suggest two broad categories of factors that have potential health and well-being effects during a disaster.

Exposure Exposure to a disaster leads to a matrix of events that, in due course, determine the health and well-being of exposed people. Immediately following a disaster such as an earthquake, practising self-protective actions can help minimise the risks. Kirschenbaum et al. (2017) highlighted the protective role of preparedness and appropriate actions in an earthquake experience, linking to the contextual factors explained in the previous section. Meanwhile, the moment of exposure is when the injuries can occur or lives could be lost. This exposure can have possible physical and mental health impacts, both acute and long-term. Elements of trauma exposures such as physical injury, the death of loved ones and threat to life could induce mental health issues (Freedy et al. 1993).

Care and Support The immediate care and support, including first aid and life-saving measures, are important strategies to promote health and well-being. Evacuation and transfer of the vulnerable to a safer location are key actions. Social support, usually provided by family, friends and society can usually help address acute mental health issues, such as fear and anxiety. Compared to the first earthquake on 25 April 2015, social support was stronger and more effective during the second earthquake on 12 May. People were more aware of what to do and what to expect during the second incident.

4.4.3 Post-Earthquake Factors

Following the earthquake and during the recovery period, complex risk factors that influenced health and well-being before the earthquakes were carried over to the post-earthquake period in Nepal. Most of the post-earthquake factors that determine health outcomes are sociopolitical and environmental in origin.

Secondary Environmental Factors Following the earthquakes, secondary hazards such as landslides and avalanches hit the mountain and hilly areas of the country, thereby causing more pressure in supplying rescue and relief materials to the hard-to-reach regions in the north of the country (Paul et al. 2017). Adverse weather conditions were also responsible for delayed rescue and relief operations (Sharma 2015a).

Ongoing Experience and the Sociopolitical Context Availability of social care and support is an important predictor of health and well-being after any disaster (Benight and Bandura 2004; Kaniasty 2012). Following the earthquake, the government activated the highest level of emergency response, known as the National Emergency Operation Centre (NEOC) at the fourth level, which was guided by the Natural Calamity Relief Act 1982 (for more details, see Chap. 6).

To manage the health service needs, the Health Operation Centre (HEOC) was activated, which coordinated the different health-related clusters—district level health clusters delivered emergency health services, water, sanitation and hygiene (WASH) clusters looked after water and sanitation issues in affected districts and nutrition clusters managed nutritional assessment and supplementation activities. To meet the healthcare needs, 4000 government and private health workers were mobilised (Paul et al. 2017). All tertiary hospitals in Kathmandu Valley were functional, yet overwhelmed. The World Health Organisation has acknowledged these efforts saved many lives, despite having the pressure—in terms of resources and service need (UN News Centre 2015). In contrast, health facilities in the rural districts suffered substantial damage causing inadequacy in healthcare (see Table 4.1). The primary healthcare network responsible for regular public health programs such as immunisation and maternal and child health services were disrupted (Simkhada et al. 2015).

The Gorkha earthquake displaced over 450,000 people and thousands now live in dismay, many of them with long-term health problems. Loss of personal resources (properties and possessions) and social resources (family members, economic opportunities) has placed the affected at a heightened risk of having negative health consequences. Relief and recovery operations were mostly concentrated at the urban and easy-to-reach areas, leaving the remote villages in the dire need of basic supplies and medicine. The displaced population was forced to live in temporary shelters and many continue to live in temporary shelters because of the almost-stagnant reconstruction work. Ineffective governance and lack of coordination between the agencies resulted in a delayed and ineffective response (Paul et al. 2017). The survivors faced two harsh monsoons and almost two severe cold seasons in shelters, without basic support services.

The political deadlock on drafting the new constitution was resolved immediately after the earthquake sequence, and the new constitution was promulgated within five months of the earthquakes. Analysts explained

earthquakes acted as a trigger to speed up the constitution drafting process, ending decade-long contentions over issues among Nepal's major political fractions (Sharma 2015b; Watson 2017). However, dissatisfaction of India grew over the new constitution, unfolding an entirely man-made disaster: a five-month-long blockade at the Indian border (Budhathoki and Gelband 2016) (see Chap. 8 for further reflections). The health and social sectors were hit by the blockade, resulting in delayed reconstruction of health facilities and depletion of stocks of medicines. After the fuel supply diminished, ambulance and emergency vehicle services were temporarily halted. Private transport became difficult, leading to overcrowded public transportation, which can be linked to the increased traffic accidents during that period (Nielsen et al. 2016). Shortage of cooking gas resulted in the use of traditional and unclean fuel and biomass, such as wood, with long-term health and environmental consequences, which could be another area of research. Budhathoki and Gelband (2016) have argued that the blockade risked the achievements Nepal made in maternal and child health and other disease-control programs.

4.5 Looking Forward

Going towards the recovery, the government of Nepal is taking a big stride for universal health coverage (UHC). Nepal's move towards UHC is slow; however, it got impetus from the recent decision by the government to roll out health insurance in 25 districts and to exempt the poor from paying fees for at least eight diseases (Ministry of Finance 2016). This is an important milestone, which is still fraught with many challenges, the same with earthquake recovery. Concerns have been raised about inadequate financial and technical resources, in addition to the contradiction in policy of simultaneously removing fees while introducing insurance. The potential revenue generation for health insurance from private pockets is not substantial compared to the need. In 2014, even before the earthquakes, about 50% of the national health budget was contributed by donors (Giri et al. 2013). Further, the billion-dollar damage to the economy and the partial or complete destruction of significant number of health facilities should not be forgotten (Sharma and Mishra 2015). On the positive side, a $4 billon commitment for investment in reconstruction and an increased commitment in rebuilding from the international aid community seem promising and offer a glimpse of hope. However, UHC cannot be sustained on foreign aid.

The mammoth task of strengthening the health system, which was forgotten in the two years after the earthquakes, needs due consideration. Rebuilding, health insurance coverage, decentralisation of the health system and governance all should start from the federal level and move to the local level. Needless to say, the future UHC structure should also address a growing burden of noncommunicable diseases in Nepal, and for that to happen, the programme has to be intertwined with existing efforts in recovery. Donors in the context of Nepal have a special role to nudge policy makers to focus on building health-promoting houses, cities and villages; continuing health system strengthening; sharing cross-country experiences; and training and capacity development for measuring progress towards recovery (Bump et al. 2016).

4.6 Conclusions

Nepal is vulnerable to a variety of disasters, both natural and man-made, each of which inflicts damages and losses. The scale of these (as accounted for in terms of lives lost and the economic damages) was the largest ever recorded and has brought Nepal's meagre preparedness into the limelight. Thinking positively, we can take disasters as an opportunity to update our knowledge and practices so we stay well prepared for the future. Also it provides a window of opportunity to strive further for universal health coverage amid the changing political climate, which is conducive for health reform. Following the two earthquakes, unprecedented incidents unfolded, such as landslides hindering the delivery of relief workers to remote areas, political instability and the border blockade that halted supply and distribution of basic commodities and medicine. All these incidents invariably impacted the general health and well-being of exposed people. The poor health outcomes among those affected can be explained by a set of proximal and distal risk factors, which we divided into pre-earthquake, during earthquake and post-earthquake. These factors need to be understood before any recovery and rebuilding start, and essentially they should be considered for every response effort. Further, the extent of damage to health facilities signifies the necessity of following stringent building codes (as identified in Chap. 2) during the reconstruction process. Had there been earthquake-resistant and well-prepared health facilities, the negative health impacts would have been considerably less; rebuilding codes should be enforced. Last, but not least, for building back better health, Nepal will need to focus on rebuilding the old structures

into smart and health-promoting cities and developing a resilient health-care system that is prepared to address not just the emergency health needs but also the long-term needs and not just in urban and easily accessible areas but in every corner of the country.

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CHAPTER 5

The Science of Earthquake Forecasting: What's Next for Nepal and the Himalayan Region?

Sanchita Neupane

5.1 Introduction

When my grandmother narrated the story of her survival during the 1934 earthquake to me as a child, I was left with the perception that earthquakes are supernatural events that happen when Lord Shiva, the deity of destruction, becomes angry. Such an understanding is common among many Nepalese who have little access to scientific knowledge and for whom the power and scale of earthquakes makes sense only as the rumblings of an angry god. For most Nepalese, therefore, earthquakes are random, unforeseeable occurrences that can be prevented only by maintaining the calmness of the gods they worship. But since the development of plate tectonic theory in the 1960s, science has progressed in understanding the processes of earthquakes and forecasting when and where they are likely to occur. This chapter is an attempt to use basic scientific understanding of earthquake processes to analyse the historical data and look at future earthquake risk in

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_5

Nepal. The chapter deals with the importance of the history of natural hazards for better preparedness by trying to understand the pattern of earthquakes in Nepal. Paradoxically, it also discusses the reasons we cannot rely only on the theory of probabilistic forecasting and that despite the knowledge we have acquired, a future earthquake can defy identified patterns.

Identifying the source of a hazard and understanding the magnitude and frequency of a hazard form integral parts of disaster risk reduction. The forecasting of how often (frequency) and how severe (magnitude) earthquakes happen in a region contributes essential information for preparedness policies and practices, such as developing stringent building codes, emergency planning, and awareness campaigns. It is unequivocal that earthquakes are unpredictable, meaning we cannot say when, where, or with what magnitude an earthquake will occur. Nevertheless, statistical tools can provide us with forecasts that form the basis for preparedness by telling us how likely an earthquake is within a specific time frame across a specific area. This allows us to say with some confidence, for instance, what the likelihood of an earthquake occurring in Nepal is in the next 50 years. Such information is critical for preparing for future disasters.

This chapter begins with a discussion of the tectonics of Nepal and the reasons behind the Gorkha earthquake. Then the chapter turns to the science of earthquake forecasting to calculate how likely the Gorkha earthquake was, and thus whether it could have been anticipated, and the probability of future earthquakes in Nepal and the wider Himalayan region. Because earthquakes are complex spatiotemporal phenomena that cannot be understood by observing one event in isolation from others, further analysis is undertaken to try to understand the temporal and spatial dimensions. Finally, a sensitivity analysis highlights the limitations of such forecasts, and the results are discussed and compared with the available literature on previous investigations for the region.

5.2 Himalayan Seismicity

The seismicity in the Himalayan region, which extends from Bhutan to Pakistan, is due to the subduction of the Indian plate under the Eurasian plate at an average rate of 20 ± 3 mm per year (Bilham et al. 2001). This subduction accumulates an average slip potential of 2 m every century along the Himalayan arc, approximately the same amount of slip generated in the Gorkha earthquake. In some regions of the Himalayas, an earthquake has not occurred for more than 500 years, meaning more than 10 m of slip has accumulated (Bilham and Ambraseys 2005).

The 25 April earthquake ruptured the Main Himalayan Thrust Fault north of Kathmandu, unzipping for 140 km to the east (Avouac et al. 2015). Geodetic measurements from radar and optical images show that the 2015 earthquake rupture was buried for its entire length, with no evidence of rupture reaching the surface (Elliott et al. 2016). Previous major earthquakes in Nepal were recorded in 1803, 1833, 1897, 1905 and 1934, but before about 1800, dates for earthquakes are less well known. The 1833 earthquake had a magnitude (M) of 7.6 and was the last earthquake to occur in the same region as the Gorkha earthquake (Elliott et al. 2016; Avouac et al. 2015). Paleoseismic evidence of surface rupture is available for other significant earthquakes, such as the 1934 Bihar-Nepal earthquake (Avouac et al. 2015). However, the uncertainties in the slip estimation for this event range from 2 to 6 m, suggesting a highly uncertain recurrence interval (Bilham et al. 2001). Thus many previous Himalayan earthquakes remain ambiguous regarding the amount of slip they sustained and thus also in terms of their magnitude.

5.3 Data

Data herein have been taken from the U.S. Geological Survey (USGS) earthquake catalogue for Nepal between 1964 and 2015. The Global Seismic Hazard Assessment Programme (GSHAP) considers 1964 as the beginning of the era of modern instrumentation and for forecasting; only earthquakes recorded since this date are considered for Nepal. Despite the USGS database listing some earthquakes in Nepal as far back as 1911, records before 1964 are considered incomplete. This agrees with the national catalogues maintained by National Society for Earthquake Technology—Nepal (NSET), which are also considered incomplete before the 1960s (NSET 2015). In total, 419 earthquakes of a magnitude greater than or equal to 4 were considered in this analysis.

5.4 Methodology

The analysis herein used the Gutenberg-Richter magnitude–frequency relationship (Gutenberg and Richter 1956) to estimate the time-independent probability of earthquakes occurring in the Himalayan region. The aim of this approach is to estimate the likelihood of earthquakes similar in size to the Gorkha earthquake as well as how frequently such earthquakes can be expected to occur.

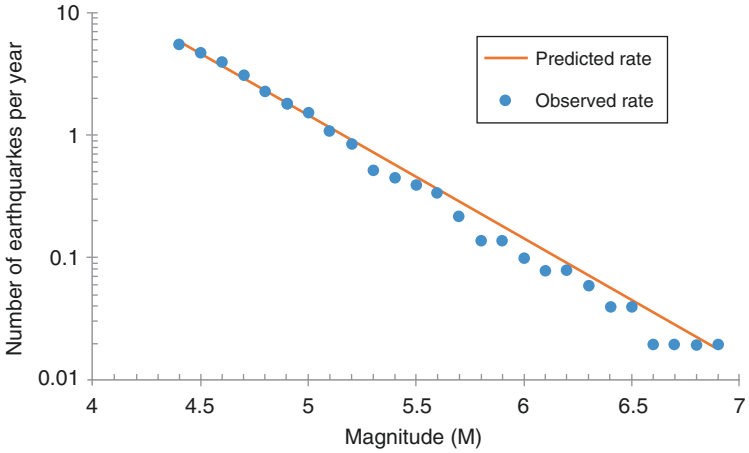

Fig. 5.1 Plot showing the frequency of earthquakes with different magnitudes in Nepal since 1964 along with the calculated best-fit line. The magnitude at which this best-fit line has a frequency of 1 represents value *a* in the Guttenberg-Richter law, and the slope of the line represents value *b*

The temporal distribution of earthquakes in any part of the earth tends to follow the Guttenberg-Richter law (Fig. 5.1), according to which the cumulative number of earthquakes with magnitude greater than or equal to some given magnitude, *M*, is given by the following equation:

$$\log N\left(M_w \geq M\right) = a - bM \tag{5.1}$$

where N represents the number of earthquakes whose recorded moment magnitude, M_w, equals or exceeds M, and a and b are constants representing the intercept (that is, where the forecast rate equals 1 per year) and slope of the best-fit line, respectively. The global mean value of b is generally considered to be 1 (Richter 1958) and is the main parameter defining the seismicity of a region. This equation can be rewritten as

$$N = aM^{-b} \tag{5.2}$$

which is more commonly known as the earthquake power law (Clauset et al. 2009). However, this distribution holds true only within a certain

range of magnitudes; it begins to break down for earthquakes with $M> \sim 8.0$ due to the relative infrequency of such events in the global historic records.

Plotting a best-fit line to the data for Nepal gives the forecast rate (R) of an earthquake of certain magnitude, given by the following equation

$$R = 10\,\hat{}\,(a - bM) \tag{5.3}$$

The values of a and b were thus calculated using a least-squares method of data fitting, which minimises the sum of squared residuals. The residual value is the difference between the fitted value and observed value. The data show apparent power law behaviour from M 4.4 to 6.9 and the values of a and b are calculated as 5.174 and 1.002, respectively (Fig. 5.1).

The probability of at least one event with a given magnitude occurring within a time period, n, also known as the exceedance probability (p) can be calculated:

$$p = 1 - (1 - R)^n \tag{5.4}$$

This allows the return period (T) of an earthquake of the same magnitude to be calculated using the Weibull distribution, which is the inverse of the exceedance probability:

$$T = 1 / p \tag{5.5}$$

Thus by using observed earthquake data from Nepal since 1964, it is possible to calculate how likely the occurrence of an earthquake of given magnitude is over a specific time period as well as how often that earthquake is expected to occur.

5.5 Forecasting the Gorkha Earthquake

5.5.1 How Likely Was the Gorkha Earthquake?

The time-independent probabilities of the Gorkha earthquake were calculated using the best-fit line shown in Fig. 5.1 and Eqs. 5.1, 5.2, 5.3, 5.4 and 5.5. At the end of 2014, the probability of an earthquake with $M \geq 7$ occurring within the next 10 and 20 years (that is, before 2024 or 2034)

were 13.47% and 25.12%, respectively. Similarly, there was a 79.6% and 95.1% chance of an earthquake with $M \geq 6$ occurring in the Nepal within the same time period. This analysis of historical data suggests that the Gorkha earthquake was a reasonably likely event and highlights how prone Nepal is to earthquakes. An earthquake of magnitude greater than 7 should therefore not have come as a surprise.

5.5.2 When Is It Likely to Occur Again?

To calculate how long it is likely to be before another earthquake similar in size to the Gorkha event occurs, the 2015 earthquake must be included in the original data. Using the Weibull equation (Eq. 5.5), the return periods for an earthquake with $M \geq 6$ and $M \geq 7$ occurring in Nepal are found to be 7 and 66 years, respectively. This suggests that at least two earthquakes similar to the Gorkha earthquake can be expected to occur in an average Nepal citizen's lifetime, while smaller, but still potentially damaging M 6.0+ earthquakes should be expected to occur at least once every decade.

5.6 Return Period Variability

5.6.1 Spatial

The forecasts given earlier for the whole of Nepal are now compared with forecasts for the whole central Himalayan arc and also the smaller central region of Nepal. This allows for an analysis of how return periods vary, depending on the size of area considered. Expanding the data used earlier to include all earthquakes within the Himalayan arc since 1964 identifies 2631 earthquakes. Similar to the analysis for the whole of Nepal, a power law was fitted to these data, and the a and b values calculated were 6.33 and 1.05, respectively. Similarly, by narrowing the data coverage to include only the 93 earthquakes since 1964 in central Nepal, which makes up one third of the total area of the country, the a and b values were 4.67 and 1.04, respectively.

The effect of these different a and b values on the return periods of earthquakes with $M \geq 7$ is shown in Fig. 5.2. Return periods for the whole Himalayan arc and central regional return are 10 and 409 years, respectively, compared to 66 years for the whole of Nepal. This analysis indicates that the calculation of return periods is highly sensitive to the spatial region.

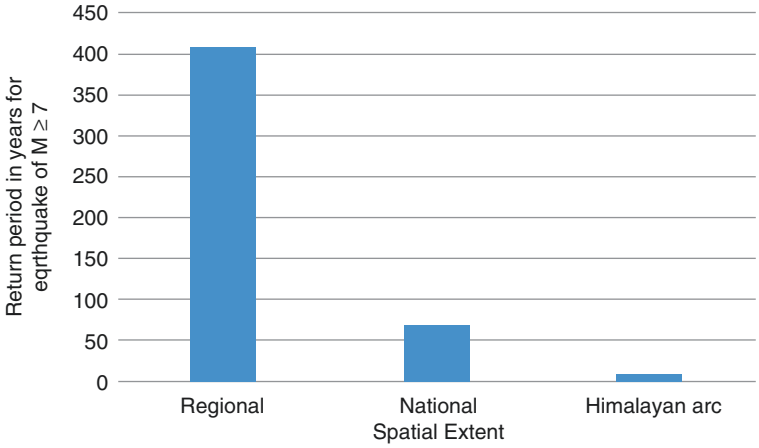

Fig. 5.2 Calculated return periods for earthquakes with $M \geq 7$ for different spatial extents

Increasing the size of the area of interest decreases the return period and vice versa. This indicates that the whole Himalayan arc is subject to extreme earthquake hazard, with M 7+ earthquakes occurring at least once a decade over the entire arc. It is, therefore, important to consider the risk within the entire Himalayan arc rather than just in Nepal or a specific region of Nepal. Calculating the time-independent probability for small regions can be highly misleading because the analysis likely underestimates the risk due to smaller numbers of historical earthquakes in the database. Hence careful selection of the spatial area of a region at risk is crucial in the estimation of an earthquake return period in risk assessments.

5.6.2 Temporal

The effect of temporal variability on the return period of an earthquake of magnitude equivalent to Gorkha earthquake was calculated using the data sets for the entire Himalayan region by iteratively decreasing the time window from which data are considered by a decade. The return period was therefore calculated for data sets from 1964 to 2014, 1974 to 2014, 1984 to 2014 and 1994 to 2014. Data from 1964 to 2014 indicate that the return period of an $M \geq 7.8$ earthquake is 72 years, whereas the data

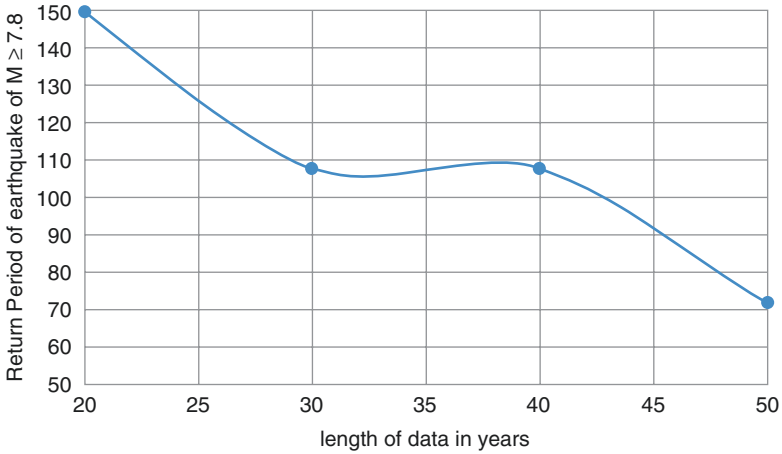

Fig. 5.3 Sensitivity of return period to the length of earthquake data

from 1994 to 2014 show that the return period is more than double this, at 150 years (Fig. 5.3).

When undertaking a time-independent analysis, the duration of data observations is another source of uncertainty. In the Himalayan region, 50 years of data (1964–2014) are inadequate for the analysis of earthquakes that have higher return periods, because there are faults showing evidence of very large earthquakes occurring 500–1000 years ago that are not included in the data (Bilham et al. 2001). Thus underestimation of the recurrence interval is highly likely from just 50 years of data, which has significant implications for risk management.

5.7 Seismicity Variation Across the Himalayan Arc

The *b* value from the power law relationship is of particular interest to seismologists. A large(r) *b* value indicates fewer earthquakes with large magnitudes are expected, whereas a small(er) *b* value indicates more earthquakes with large magnitudes are expected. It is interesting that researchers have previously used the *b* value to identify seismic quiescence or enhanced seismic activity as an attempt to understand precursory behaviour (Singh et al. 2010). To understand if and how seismic behaviour varies across the Himalayan arc, the area is split into six distinct regions to compare the cor-

responding *b* values. Using the data sets from 1964, there were fewer than 25 earthquakes of $M \geq 4$ in some regions. Thus long-term data from the early instrumentation period of 1911–2016 were used in the calculation, despite data from pre-1964 being incomplete. The boundaries between regions were chosen to reflect changes in the geological settings based on different long-term subduction velocities (Stevens and Avouac 2015). The calculated *b* values are represented in Fig. 5.4, with Nepal located in regions 3, 4 and 5.

The Gorkha earthquake occurred in central Nepal, which is located in region 4 of the Himalayan arc. Notably, this region has the lowest *b* value across the entire arc, indicating a relative abundance of historical large events. The higher values in other regions reflect the fact that far fewer large historical earthquakes have occurred, and it is especially notable that the easternmost region has the highest *b* value. One conclusion that can be drawn from this analysis is that, if earthquake occurrence is relatively constant throughout the entire arc, there is a possibility of future large earthquakes throughout the Himalayan arc, with the region east of Bhutan being of particular concern. However, it should be noted that limited data in the region make the comparisons highly uncertain.

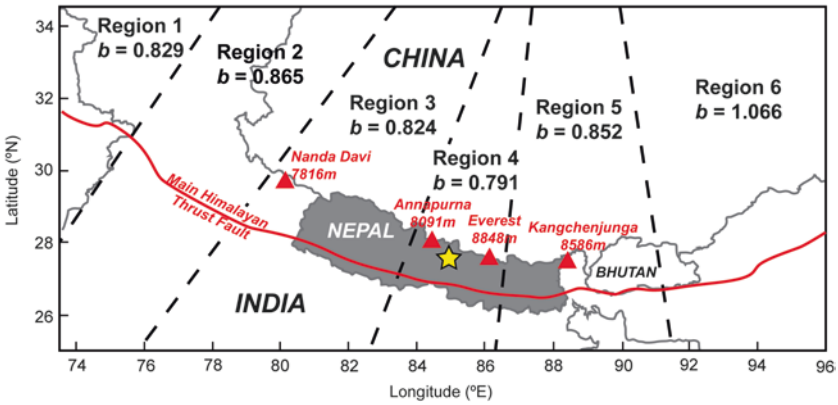

Fig. 5.4 Different regions of the Himalayan arc and their corresponding *b* values. *Dashed black lines* show region boundaries; *solid grey lines* show national borders

5.8 Discussion and Conclusions

In addition to the analysis undertaken herein, regions of high seismic risk can be determined from the presence of seismic gaps, when large earthquakes have not occurred for a long time, by calculating the strain accumulated since the last earthquake. Slip potential as high as 10 m is stored in various places throughout the Himalayan region, indicating that earthquakes of M 8+ are possible (Bilham et al. 2001). However, the identification of seismic gaps does not constitute robust earthquake forecasting because recurrence time is highly uncertain, even if the location and magnitude of past earthquakes are identified (Rikitake 1981). The uncertainty related to the lead time, the period after which an earthquake is expected to occur, ranges from seconds to decades. Also, an occurrence of one earthquake does not mean the whole accumulated strain is released. The residual strain on the fault and the strain on the nearby faults could result in another big earthquake in the region at a shorter interval.

Recent studies show that there is a 500-year seismic gap west of Kathmandu (region 3 in Fig. 5.4), which has accumulated a slip potential of ~10 m (Avouac et al. 2015). Also, the Gorkha earthquake failed to rupture the Main Himalayan Thrust Fault south of Kathmandu, potentially increasing the strain accumulated on this section of the fault (Elliott et al. 2016).

This chapter has shown that earthquakes of $M \geq 6$ can be expected once a decade in Nepal, and that most Nepalese can expect to experience at least one Gorkha-size ($M \geq 7$) event in their lifetime. Expanded to the whole Himalayan arc, this analysis again shows that Gorkha-size earthquakes occur nearly every decade. However, these forecasts are limited by the relative lack of historical records and are influenced by the choice of spatial and temporal extent. Nevertheless, even with these limitations, probabilistic forecasting can be a powerful basis for risk management and for the comparison of risk among regions. Simple analyses, such as this, can help demonstrate that large earthquakes in Nepal are common and, on the whole, foreseeable, rather than random events brought on by Lord Shiva. Such understanding may help the population of Nepal better understand the earthquake risks they face and allow better planning and preparation for future events.

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CHAPTER 6

Disaster Games and the Role of Science for Informing High-level Emergency Response Planning for Nepal

T.R. Robinson

6.1 Introduction

Nepal is one of the most vulnerable nations to disasters and is especially vulnerable to earthquakes. Although the 2015 earthquake was the largest to strike Nepal in 80 years, far larger earthquakes are known to have occurred historically, with major earthquakes in 1934, 1505, 1255, and around 1100 (Lave et al. 2005; Mugnier et al. 2013; Bilham and Ambraseys 2005). The 1505 event was the largest of these, being 15 times stronger than the Gorkha event, with a magnitude (M_w) of 8.6. Current research suggests events of this size may recur every 500 years (Feldl and Bilham 2006), highlighting the threat earthquakes pose to Nepal. The Gorkha earthquake resulted in the largest multinational disaster response in Nepal since at least 1988, and a future earthquake on the scale of the 1505 event would require a substantial international response effort.

Emergency response cannot be effectively undertaken *ad hoc*; it requires responders to be highly trained and well prepared for the challenges a disaster could bring. However, developing appropriate training activities is difficult. One of the most widely used techniques is simulations, or disaster

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_6

games (see Bearnson and Wiker 2005; Scherer et al. 2007; Salas et al. 1998; Werth 2011; Houtkamp and Bos 2007; Zook et al. 2012). Simulations have been shown to increase safety, decrease errors and improve judgement and self-confidence (Bearnson and Wiker 2005; Scherer et al. 2007). It is important to note that simulations act as a means to invoke and test the necessary processes and behaviours involved in responding to a disaster, helping ensure responders are best equipped to deal with an emergency when it occurs (Holling 2004; Park et al. 2013).

Nepal last undertook a large-scale earthquake disaster game in 2007. This simulation brought together Nepalese and international military and humanitarian responders to plan and prepare for a future earthquake striking the Kathmandu Valley. It showed that international teams were unlikely to arrive within the first 72 hours, and there was a dire need for local people to be trained in emergency-response activities, such as medical first responder (MFRs) and collapsed structure search and rescue (CSSR). These lessons and the resulting training imparted (see Chap. 2) resulted in over 22,000 lives being saved during the Gorkha earthquake (see Chaps. 2 and 3), much more than halving the total number of fatalities that could otherwise have occurred.

However, after the Gorkha earthquake of 2015, the government of Nepal (GoN) has sought to further improve the nation's response capacity and requested a major disaster simulation to test the national and international response another major earthquake would require. This chapter provides a critical overview of the resulting simulation and its key findings and recommendations and discusses the role of science in informing these high-level planning activities in Nepal and elsewhere.

6.2 Disaster Planning in the Asia-Pacific Region

6.2.1 The Multinational Planning Augmentation Team

Nepal is a member of the Multinational Planning Augmentation Team (MPAT), which is a cooperative multinational military effort led by the U.S. Pacific Command (US PACOM). MPAT aims to develop a team of military planners from nations with interests in the Asia-Pacific region to rapidly establish a multinational military response headquarters in the wake of a disaster (Weidie 2006). Founded in 2000 and currently composed of 31 nations, MPAT hopes to augment the sharing of information and jointly develop plans for better multinational coordination during emergencies to:

- Improve the speed of multinational crisis response.
- Improve multinational force interoperability.
- Increase task force effectiveness.
- Provide unity of effort among members.

MPAT embraces the view held by most researchers (for example, Alexander 1993; Perry and Lindell 2003) that emergency response requires an integrated approach across the military, government, civilian, humanitarian and scientific communities and draws on expertise from numerous non-military groups, including the Pacific Disaster Centre (PDC), the United Nations (UN) and the International Committee of the Red Cross/Crescent (ICRC).

6.2.2 Tempest Express Disaster Games

One of MPAT's flagship activities is the regular hosting of large-scale disaster games, known as Tempest Express (TE). These simulations are held in, and at the request of, individual member nations and bring together military planners from all members as well as relevant government and humanitarian groups. In essence, the goal of TE is to practice responding to various emergencies so the behaviours and processes required become habitual among emergency responders in member nations. At the time of writing, 29 versions of TE have been held throughout the Asia-Pacific region.

The last TE held in Nepal was in 2007 and focussed on a localised earthquake of similar magnitude to the Gorkha earthquake striking the Kathmandu Valley. The major lessons focussed on the lack of access for responders into affected areas due to limited airport capacity, narrow roads blocked by debris, and failures of strategic bridges. The simulation highlighted the need for locally trained emergency responders, particularly those with skills in MFR, CSSR, basic emergency response (BEMR) and community fire response (CFR).

While these lessons proved crucial for the 2015 response, the impacts from the Gorkha earthquake were primarily felt in the rural and isolated regions north of Kathmandu (Goda et al. 2015), which posed a different response from that required for an urban earthquake. Like much of Asia, Nepal is rapidly urbanising, yet a substantial proportion of its population still live rurally. With the Gorkha earthquake demonstrating the differences in the necessary response between urban and rural disasters, there is

currently a strong need for Nepal to reevaluate some of the lessons from the 2007 simulation and plan a response that involves both urban and rural populations.

6.3 The Role of Science in Disaster Games

The point of disaster games like TE is to allow international responders to practice responding together and to identify any flaws or difficulties in the response effort. Identifying these flaws is essential, because during a real response such glitches can result in confusion, delays and indecision, leading to avoidable losses. The goal is for the processes and behaviours required to become habitual and thus enable a more effective and efficient response.

For this to occur, it is essential that the scenario be as realistic as possible (Alexander 2000). If it is not realistic, then participants are unlikely to react and behave as required. Any findings and recommendations will thus, at best, be irrelevant and, at worst, be damaging to future response efforts. It is therefore imperative that disaster game scenarios are embedded within the relevant scientific field. As well as allowing subject experts to apply the most current scientific understanding, this also forms an effective communication tool by sharing relevant scientific information directly with responders. It also enables the development of strategic institutional relationships that are essential both for undertaking a coordinated response (Kapucu 2005) and for establishing trust between responders and experts. This is crucial because responders must trust the information and advice they receive from experts during a response, enabling them to react faster to a chaotic event.

For simulations to mimic the reality of a disaster, it is important that information flows are strictly controlled, both in terms of the detail contained and the time required. This provides a further role for experts in terms of information management, by feeding information into different sections of the exercise as necessary. When decisions during the simulation lead to information being fed back to participant experts (known as requests for information), those experts must discuss the potential outcomes of the decision(s) and agree on the best course of action. Information is then relayed back to other participants at an appropriate time and manner. This way information is managed and controlled in a way that allows the simulation to mimic time delays in data gathering and allows the scenario to progress.

6.4 Tempest Express 28

6.4.1 Overview

After the Gorkha earthquake, the GoN requested that MPAT deliver a Tempest Express disaster game (TE28), to practice national and international responses for an earthquake larger than the 2015 event. The aims of this simulation were as follows:

1. To familiarise participants with natural hazards in Nepal and the relevant disaster management mechanisms.
2. To develop an understanding of the needs, available capabilities and support requirements for a future disaster.
3. To practice disaster response procedures and review and identify improvements to coordination mechanisms.
4. To identify recommended actions for stakeholders.

The simulation took place over 10 days in March 2016 and involved more than 150 participants, primarily from Nepal. Participants included members of the armed police force; the army; the central, regional and local governments; and various nongovernmental organisations (NGOs), including NSET. International participants were made up primarily of specialist planners from the armed forces of MPAT member nations, although notably India did not participate due to the political and economic tensions at the time (see Chap. 8). A further notable absence was the Chinese armed forces; China is not an MPAT member nation. The absence of India and China proved a major limitation of TE28 because both countries formed the majority of the international response effort during the Gorkha earthquake. However, during the 2015 response, both nations operated independently with limited communication to other responders, including the GoN, and it was considered likely this would recur in a future disaster. Thus their absence from TE28 likely reflects the unfortunate reality of any future response in Nepal.

The simulation followed a traditional tabletop style (Alexander 1999), in which participants simulate the high-level decision making and command-and-control structure required, but no field component (that is, no actors with fake injuries requiring treatment) was included. This type of simulation focusses primarily on testing the decision making, communication and interactions among participants.

6.4.2 *Scenario*

The scenario was jointly developed by researchers from Durham University and NSET using the most up-to-date understanding of earthquake hazards in Nepal available. The aim was to develop a reference event to provide responders with a representative example of what was expected to happen in the future. The scenario was based on a 1505-style earthquake, which is considered overdue (Feldl and Bilham 2006)—namely a M_w 8.6 earthquake striking western Nepal (Fig. 6.1). Such an earthquake was considered one of the most extreme hazards facing Nepal and likely to occur in the near future (Feldl and Bilham 2006). Damage and casualties were calculated using the most recent census (2011), which, for the first time, included construction details of all Nepalese households. Using fragility curves (which describe the likelihood of building collapse at a given shaking intensity) specifically for Nepalese structures derived from previous experiments by NSET (Guragain 2015) and fatality rates from HAZUS (Kircher et al. 2006), the total number of collapsed buildings and resulting casualties were estimated. The results suggested that such an earthquake

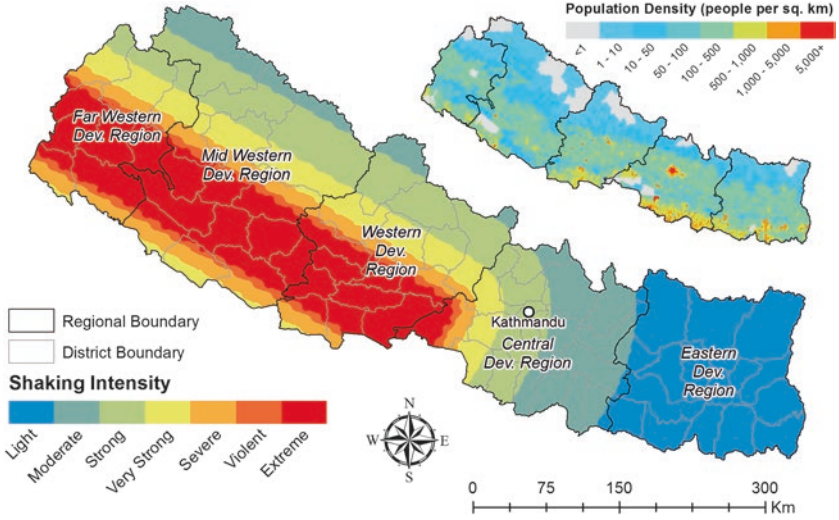

Fig. 6.1 Scenario earthquake used in TE28 compared to population density throughout Nepal from the 2011 census. NB: The boundaries and names of development regions shown in Figs. 6.1–6.3 have subsequently been as per Nepal's new constitution (see Chap. 8)

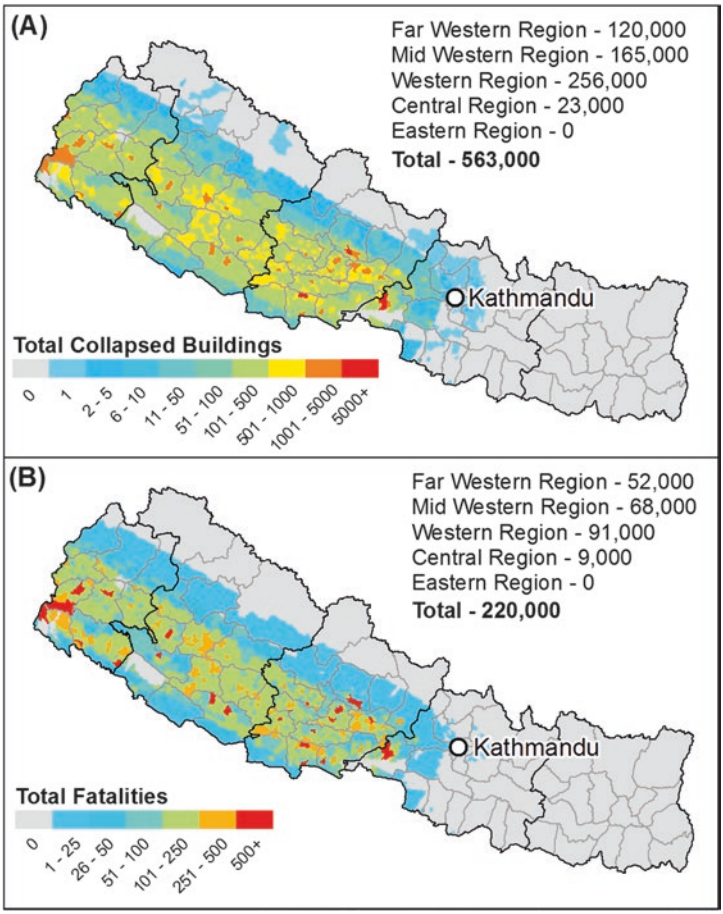

Fig. 6.2 (**a**) Distribution of collapsed households resulting from the TE28 earthquake scenario. (**b**) Distribution of fatalities from TE28

could cause the collapse of up to 550,000 homes and lead to about 200,000 fatalities (Fig. 6.2). It is important to note that for the first time for a TE, advances in landslide modelling (Kritikos et al. 2015) were utilised to estimate the extent of landsliding likely to occur and the losses this would inflict (Fig. 6.3). Landsliding and the consequent infrastructure losses posed a substantial issue for responders during the Gorkha earthquake (Kargel et al. 2016) by cutting off badly affected rural areas; thus

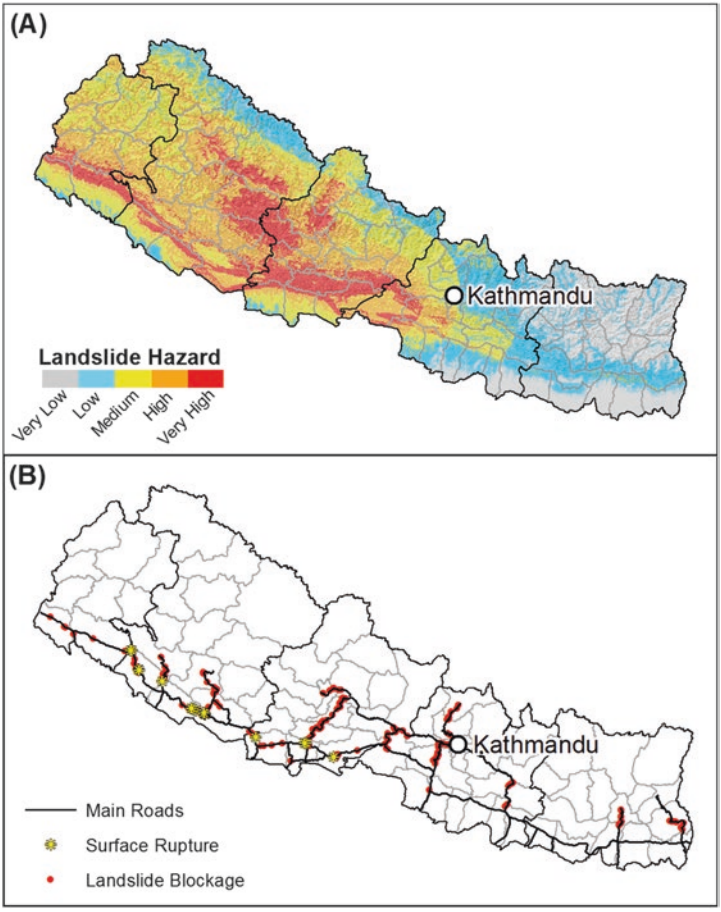

Fig. 6.3 (**a**) Likelihood of landslides occurring from the TE28 earthquake scenario. (**b**) Locations of blocked main roads caused by landslides and fault surface rupture from TE28

most of the affected population was accessible only by air. With limited air capacity in Nepal this proved a major challenge and one that required an urgent solution that TE28 could focus on identifying. As a result of these efforts, the TE28 scenario was one of the most detailed and realistic scenarios developed for a TE disaster game.

6.4.3 *Response Structure*

The response structure during TE28 was set up to replicate the response structure during the 2015 earthquake. This structure was developed by the Natural Calamity Relief Act (GoN 1982) and was most recently updated by the National Strategy for Disaster Risk Management (NSDRM) by the Ministry of Home Affairs (MoHA 2009).

Immediately following a disaster the Central Natural Disaster Relief Committee (CNDRC) is activated by MoHA, the apex government body during crisis response (Fig. 6.4). The CNDRC is made up of a variety of government ministries and departments as well as the chief military officer (CMO) and other high-ranking military officers. Its role is to act as the

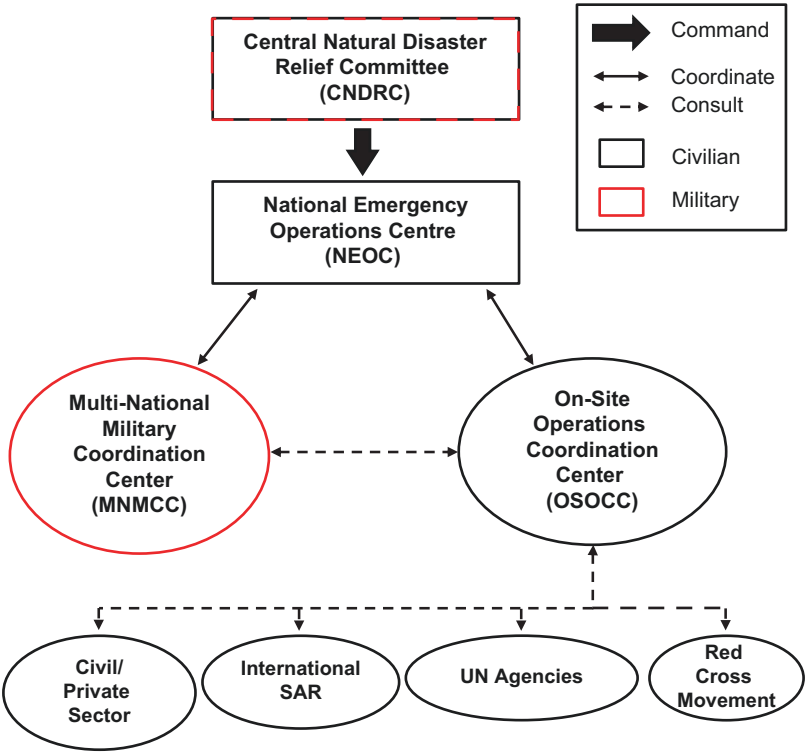

Fig. 6.4 Disaster response structure in Nepal as set up for the TE28 simulation

government's decision-making body and control the response. It is the job of the CNDRC to examine information passed to it from below (Fig. 6.4) and make decisions on how best to respond to reduce losses. The CNDRC makes national-level decisions, including the declaration of an emergency and asking for and accepting aid.

The National Emergency Operations Centre (NEOC) is responsible for the coordination and mobilisation of national-level operations (Fig. 6.4). The NEOC's role is to pass gathered information to the CNDRC and to pass back their decisions. For this reason the NEOC is composed entirely of civilian personnel from a variety of government ministries and departments as well as leading scientific experts from groups such as NSET.

Civilian activities are coordinated through the On-site Operations Coordination Centre (OSOCC). The OSOCC's role is to coordinate the activities of all nonmilitary response groups. It is set up by either the first search and rescue (SAR) team to arrive in country or the first UN Office for Coordination of Humanitarian Affairs (OCHA) field team to arrive. The OSOCC focusses on the distribution of aid in the form of shelter, food, healthcare and other activities.

The military response is coordinated through the Multi-National Military Coordination Centre (MNMCC). This is composed of representatives from the Nepalese army as well as planners from all responding international militaries. The MNMCC acts primarily as a trading floor, in which each nation provides a list of its available assets and their capabilities. The MNMCC discusses how best to group and deploy these assets and when to request for extra resources. An important role is making sure militaries are partnered to ensure the best coordination of asset deployment. For instance, both the U.S. and UK armed services have access to the most effective air assets and are usually therefore partnered with less well-endowed nations to facilitate their deployment.

A more comprehensive outline of this structure can be found in the National Disaster Response Framework (NDRF; MoHA 2013).

6.5 Critical Issues Affecting Response Planning

The TE28 simulation presented the participants with numerous difficult issues likely to arise from a future earthquake in Nepal.

6.5.1 Remoteness

The area primarily affected by the scenario is extremely remote. Western Nepal has limited road access and no major airfields that can host large fixed-wing military aircraft. Furthermore, the region is extensively mountainous, with people living on steep slopes at elevations of 1000–3000 m. Gaining access to provide aid and evacuate casualties thus presented a substantial test of the response planning effort, especially with most major access roads blocked by landslides (Fig. 6.3). During the 2015 response, many remote areas became accessible by helicopter only, making distribution of aid materials especially difficult. Future disasters in Nepal are almost certain to involve substantial problems with access to extremely remote communities. TE28 therefore forced participants to find ways to carry out an effective response in such isolated conditions.

6.5.2 Tribhuvan International Airport

Nepal's only airport capable of hosting large, heavy laden fixed-wing aircraft is Tribhuvan International Airport (TIA) in Kathmandu. However, the runway is capable of receiving only limited numbers of heavy aircraft landings before it begins to crack and become unusable. During the 2015 emergency response, this capacity was exceeded, and damage to the runway was noted by engineers. Further, pilots cannot land without visual contact of the runway and aircraft must carry sufficient fuel to return as well as their own unloading equipment, reducing the amount of aid they can carry. Only about 10 aircraft can be parked at the terminal at any one time. Because more aircraft and larger amounts of aid were required for the TE28 scenario than the 2015 response, planners at TE28 were required to think how best to mitigate the issues with TIA during a major response.

6.5.3 Distribution of Casualties

Although the number of casualties estimated by the TE28 scenario seemed large, similar numbers have been witnessed in other major earthquakes (Table 6.1). While the number of fatalities in the scenario is not unheard of, even in modern times, their relative spatial distribution is especially difficult for responders. Casualties were distributed across a large, remote area of more than 100,000 km^2. Combining rural and urban communities, this

Table 6.1 Summary of the 10 Largest Earthquake Death Tolls Since 1900

Earthquake	*Year*	*Estimated Number of Fatalities*
Haiyuan, China	1920	273,000
Tangshan, China	1976	240,000
Indian Ocean	2004	230,000
Kanto, Japan	1923	140,000
Haiti	2010	140,000
Ashgabat, Turkmenistan	1948	120,000
Sichuan, China	2008	90,000
Kashmir, Pakistan	2005	85,000
Messina, Italy	1908	85,000
Ancash, Peru	1970	65,000
TE28 Nepal	*Scenario*	*200,000*

Source: After Daniell et al. (2011)

involves thousands of affected individual communities. Rapidly accessing each community is a complex task for a relatively small response force, especially considering the lack of road access to most areas (Fig. 6.3). TE28 participants thus had to address how the response could best provide for this large distribution.

6.5.4 Mass Displacement of People

With such large numbers of damaged and collapsed buildings (1.5 million in total), the TE28 scenario included the displacement of nearly 7 million people (25% of the total population). Many of these internally displaced people (IDP) are likely to be injured and without food, water and shelter. Providing urgent aid to such a large number of people distributed over huge areas (discussed earlier) is a vital concern for emergency responders. With many of these people living on steep slopes and at high elevations, exposure becomes a severe problem, potentially leading to mass internal migration. In turn, this could lead to a prolonged humanitarian crises; thus planning how to respond to so many IDP became a vital component of TE28.

6.6 Findings and Recommendations

As a result of TE28, more than 50 recommendations were made to the GoN on how to improve emergency response to future disasters in Nepal. Here, several of the key findings are presented and discussed.

6.6.1 *In-Country Search and Rescue Capabilities*

The work done to train local people in MFR, CSSR, BEMR and CFR proved invaluable in the 2015 response, saving the lives of almost 22,000 people (see Chaps. 2 and 3). This training resulted from an acceptance following the 2007 TE that it would take trained international responders more than 72 hours to arrive after the earthquake. From TE28, it was clear little has changed in this regard, and for exceptionally remote areas, it could take international responders more than a week to arrive. Continued and further investment in training local people in MFR, CSSR, BEMR and CFR is therefore essential for saving lives in future earthquake disasters. Priority should be given towards particularly remote communities, where access is already limited and where local people present the *only* opportunity to save lives of buried and trapped victims. Such an undertaking would require a modest financial investment in comparison to the benefits it is likely to achieve.

6.6.2 *Air Facilities*

Issues with air access were one of the greatest concerns during TE28. With limited to no ground access and highly distributed casualties, air access was deemed the only feasible means of deploying aid. However, issues with accessibility, capacity and facilities at TIA presented a major issue for response planners. Consequently, numerous recommendations for improving air facilities were made.

First, it was suggested that Nepal seek bilateral agreements with India, China and Bangladesh for use of their airports after a disaster. For parts of western Nepal, New Delhi is closer than Kathmandu, and parts of eastern Nepal are similar distances from Dhaka as Kathmandu. The use of these airports would increase regional air response capacity, reduce pressure on TIA and potentially decrease the time required to transport aid from the initial airport to its required location. Ground access from India and Bangladesh provides numerous alternative routes to affected areas, increasing transport redundancy and the likelihood of ground access remaining possible. Such an undertaking is unlikely to require financial commitments and will potentially have political implications in terms of greater mutual aid among Nepal, India, Bangladesh and China, which may prove vital in future disasters in these nations.

Creating and integrating an Airport Coordination Centre (ACC) into the response structure was also recommended (Fig. 6.5). No direct committee is tasked with overseeing the arrival of aid materials and international responders. This is particularly complex, with customs and immigration requirements leading to long waiting times at the airport for arriving responders. An ACC would counter this by coordinating the running of the airport during an emergency and would require no major financial commitments from the GoN. The ACC is proposed to be made up of a combination of trained personnel from the Nepalese Security Forces, TIA, MoHA, and customs and immigration. The role of the ACC would be to coordinate the smooth operation of incoming aid through the airport and to effectively manage incoming and outgoing aircraft.

Lack of road access forced planners to distribute most aid in TE28 by air, in particular through heavy lift military helicopters. However, a lack of landing sites meant that in many circumstances aid needed to be transported by foot, sometimes taking several days. It was therefore recommended that the government invest in establishing numerous helicopter

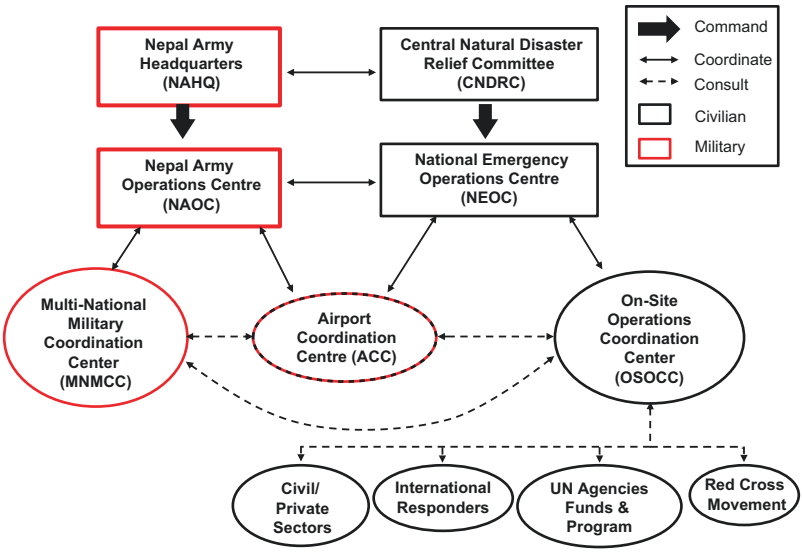

Fig. 6.5 Suggested new disaster response coordination in Nepal following the TE28 simulation. Note the increased separation between military and civilian groups and the inclusion of an Airport Coordination Centre (ACC)

landing zones throughout particularly remote areas. Although costly, such a proposal would have the benefit of increasing access to remote areas even outside of disasters.

A further recommendation was for investment in greater fuel capacity and unloading equipment at TIA. This would allow aircraft to focus on carrying the maximum possible aid during times of disaster as well as increasing TIA's capacity for commercial flights at other times, potentially boosting tourism. As with helicopter landing sites, this requires a substantial financial investment to purchase suitable amounts of expensive equipment, something that is unpalatable to most governments, including the GoN. The recommendations for increasing air capacity highlight the pressures central governments can experience after conducting planning simulations, with calls for large-scale financial investment. Finding a balance between spending on everyday aid and future disaster planning activities remains a complex and difficult challenge globally.

6.6.3 Evacuation and IDP Camp Management

Given the large numbers of IDPs forecast as part of the simulation, it was highlighted that Nepal currently does not have sufficient plans in place for the creation of IDP camps following a major disaster (see Chap. 3 for comments on the 2015 response). It was therefore recommended that the GoN undertake immediate planning for the creation of large-scale semi-permanent IDP camps within Nepal. Although this recommendation requires no immediate financial commitment, it does require the GoN to consider complex issues around the evacuation and safe housing of large numbers of people who are at risk of becoming displaced in a future earthquake.

6.6.4 Coordination Structure

Several recommendations were made to adapt the current coordination structure for the purpose of clarity and communication flow. The main recommendation pertained to the current mixing of civilian and military coordination centres (Fig. 6.4), which added confusion to traditional command and control structures and resulted in conflicts with international military. Instead, it was suggested that civilian and military coordination groups be separated, with consultation among groups at the lower levels and coordination of efforts undertaken at the higher levels (Fig. 6.5). This

requires removing the military presence from the CNDRC and creating a parallel Nepalese Army Headquarters (NAHQ), with similar decision-making capabilities over specifically military matters. The NAHQ would coordinate with the CNDRC on joint matters, but traditional military command chains would remain intact. A Nepal Army Operations Centre (NAOC) is required in parallel to the NEOC and would likewise coordinate with the NEOC on joint matters. In this new coordination structure, only the ACC would become a joint military-civilian response group.

A further suggestion was for the empowerment of response groups below the NEOC by entrusting them with greater decision-making capabilities. The original coordination structure was seen to be too restrictive, with on-the-ground responders feeling unable to make any effective decisions. Instead all decisions were deferred to the CNDRC. This led to both the NEOC and CNDRC becoming overwhelmed, slowing the flow of information. Consequently, key decisions were delayed, misinterpreted or forgotten, leading to congestion and confusion. Giving down-chain groups some decision-making capabilities would help alleviate these problems and speed up the response action. This requires no financial investment; however, it does require a societal shift in the way emergencies are perceived and coordinated in Nepal, something that is unlikely to prove easy to accommodate.

6.7 Conclusions

Emergency response is always chaotic and fast paced thus, inevitably, mistakes will always occur. However, these mistakes can be limited and reduced through effective training via simulations. Simulations can identify key flaws in the necessary response behaviours and processes, allowing these to be addressed and corrected before a disaster occurs. However, for this to happen it requires that the scenarios be as realistic as possible. Thus simulations must take into account the most recent scientific knowledge. TE28 is an example of what can be achieved when simulations do just this. The scenario developed showed that large numbers of fatalities and IDP are likely across large areas of Nepal and that landslides will pose a substantial risk to ground-based transport infrastructure. To respond to these issues, TE28 participants found their efforts would be severely hampered by, primarily, a lack of suitable air facilities within Nepal. With ground routes most probably badly affected by landslides, access by air is likely to be the only viable option for aid distribution. Identifying these issues

before the next major earthquake strikes Nepal can allow the GoN to make meaningful proactive changes, potentially leading to large improvements for response. However, even if all the recommendations were undertaken, it would still take international responders up to a week to access the most remote areas. It is therefore essential the GoN continues its current efforts to train local people in emergency response because it is they who be the first responders in most locations.

In reality, many of the recommendations require substantial financial investment from the GoN. Such an undertaking is unlikely to occur without either increasing the current international aid spent on Nepal, or repurposing some of the current aid budget at the expense of other vital everyday aid. However, several recommendations require limited or no financial investment, instead focussing on human resources and response structure. Prioritising these changes may enable Nepal to make substantial gains in emergency response efforts for future earthquakes, with limited need for major financial investment.

Nepal has so far made great strides along the tightrope to improve its emergency response plans, and this resulted in many lives being saved in the 2015 disaster. Continued investment and progress in emergency response planning is required, however, to save even more lives in the next major disaster.

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PART II

Disciplinary Perspectives

CHAPTER 7

Communities in the Aftermath of Nepal's Earthquake

Ben Campbell

7.1 Introduction

The voices of people who have most directly been impacted by the destructive powers of an earthquake are the least likely to be heard, given the noise of outsiders' organisations, agendas and projects that arrive into the circumstances of aftermath. This is the argument of Ed Simpson's (2013) study of the Gujarat earthquake in 2001, and this chapter discusses the voices of people from earthquake-affected districts by two methods. First, for Nepal's Rasuwa District, which suffered the highest death rate of any district as a proportion of its population, I describe gathering accounts from people whom I already knew well, about how they experienced the immediate collapse of their everyday world and how they took steps to put their community back together. Second, I discuss a survey conducted across several districts into the ways that loss of energy systems configured villagers' perceptions of disruption and isolation. These two approaches reveal ways of understanding what was going on within affected communities in terms of shockwaves, how people interpreted their pained dislocation and emotional numbness, and how they went about restoring a make-do semblance of normality when faced with massive delays in state responses to the crisis and even state refusal to recognise citizens' exceptional needs.

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_7

These personal accounts reveal fault lines and fissures in Nepal's make-do political composition and speak to the gross disparities of development expectations that continue to be reflected in systemic levels of exclusion and ethnic marginalisation. In facing the rubble of their dwellings and the problems encountered in relief and recovery programs, the villagers give voice to new understandings of how their built environment compares to that of wealthier citizens who were not so severely impacted. They voice old complaints of poor treatment at the hands of the state authorities who have most influence over the villagers' capacity to be resilient, that is the national park system. The argument of the chapter moves from the village-level rebuilding of everyday lives to consider the notion of building back better[1] in the light of a study I helped design that has gathered data on experiences of community resilience in relation to the earthquake's effects on energy systems in three of the most affected districts (Gorkha, Rasuwa, Sindhupalchok). For all that the built environment was delivered a hammer blow, it was the relation to the state and the low priority given to relief and recovery that were uppermost in villagers' consciousness.

7.2 Tamsaling

On the map of ethnic distribution across districts, one of the most ethnically homogenous is Rasuwa. Listed as 80% Tamang, this district is perceived by most Nepalese as strange and rough compared to more developed, exotic, picturesque or climatically benign settings. The Nepali-speaking officials who are posted here tend to stay close to their offices and the small bazaar areas servicing them. The resident population of Tamang speakers belong to a number of different clans who migrated from Tibet over the last thousand years, bringing religious, linguistic, trade and political connections that have been kept alive via cross-border interactions. Tamang is a group of dialects, and I learned the western variant during fieldwork in 1989–91. I used it to understand the effects on local institutions and agropastoral livelihoods after a road was constructed, with a consequent market expansion. How did subsistence systems among Tamang households at the village level respond in cooperative resilience when faced with such change? The road and the creation of a national park east of the Trishuli River involved the dismantling of the area's politico-cultural buffer from direct state interference in everyday life that the mountain geography had afforded.

The Tamang number over 1.5 million, and of all Nepal's indigenous groups (Janajati), have tenaciously retained their language along with a culturally distanced relation to the state. This takes the form of adherence to a Buddhist–shamanic religious complex or, more recently, Christian conversion (Campbell 2016); maintenance of a social world of clans allied through cross-cousin marriage and the consumption of beef by a majority of clans. The Tamang were historically excluded from the core of the Gorkha regime's polity following insurgencies in the late eighteenth century. They mostly live on ridges and mountainsides and farm unirrigated fields and keep livestock, though less extensively than before in districts encircling the Kathmandu Valley. The Rana regime (1847–1950) excluded this area from Gurkha recruitment because they provided the portering manpower for trans-Himalayan trade and corvée services to the state and later worked for the trekking industry (Campbell 1997). Here the impact of the earthquake hit a population marked by centuries of structural violence. The earthquake reopened historical scars that the new constitution had recently aimed to heal in an ethnically realigned federalism.

7.3 Sangül

I had experienced several minor earthquakes (*sangül* in Tamang) over the years in Rasuwa, but the tremor that hit central Nepal on 25 April 2015 reverberated through time and space and amplified associations between poverty, place, nature and power in the attention of locals and commentators in the aftermath of the shocks. The houses were simply made from stone, mud and timber. The tremors raised clouds of dust into the air and sent landslides tumbling down mountainsides, damming river courses, which then backed up and subsequently burst, causing devastating floods. As the dust settled and the effects of the tremors became clearer, people began to talk about links between the sites of worst human impact, and these affected areas' ethnicity and economic characteristics. Some commentators began to speak of a Tamang epicentre.

I learned of the earthquake on 25 April, but friends' mobile phones were down. I found one villager by email who was working in Malaysia. He had news of two deaths, one of them his brother's son. After three days, I received a call from the family I know best, whose son had charged his phone in the next village. His clansman there had a solar home system with mobile charging facility that survived. The situation of loss now

became clearer. Apart from the first two deaths reported, my close friend's older brother's wife had also died at a road construction camp near the China border. All 70 village houses, the school and the Buddhist temple had collapsed. The only building left standing was a new house being built of concrete, owned by the only village employee of the national park.

In July 2015 I was able to visit and began filming my village friends as they spoke to me of what it was like during the earthquake and immediately after:

> There was dust everywhere, you could hardly see. People were crying. Great holes appeared in the road. It kept on going. You couldn't keep still. It threw you one way, then another. All the houses fell down. People gathered up the hill to spend the next nights all together in a temporary shelter.

A group of young men walked to town along the road that remained impassable to vehicles for another couple of days, to carry home sacks of food. While people stayed in touch from their temporary collective shelter, there was a looming concern to rebuild at least one room per household to keep dry during the impending monsoon. I was told back in April they would need truckloads of tin sheeting for the roofs. An Irish charity came to help with donations of bundles of tin just before the monsoon.

In July, the scene was one of busy cooperative labour gangs moving day by day around the village. As with the agricultural labour system I had studied 25 years previously, the same principle of rotational days of work was being applied to house reconstruction (Campbell 1994). In Tamang this is called *nang laba*; in Nepali, *parma*. Groups of four, five or six households were forming work teams for clearing the stones, timber, roofing and rubbish, and then rebuilding, concentrating on just one of the group's houses each day. The momentum and capacity for domestic rebuilding of village houses in a getting-by, temporary fashion was evident at this stage, and villagers reorganised their ideas for how I could help in another direction. I was taken uphill to visit the Buddhist temple. From up on the ridge, I could look both ways to the north and to the south and see the extent of the devastation. Great landslide flows gashed the mountainsides on the slopes all along the western side of the valley. People pointed out to me where whole hamlets had been swept away, especially at the Mailung tributary and farther north at Haku village. 'We all belong in this one territory', said one man, extending his gaze across this arc of

Fig. 7.1 The houses of the gods also need rebuilding. At the *gombo* site in Tengu, Rasuwa (Source: Author's own)

settlements, forests and clusters of terraced fields, where everybody has shared kin and clan connections in this large Tamang community.

The scene at the temple (*gombo*) was less advanced as a recovery site than the domestic dwellings. What was remarkable was how well the resident family of gods in the temple had survived (Fig. 7.1). The roof above the main altar had clearly been built with more robust materials and skill. Tarpaulin sheets were carefully removed to reveal the figures of Guru Rinpoche, Chenrezig and Mahaguru and their female consorts, remarkably well preserved in the circumstances. On closer inspection there were cuts and grazes and damaged accessories were noticeable. Gangs of boys and young men were shovelling rubble and clearing the space to locate the wall foundations.

I reflected on the fact that 25 years ago this village did not even have a temple. In 1998 the leader of the district development committee in Dhunche (later assassinated in a Maoist ambush) made some funds available, to which the villagers supplemented with contributions in kind. The project to fund a temple building in this village had, however, been objected to by wealthier people in the district:

> What do they want a temple for? People in that village don't even live in houses, but sleep under bamboo mats in animal shelters.

These words were reported from the budget allocation meeting at the district capital, and the slur directed at this community's citizens hurt their collective reputation, though it was indeed correct that its two wards were among the poorest of the Village Development Committee area. Just as back then, now also it was a matter of pride to be able to bring the *gombo* back into a condition for performing a ritual that would gather the whole village together, raising general esteem and providing a sense of recovery.

In the summer of 2015 the primary goal was to put the temple back in shape in order to hold a celebration of Tsechu at the next full moon. This is a festival that accumulates merit for collective benefit and involves making an elaborately adorned altar of *tormos* (images made of boiled rice and coloured by mixing dye into butter), lamas chanting sacred texts and laypersons' dancing and singing. It brings all households into a community of shared participation by the distribution of blessings (*wang*) contained in the pieces of tormo that are given to each household for their individual share of the blessing at the end of Tsechu. The celebration involves a systematic reckoning of all the village households and circulates the rights and entitlements of belonging in the community by deliberately recognising the presence and role of each household as an autonomous unit of account, for all religious and life-cycle events.

Domestic well-being is at the core of many Tamang rites of purification, which expel malevolent forces. Buddhist lamas have their methods for achieving peaceful domestic order through the binding oaths of the dharma. By contrast, the rites of the shaman (*bombo*) directly confront bad energies that pervade all the domestic activities of life in the round: feeding and raising families, fermenting beer, storing grains. The bombo communicates with spirit beings, asking them to stay in their own worlds. The bombo best known to me explained that his powers of knowing the place of humans in this world came to him through an abduction by the *longai* when he was young. These are the Tamangs' yeti, which are encountered in forests or caves. During his abduction with the family of longai, he saw the foods they ate, including insects and soil (*sepra* in Tamang).[2] The lognai live in their homes and have their foods, whereas human homes and foods are appropriate to humans. The bombo understands how the world appears as home to different kinds of beings.

As I was being told about the plans for the Buddhist Tsechu ritual, I heard familiar voices approaching. It was the daughter of the old bombo. His daughter sat down on a rock and began to tell her experiences of the earthquake. She had been way down by the family house near the water source. The house had collapsed ('nothing is left'), and she moved up to live in her brother's house, bringing her old mother with her. She spoke of what it was like trying to live in the conditions immediately after the earthquake. She explained how all the food stores in the ruins of the house had been covered and permeated with the dust from the demolished buildings, which were made of only mud and stone.

> '*Sepra, sepra tee no, ken ti, tungba deng, sepra tee no*', she repeated. 'Whatever you ate, whatever you drank, it was always full of dust and soil, everywhere just dust and soil'.

Of course, this description of eating soil, coming from the bombo's daughter, took me back to her father's account at the hearth of the longai, and the effect was not simply to communicate the reality of trying to survive with degraded food supplies, it was also to get across the very precarious condition of human dignity in which they had found themselves, with all the precious things and qualities of domestic normality smothered in dust and soil. Nor was the situation improved when government relief food supplies were literally mouldy and rotten. It was so bad and degraded people did not even want to use it as chicken feed.

7.4 Postpeasant Moral Ecologies

In the aftermath of the earthquake, villagers spoke with a sense of injustice about how the national park did not respond with any flexibility to people's immediate needs for emergency shelter. They were faced with how to survive in the impending monsoon. A small hamlet situated way downhill by the course of the main Trishuli River lost five people to the landslide and flood. They were all women who had been cutting fodder together. These five motherless households relocated 1000 m uphill at the main road. An approach was made to ask permission from the national park to cut enough timber to for temporary dwellings for these destitute families. The park office responded that it could not deal with small amounts of timber, and they would process applications for only 100 cubic feet and more.

Here was an occasion when the park could have shown some attentiveness to the plight of utterly devastated villagers in extreme circumstances and could have been rewarded by goodwill for demonstrating a sense of compassionate partnership and fellow citizenship between local residents and the guardians of the natural resources of the park. This opportunity for extending a hand of humanitarian assistance by acknowledging people's awful suffering was passed up. It only reinforced the Tamang people's perception of state institutions being inaccessible and uninterested in the plight of the suffering. In the end, it was not state offices but foreign nongovernmental organisations (NGOs) that delivered quantities of sufficiently long tin sheeting that could be used in rounded arc fashion (not even requiring any timber struts) to make dwellings for the refugee families, just in time before the monsoon arrived. To their credit, it should also be mentioned that World Wide Fund for nature (WWF) came to distribute improved cook stoves at low cost (2500 rupees), which had never previously been installed in this village, except in a select few homes.

This incident recalled the estrangement between park and people in the days before the introduction of democracy and later attempts at improving this relationship through the national park's buffer zone programme (Campbell 2005), but today's political-economic configuration is not as it was during the 1990s, when my main research took place. Most villagers and local townspeople are no longer as closely dependent on subsistence livelihoods as they once were. A major socioeconomic transition has been going on, with labour outmigration and abandonment of subsistence cropping patterns. The viability of indigenous agropastoralism was undermined by the excessive costs in evading the state's regime of nature protection and by the logic of the market coming home to roost when people saw that, after their family members had gone abroad for work, they could not sustain the rotational labour gangs. This is a generational shift in the governance of the energy of human labour. It served as the primary means by which informal community governance structures organised subsistence livelihoods and other everyday infrastructures. This hollowing out of human resources and unhitching from other factors affecting the activities of everyday life (especially climate change) need to be taken into consideration when thinking about capacities for community resilience holistically.

7.5 Regional Vulnerabilities and Resilience

If Rasuwa District has the greatest relative proportion of Tamang speakers, perhaps the most ethnically aware of the districts within the Tamang heartlands denoted by the name Tamsaling is Kavre District. It is to the east of Kathmandu, lower in altitude and the centre of the eastern dialect group of Tamang. Most of the clan names are shared, so people can behave as among kin in the two locations. The Temal ridge is there, which is renowned as a strong pulsing centre of Tamang culture and society. Thanks to a Durham award for International Engagement, I visited Kavre to understand the distribution of the earthquake's effects. I was hosted by Dr. Mukta Singh Tamang, who in return gave a seminar on the earthquake to Durham University's Institute of Hazard Risk and Resilience (IHRR) on 27 June 2016. In Kavre, the number of fatalities was not as high as other districts, but there was damage to houses built right on the crests of some ridgetops. The style of architecture and materials are somewhat different in Kavre from those in Rasuwa (the latter more rugged and mountainous). The use of small ceramic roofing tiles gives a very different appearance. In May 2016, over a year after the earthquake, the district had still not received money for rebuilding. People had gathered and sorted materials from the rubble. There were separate piles of beams and timbers, doors and window frames, stones and roofing tiles carefully being added to, as clusters of hamlets pulled apart the material fabric of their dwellings to use later in putting them back together again.

In May 2016 it was evident that one of the factors making it difficult to adjust to the conditions of survival was the premonsoon drought, which has become the new normal over the last two decades (Campbell 2017). The effects of climate change were exacerbated by the earthquake having reduced the volume of the streams, and many water sources disappeared altogether. Driving along the Temal ridge one afternoon revealed an expansive, desiccated landscape. It was obvious, though, that the people of Temal had been recipients of a water-harvesting support project, manifest in large, rounded, reinforced-concrete water containers outside school buildings and many homes.

The drought also increases the chance of forest fires, and we came across one instance of a micro-hydropower unit having been recently engulfed and destroyed by fire. Earthquake effects were combining in brutal fashion with property loss and the changing climate, leading to agricultural inactivity. There was also a rising sense of despair at the lack of support received from government.

7.6 An Energy View on the Earthquake

Perceptions of the social value of technologies such as micro-hydropower, solar power and biogas (Campbell and Sallis 2013) and their resilience to the effects of earthquakes and climate change became the theme for the rest of my visit in May 2016. I had been collaborating with a group of researchers in the UK connected through the Low Carbon Energy for Development Network, which the Durham Energy Institute had a hand in establishing in 2012.[3] Long Seng To of University College London (UCL) put together a multidisciplinary team (for which I was the anthropological consultant) and secured a small grant to explore the topic of enhancing community resilience using renewable energy in Nepal in a number of earthquake-affected districts as a pilot study. In a blog post published by the research team, we stated:

> The earthquake crisis aggravated Nepal's already strained energy situation and demonstrated that the situation is fragile, insecure and vulnerable to system-level shocks. This event reinforces the World Bank's pre-quake assessment (World Bank 2015) that Nepal's physical energy infrastructure is both highly vulnerable and of limited adaptive capacity, citing a high exposure to climate-related hazards and limited capacity to adapt across economic, technical and institutional domains.

We had designed a structure for pilot research across Gorkha, Rasuwa and Sindhupalchok (the three most affected districts) to look at the post-earthquake role of renewable energy. We joined with a local NGO and were assisted by Niraj Subedi, Long Seng To's colleague from previous Nepal work. We had planned the study to look at the main questions of

- How were existing renewable energy systems used to meet energy needs after the earthquake?
- Could energy services be restored more quickly by helping communities repair or redeploy renewable energy systems after a disaster? What kind of support do they need to do this?
- What role did renewable energy play in relief and recovery initiatives? Did these activities contribute to long-term development and reduce vulnerability?

We wanted to assess the impact of the earthquake on whole livelihood systems and to gather information on the extent to which concerns of energy featured significantly in these. Along with a household survey to be

conducted in both grid-connected and off-grid settlements, a set of focus group discussions were conducted to gather the narrative dimensions of different communities' experiences.

Community energy governance has been a notable feature of Nepal's expanding renewable-energy sector. This has built on the success of community forestry projects in much of the mid-hills zone. The community scale of development work in Nepal is more likely to succeed due to the historical strength of community-based informal government institutions. These interweave the habits and expectations of reciprocity and redistribution by which men and women have cared for the agropastoral subsistence economy, learned the value of forests and water and organised access entitlement in distinctive arrangements of interethnic exchange and locality-specific pragmatics to complement each niche, classically characterised in the writing of Fürer-Haimendorf (1975). This is not to imply in any way a utopian order of social cohesion—far from it; but there is a critically sophisticated indigenous disposition for how to be collectively autonomous, how not to depend on cash (barter exchange was always preferable) and how to avoid being exploited by outsiders with demands for voluntary labour.

The focus group discussions revealed some remarkable material for reflecting on how rural communities have become dependent on new energy sources and how the experience of the earthquake was narrated, with a prominent role given to the sudden loss of power. The initial analysis of the results from focus group reports provides special insight into four areas of disaster aftermath and resilience:

1. The sense of existential vulnerability, the need for help in feeling safe, the task of taking care of the injured and the disruption to normal life.
2. The processes of engaging community-based resourcefulness.
3. The condition of make-do first-stage recovery.
4. The need to engage the state.

Energy service failure has become a key idiom of the postdisaster period and destabilisation of everyday life. The people in Manbu (Gorkha District) reported:

> We couldn't get latest news due to not having access to energy. It was also difficult for us to walk in the dark, to treat the wounded. Electricity based agro processing mill wasn't operational.

The earthquake shocked people when modern activities were no longer available. Lighting, TV, radio and mobile phones symbolise development and prestige status apart from their functionality.

The Dandagaon (Rasuwa District) focus group came up with one of the most powerful narratives on the energy component of the disaster's impact:

> The entire village had electric lighting facility before the earthquake and it felt like living in paradise.
>
> We used to charge our mobile phones and listen to radio. But after the earthquake our entire world has fallen into darkness.

They lost land, houses, food, drinking water and their micro-hydropower system that gave them lighting:

> We had to live in a forest cave for thirteen days without any food.

In the same district of Rasuwa, at Yarsa:

> Everything got destroyed as the result of the earthquake. Transmission wires got cut off, water storage tank and power house got destroyed. The water source also got buried due to landslide. Our community sustained enormous losses and nothing is left.

Off-grid villagers have spoken of how energy failure exacerbated the sense of being cut off. They had difficulty coping in the immediate aftermath and, subsequently, trying to get things up and running again.

The most positive example of resourcefulness came from Thangpaldhap in Sindhupalchok:

> It took around two months to completely get electricity back on service. Each electricity pole had 4 lines but they were changed to 2 lines and this was how we managed to get electricity supply system operational again. The uprooted poles were erected up again. Micro-hydro powerhouse has collapsed and we haven't been able to get there yet.
>
> The community people helped repair damage by volunteering one person per household. No other organizations helped us to re-establish electricity supply system not even Government or NEA ... the villagers had to do everything on their own.

In the state of make-do recovery and readjustment to diminished energy provision, people reflected on the role played by modern energy systems, which have provided precious support for modernising people's lives.

The focus group at Thangpaldhap (an off-grid site in Sindhupalchok) remarked:

> Before earthquake, energy was used at household and personal level in this community for lighting, T.V, Fridge, Rice cooker, Mobile Phones etc.
>
> Things have changed now because in the past energy was wasted in this community but now there isn't even 40% consumption compared to then.

7.7 Engaging the State

The testimonies of the focus groups concur with the accounts I gathered from Rasuwa that since the earthquake there has been frustration due to the lateness of response and delays in recovery assistance from the state. The national political system was already stretched after finally putting in place a new constitution, 10 years after the civil war. International NGOs were extremely generous and effective in handing out immediate assistance and materials. In the Tamang epicentre, however, old distrust in the state resurfaced. The first sums of money for rebuilding houses were given only in November 2016, and they hardly covered a quarter of the cost of what was required. A feature of the new constitution is its federal character, which potentially could address systemic and historical aspects of ethnic marginalisation, underdevelopment and central neglect.

Shradha Ghale wrote in *Wire* on 27 October 2015 that the indigenous people

> believe that measures to redress past injustices must necessarily address their concerns related to identity.… [P]rovinces in federal Nepal should encompass the territories to which Janajatis have deep historical ties. People in provinces would have a primary say in matters that affect them—how to use their natural resources, whom to elect to local bodies, which language to use in offices, courts and schools, and what constitutes development and well-being.

The state does not have caste and ethnicity data to see the unequal distribution of both damage and relief. Nor does the National Reconstruction Authority even include representatives from the victim communities. These circumstances diminish the likelihood that the voices of the more vulnerable communities will be heard.

7.8 Conclusion

The earthquakes that hit Nepal in 2015 did more than reduce to rubble the material dwellings of millions of poor people. They ruptured the means of communication among communities, their distributed kin and new infrastructures of modernity. Old traditions of village self-help kicked in to recover a semblance of survivability; however, food aid that was not even fit for livestock and the refusal of any flexibility from state offices that control forest resources (the traditional safety net for resilience), reminded Tamang villagers of their distance from the state and disempowered them from local means of emergency recovery. In the monsoon of 2015 the villagers most known to me made it their collective priority to rebuild their Buddhist temple, reaccommodate their fragile family of statues and, thereby, restore their internal communicative order for recognising the recovering citizenship of household dharma, from which blessings and power can circulate.

Other communication networks were disrupted by the failure of energy systems, and the reports gathered from focus groups across three affected districts speak of the sudden sense of being cut off from the benefits of micro-hydropower, solar and biogas installations and feeling disconnected from what was retrospectively a paradise. As things came tumbling down, people lurched into a limbo land of space and time, confronting the extremes of human predicaments and finding the resourcefulness to remake a rough-and-ready home base. In doing so they took stock of where and how they now stood on the earth, while waiting for the lights to come back on. They made new kinds of judgements about where they now stand and who they can rely on.

Notes

1. Sendai Framework for Disaster Risk Reduction 2015.
2. An interview with the bombo can be viewed in the film S*hamanic Pilgrimage to Gosainkund* by Ben Campbell and Cosmo Campbell (2004).
3. Concerns about energy services appropriate to humanitarian situations have led to various research programme initiatives, including Department for International Development (DFID's) Moving Energy Initiative.

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CHAPTER 8

The Earthquake and Ideas Lying Around

Hanna A. Ruszczyk

8.1 Ideas Lying Around

The aftermath of the Gorkha earthquake in terms of what the earthquake allowed to happen in Nepal is discussed in this chapter. I explore how the government utilised the earthquake sequence to propel ideas that were lying around in the background (Hyndman 2011). There were two 'ideas that were lying around' in April 2015. The first idea was the necessity to implement earthquake-resistant construction (ERC) bylaws as well as urban planning in the rapidly urbanising country. The second idea lying around was the need to promulgate the long-debated constitution.

In *Dual Disasters*, detailing the 2004 Indian Ocean tsunami impact, Hyndman (2011, 116) suggests that Milton Friedman's crisis hypothesis proved to be correct, 'a crisis—actual or perceived—produces real change. When that crisis occurs, the actions that are taken depend on the ideas that are lying around' (Friedman and Friedman 2002, xiv). In Aceh, Indonesia, the tsunami solidified the peace process and strengthened political resolve to stop the conflict between the Free Aceh movement and the government.

I propose that implementation of urban planning and earthquake-resistant construction as well as the political implications of the constitution and the ensuing economic blockade were as important as the

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_8

earthquake for large segments of Nepal's residents. This can be seen from the impact on Bharatpur, a medium-size Nepalese city not significantly devastated by the earthquake. I will explore what the earthquake allowed to happen through the lens of one of the largest and most rapidly urbanising cities located outside the 14 designated severely impacted districts of Nepal. The earthquake primarily affected rural areas, with the exception of Kathmandu Valley. A total of 14 districts out of the 75 were designated severely impacted, and 31 districts were designated impacted districts. Chitwan District is in the latter group.

8.2 An Earthquake

I was in Bharatpur, Nepal, only 38 miles south of the 25 April epicentre, conducting my long-term research on urban disaster community resilience, when the earthquake began, when the ground shook. The following excerpts are from my Durham University, Department of Geography PhD researcher blog[1]:

> The earthquake started at 11:56 a.m. on the day of rest (Saturday), therefore there were few vehicles traveling, the shops were still closed and few people were out in Bharatpur. My research assistant and I were walking on New Road in the industrial area of town where the India bound trucks get serviced, where buses are made etc. It is a wide unpaved road near the river. The metal was shaking on the commercial building near me. I asked R what he thought was going on. He said, "earthquake". I felt faint and not stable on the ground, there was a yellow haze and it appeared as if waves were coming from the ground and the ground was shaking horizontally. It lasted around a minute and a half. I swayed but did not fall. ...
>
> The city's infrastructure was intact and only a few buildings were damaged. The 6.7-magnitude aftershock on Sunday, April 26, was especially grim and felt almost as powerful as the Saturday earthquake. In the first 72 hours, we experienced 68 aftershocks. It was, quite simply, terrifying.

Within five to seven days after the earthquake, Bharatpur (in Chitwan District) was a transit point for people fleeing Kathmandu Valley by public transportation, primarily via bus. Due to the perception that Kathmandu Valley was dangerous; people were fleeing to temporarily live with their extended families. According to the Sub-Metropolitan City of Bharatpur (SMCB) authorities, Bharatpur provided food and water to over 100,000 people who were travelling onward to southeastern and southwestern parts of Nepal.

According to the SMCB, the 12 May earthquake caused structural damage in the city: 100 buildings were totally destroyed and 300 buildings were partially collapsed. The SMCB staff struggled with the volume of requests for structural integrity assessments of earthquake damage. Subsequently, the SMCB trained 38 volunteer engineer consultants who assessed 3000 reported damaged buildings out of a building stock of 40,000.

I wrote an article for the *Natural Hazards Observer* in August 2015. This is the concluding paragraph:

> I will return to Bharatpur in late September 2015 to continue my [PhD] fieldwork. I look forward to learning how people and the government have incorporated the earthquake experience into their lives and professional work and if the experience will change more than natural hazards mitigation, preparation and response in Nepal. I wonder if there will be changes in the political sphere, the creation of a constitution and possible municipal elections.

I sought to learn how my National Society for Earthquake Technology—Nepal (NSET) colleagues, the Bharatpur residents and the key stakeholders for the doctoral research had incorporated the earthquake experience in their lives and how important the earthquake continued to be to them. Anthropologist Edward Simpson, in his book *Political Biography of an Earthquake: Aftermath and Amnesia in Gujarat, India* (2013), describes how earthquakes are a special kind of a hazard that creates ruptures in physical, social, political and economic spheres and by which a new kind of a future can be imagined and created. He discovered that the 2001 Gujarat earthquake radically changed Gujarat, India, in the ensuing decade, leading to the 'Gujarat model' for economic development. Likewise, the Gorkha earthquake is in the process of changing Nepal physically, politically, socially and economically.

8.3 Urban Transformation

The first idea lying around that the earthquake propelled is the combination of earthquake-resistant construction and urban planning in the form of land use plans. Until very recently, Nepal was considered a rural country, albeit undergoing rapid transformation. The government, through the Ministry of Federal Affairs and Local Development (MFALD), is spearheading the transformation of Nepal from a rural country to an increasingly urban one.

In 1991, there were 33 municipalities, in 2001 there were 58 municipalities, including the metropolitan city of Kathmandu and four sub-metropolitan cities (Tanaka 2009, 144). Until April 2014, Nepal was a rural country, where 86% of its population (IFAD 2014) lived in rural areas (led by village development committees). In May 2014, 72 additional municipalities were created in Nepal (total of 130). Six months passed before these new municipalities were trained on their roles and responsibilities, including how to implement the National Building Code. This training was provided by MFALD, with financial support from the German government. In December 2014, an additional 61 municipalities were created, and some of the existing cities were enlarged, resulting in a total of 191 municipalities. In early 2015, an additional 28 municipalities were created for a total of 219. These 90 newer municipalities have not been sufficiently trained by the government in their new responsibilities, partly due to the earthquake sequence and, subsequently, the constitution and the economic blockade. Nepal is now over 40% urban in population according to MFALD.

Bharatpur is the fifth largest city of Nepal and is located in central Terai, near the border with India. Bharatpur is very different from the rural hilly and mountainous regions devastated by the earthquake. It is also very different in ethnic and caste composition from the rest of the Terai due to the significant migration of high caste groups from the hills into Bharatpur in the past three decades. Bharatpur has changed rapidly, both demographically and physically since the early 2000s. Until November 2014, Bharatpur Municipality had 14 wards and a population of 144,000. In December 2014, it became a sub-metropolitan city with 29 wards; its physical area increased by 50% and its population increased over 50% due to five amalgamated villages in the southeast and southwest of the city. These villages brought their rural poverty and specific hazards (river flooding and wild animal attacks from the jungle) to the newly created SMCB. Five months later, the earthquake struck.

The change of status from a municipality to a sub-metropolitan city, the increase in population and size of the city as well as the local authority's increase in responsibilities post-earthquake are intertwined in Bharatpur. Bharatpur can be viewed as indicative of the emerging issues and changes taking place in many other enlarged or new municipalities in Nepal post-earthquake. It is at this level, the local authority and its relationship with residents, that the impact of the earthquake and what the earthquake allowed to take place can be seen and felt most intensively.

According to the new leader of the SMCB, the government representative in Bharatpur, there are five important challenges facing post-earthquake Bharatpur (in 2015): urbanisation, solid waste management, introduction of street lighting, formalising informal businesses and increasing the tax base and implementing the National Building Code and strengthening building regulations. Disaster risk reduction (DRR) is on the list of challenges Bharatpur faces (at the bottom) in the form of the building code. From the perspective of the local authority, DRR is important, but only one of many other issues facing the rapidly urbanising city.

8.4 Earthquake-Resistant Construction in Nepal

As part of the reconstruction process post-earthquake, MFALD declared it would strictly enforce the National Building Code and earthquake-resistant construction of houses throughout the country. MFALD explained that the Department of Urban Development and Building Construction had developed amendments to the building code. These building bylaws needed to be approved by each municipality. This momentum is a positive sign for Nepal. There is a window of opportunity (Birkmann et al. 2008) for improved practices related to earthquake-resistant construction to be developed and implemented before collective institutional memory of the earthquake fades into the background.

There appears to be an understanding in the national government that this earthquake was not 'the big one', which had been expected and on which disaster scenarios had been built. Fears that the next earthquake, whenever that will be, will lead to higher fatalities and more devastation than the Gorkha earthquake are reinforcing national efforts to focus on building an earthquake-resistant infrastructure and resilient houses in the future. The Nepalese government, mobilised by the Gorkha earthquake, is requiring all local authorities to fully enforce urban planning measures, including the National Building Code and earthquake-resistant construction.

The local authorities are thrust in the midst of the government's efforts to decentralise responsibility for earthquake-resistant construction and urban planning. The Bharatpur local authority is acutely aware it will be held accountable in the future to the government, although it is struggling with insufficient human and financial resources to carry out its statutory responsibilities. Pelling (2012, 147) suggests disasters can weaken local authorities 'even further as their functions are overwhelmed'. There

has not been any additional allocated resources after the change in status to sub-metropolitan city or after the earthquake. Only additional responsibilities, in the form of development and disaster risk reduction initiatives have been given.

Before the April 2015 Gorkha earthquake, the SMCB was already attempting to implement the National Building Code (see Chap. 2). The local authority was training masons, building contractors, engineers and homeowners on ERC, with the technical support of NSET and the financial support of the U.S. Agency for International Development (USAID). After the earthquake, the local authority's motivation and determination was intensified due to pressure from MFALD. In September 2015, the SMCB executive officer met with hundreds of representatives of the construction industry and government officials to discuss the government's ERC policy. The officer publicly declared that his sub-metropolitan city would begin implementing the National Building Code 'without flexibility'.

The earthquake sequence galvanised the SMCB to intensify its efforts to enforce earthquake-resistant bylaws and the full implementation of the building code related to construction of new housing and commercial buildings because the MFALD was pressuring local authorities throughout the country. The responsibility for ensuring new construction is earthquake resistant is also beginning to shift from the public sector to the private sector. Issues of accountability, ability, training and resources within the private sector and within the local authority to process this increased workload remain to be resolved.

8.5 Urban Planning in Nepal

Post-earthquake, urban planning and land use planning became more important for the new sub-metropolitan city due to pressure from the MFALD. A senior official leading urban planning for the sub-metropolitan city explained after the earthquake:

> Now that we have 29 wards, it is more complicated, the area of the SMC is too big. In the near future, there will be a SMC master plan with a land use plan. At the present time there is no demarcation of land use. People will be angry that agricultural land cannot be residential. It is all easy on paper but in the "field" [in reality] it is difficult to implement [for the local authority]. We will also be implementing the national building code and guidelines post earthquake.

He continued by stressing that the local authority does not have the financial resources to purchase land for infrastructure initiatives or the political power to lead urban planning. 'It is back to front', according to this key respondent from the SMCB; the urban local authority is following development led by residents rather than planning it. The local officials are overwhelmed with their increased responsibilities, lack of additional resources and lack of understanding how best to implement the government dictates.

The SMCB's mandated requirement to implement urban planning in the form of a land use plan that will govern space in the city is also being viewed by many residents as a potential hardship where they will have fewer mechanisms to informally influence the urban landscape. This is important to consider because in the recent past, residents through their neighbourhood groups, called Tole-level organisations (TLOs), have been reworking the urban physical infrastructure in informal ways, in a grey space (Yiftachel 2009) created by the local authority.

The TLOs have allowed residents to influence and shape the city in an environment in which there has been no local elections since 1997. The informality of residents and the local authority, in relation to infrastructure investment (roads), has allowed the city to develop in the past decade, in spite of the local authority's limited financial resources. In the future, the collective social action, in the form of TLOs, may not be as powerful in some parts of the city if the land use plan is implemented. Mechanisms to influence the urban environment may need to be adjusted by residents.

The newly amalgamated rural wards will be particularly impacted by the new emphasis on urban planning and land use planning. Residents may not be able to sell agricultural land for house construction, and new housing construction is expected to be more tightly controlled. These changes will strengthen Bharatpur's resilience to earthquakes in the long term. In the short and medium term, these events create a perception of uncertainty for the local authority and residents because the mechanisms to informally influence their urban landscape appear to be curtailed.

Bankoff et al. (2015, 6) propose a disaster 'can be seen as simply as [an] agent of change in its broadest perspective capable of offering opportunities to push through needed policy solutions'. To what extent informality by residents for infrastructure provision will be eliminated or curtailed is unclear. It may involve a half solution; a new grey space may emerge, in which urban planning and earthquake-resistant construction implementation are broken down, frozen or modified.

Under no circumstances am I proposing that implementation of the National Building Code should not be adhered to; it is the cornerstone to earthquake-resilient construction (Wisner et al. 2012; Bosher 2008). My point is that the earthquake allowed the government to take ideas that had been lying around (ERC and urban planning) and propel implementation, albeit without ensuring the local authorities had the resources and tools to guarantee success. The government is also not ensuring mechanisms are in place for residents to have their voices heard and needs met in this uncertain environment. It is here, at the local level, at the interface between the local authority and residents where implementation may stall.

8.6 Historical Perspective of Urban Planning Post-Earthquakes

The fact that the Nepal government is using the earthquake to propel implementation of urban planning and earthquake-resistant construction is not a novel occurrence. The rebuilding of Lisbon after the great earthquake of 1755 is one of the first historical examples. The Portuguese state became intimately involved in the recovery and reconstruction process (Clark 2011). The state developed integrated urban planning and seismic-resistant building codes, many of which continued to be standard practice until the 1920s.

In 1934, issues of urban planning and earthquake-resistant construction were also discussed after the great earthquake of 15 January 1934. Major General Brahma Shumsher J. B. Rana, in his book *The Great Earthquake in Nepal, 1934 A.D.* (1935; translated into English in 2013 by Lall), meticulously detailed the recovery and reconstruction of Nepal. In relation to urban planning, he argued 'to increase the height of buildings where the streets are narrow is to invite a greater loss in an earthquake in the future' (1935 [2013], 87). He concluded the book (ibid., 97) by stating:

> Our knowledge had increased not only in the construction of houses and mansions but in laying towns too. Japan[2] has shown the way in this matter to the world. They have built better-looking, stronger and bigger cities in the place of those that were destroyed by earthquakes. They have built clean and wider streets in the place of narrow streets and lands where many lives are lost in earthquakes.

Major General Rana did not discuss why Japanese best practices were not utilised in Nepal's three cities of Kathmandu Valley (Patan, Kathmandu and Bhaktapur), although he did imply that cost may have played a role. The earthquake of 1988, which particularly impacted eastern Nepal, raised preparedness issues for Nepal as a whole (see Chap. 2).

8.7 Constitution Promulgated

Academic scholarship also shows that earthquakes have been utilised as opportunities for political and economic renewal, as a way to boost national pride and optimism. After the great Hanshin-Awaji earthquake of 1995 in Japan, Kobe was reconstructed in a 'Phoenix-like manner', with large infrastructure projects (Edgington 2010, 225).

After the Gujarat, India, 2001 earthquake, Simpson suggests there was competition to impose meaning from the earthquake: 'it was the identity of India's recent past and the immediate future which was being fought over, and in this regard, the stakes were rather high' (2013, 5). The Indian government created the Gujarat model after the earthquake. The same can be said for Nepal and the government's desire to capitalise on national optimism. Government officials were pleased that the Gorkha earthquake was not as devastating as had been expected and the initial response was managed well.

The constitution is the second idea lying around that the earthquake breathed life into and allowed to happen. The Nepal government, the constituent assembly, may have utilised the momentum created by a positive collective spirit after the Gorkha earthquake to attempt to transform the country by the promulgation of a new constitution. On 20 September 2015, the announcement of the constitution surprised most people domestically, including the Indian government, which had not expected Nepalese politicians to rally together to pass it (Fig. 8.1).

After seven years of trying to pass a new constitution and the second elected constituent assembly tasked with this goal, the earthquake accelerated the process. According to Amod Dixit, the founder and executive director of the NSET: 'If there had not been an earthquake, the constitution would not have been passed. The earthquake made people and politicians run and take action; while before they could not even walk'.

The political leaders in Kathmandu were spurred to come to consensus on the constitution after the earthquake. The earthquake may have

Fig. 8.1 Welcoming Nepal's new constitution 20 September 2015 in Bharatpur, Nepal (Source: Author's own)

mobilised leaders, who were relieved that the impact of the earthquake was not as devastating as had been expected. A political space was created where the previously quarrelling political parties agreed to pass the constitution and almost unanimously voted in favour of the constitution. This occurred in spite of protests and clashes on the Terai (flat plains bordering India) during the summer months of 2015. Some of the protests were violent, resulting in tens of people dying. This constitution has several shortcomings that the large Madhesi and Tharu ethnic communities of the Terai object to. Concerns regarding how federalism will be structured and how the country will be organised and governed remain.

I was in Nepal conducting fieldwork in Bharatpur, when the constitution was passed. People were hopeful for the country, though shocked by the tensions and deaths in the Terai, which had occurred throughout the summer and into the autumn. To a greater extent than the earthquake, the constitution is the performative event for residents in Bharatpur. It highlights people's desire for more than everyday systems. The passing of the constitution provided people with a forum to vocalise a desire for a better future; a future in which residents can aspire for more than coping and

being resilient. People manage in everyday life; they show resilience and at times are able to rework the urban reality to suit their needs and desires. The constitution raised an issue beyond the control of people—structures of government that can lead and manage the country for a better future.

The promulgation of the constitution had a powerful emotional impact on residents in Bharatpur. The people expressed their hopes and desire for the central government to lead the country and to create systems of government that will lead to stability and security for all of Nepal's residents. In the immediate aftermath of the passing of the constitution, many residents in Bharatpur were hopeful their country would emerge with proper governance systems in place, thus ensuring their nation would no longer be in transition. A businessman suggested, 'If the government is stable, it [the future] will be better. One or two people cannot change anything. We need the government'. This statement about the necessity for a stable government was repeatedly voiced in Bharatpur. Hope was raised and then dashed in the days, weeks and months after the constitution was promulgated.

8.8 Unofficial Economic Blockade

Nepal, a land-locked country, imports most of its goods from and via India. The passage of the Nepalese constitution spurred the devastating (unofficial) economic blockade on the Indian border crossings. The Indian government declared it was not safe for transportation vehicles to enter Nepal, resulting in economic turmoil throughout the country. The World Bank (2016, 1) stated, '2015 will be remembered as the year of twin shocks for Nepal', referring to the April–May earthquakes and the near complete disruption of external trade after the adoption of the new constitution in September. The World Bank continued: 'Nepal is not only a landlocked country, but is also an India-locked country' (ibid., 3); 85% of all external trade comes via India into Nepal.

The blockade ultimately resulted in almost five months of being cut off from essential items. From late September, there were minimal imports of essential goods, such as cooking gas, food, medicine, petrol, kerosene and construction materials necessary to rebuild hundreds of thousands of homes destroyed by the earthquake. Very few people expected the blockade to last more than a few days, possibly a few weeks. Winter set in and temperatures plummeted. Trees from the forests were felled and utilised as fuel for heating and cooking.

This blockade of goods created crippling economic devastation and indirectly targeted businesses and ordinary people throughout the country. It is difficult to underscore the hardship. The economic blockade impacted many millions more people throughout the country than did the earthquake.

The black market flourished in fuel and other essentials for months due to the unofficial blockade, money was made: some officials profited from the black market trade, but people throughout Nepal suffered. The ramifications will be felt for at least a decade. During the autumn, the Nepalese people, and especially the youth, had a target for their frustrations: India and, to a lesser extent, their own government and politicians.

Crisis situations are open to intensified exploitation and appropriation (Simpson 2013; Clark 2011; Klein 2008). Historically, India has influenced Nepalese affairs in a big brother role, and Narendra Modi, India's prime minister, may have been surprised by Nepal's unwillingness to acquiesce to India's suggestions related to the constitution supporting Madhesi and Tharu demands. India's actions after the constitution in the autumn of 2015 erased much of the tremendous goodwill created by India's rapid, timely and generous efforts post-earthquake. The silence of the international community in response to the economic blockade and the economic unravelling of their country also disappointed Nepal's citizens.

In February 2016, the international border crossings with India were quietly and fully reopened with no fanfare, and trade resumed. It is unclear what political wrangling took place and why the tensions in the Terai were silenced and the blockade disappeared. It is unclear how the Nepalese government, the Madhesi political leaders who demand more rights for their group and the Indian government will resolve the political, economic and environmental resource debates that continue to linger.

An earthquake can be viewed as a crisis or a catastrophe 'resulting in dual or even multiple disasters at once' (Hyndman 2011, xi). The earthquake, the passing of the constitution and the economic blockade warrant consideration as chapters of one book. Clark (2011, 73) suggests that a 'disaster demands change, precisely because of its profound rupture with the past, because of the impossibility of recasting it into positivity, of redeeming it, or even of making sense of it'. In Nepal, during the course of 2015, changes were made, and it is unclear how they will be enacted.

8.9 Conclusion

The Gorkha earthquake of April 2015 took hold of two ideas that had been lying around and propelled them into being. How the earthquake changed the environment for people who were not directly impacted—those who did not lose their homes, their families and their livelihoods or those who were not displaced—warrants reflection. An earthquake changes everything (Simpson 2013) and everyone in some way. The local level is where the changes post-earthquake can be seen and felt most intensively. What the earthquake allowed to happen was explored through the lens of Bharatpur, a city not located in one of the designated earthquake-impacted districts of Nepal.

The earthquake allowed ideas to come to life. The first idea lying around that the earthquake propelled is the combination of earthquake-resistant construction and urban planning in the form of land use plans. The government pressured local authorities to implement the National Building Code and earthquake-resistant construction bylaws after the earthquake. The necessity to consider urban planning was also renewed. Responsibility for implementation has been firmly placed with local authorities. This has occurred in an environment in which two thirds of municipalities in Nepal were created in the 12 months before the earthquake, and as of yet, they do not have the institutional, technical and financial capacity to meet this expectation. How municipalities will be able to cope is unclear.

The constitution is the second idea lying around that the earthquake propelled into action. The Nepalese government and the constituent assembly may have utilised the momentum created by a positive collective spirit after the Gorkha earthquake to attempt to transform the country by the creation of a new constitution. After seven years of debate, the constitution was promulgated in September 2015. Tensions surrounding some aspects of the constitution continued, but people were hopeful. The unexpected unofficial economic blockade on Indian border crossings, through which 85% of international trade enters Nepal, was devastating. This five-month economic crisis prevented the basic goods and materials required for the reconstruction of earthquake-destroyed homes from arriving in Nepal during a cold winter. The economic blockade negatively impacted millions more people throughout the country than did the earthquake. The impact from the Gorkha earthquake of 2015 will continue to unfold for years to come.

Notes

1. *Durham Geography Postgraduates*, 'Nepal Earthquake by Hanna Ruszczyk', 28 April 2015. http://community.dur.ac.uk/geopad/2015/04.
2. Japan had a devastating earthquake in 1923 from which the Nepal and Bihar State, India, governments were learning best practices over a decade later.

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CHAPTER 9

Green Social Work and the Uptake by the Nepal School of Social Work: Building Resilience in Disaster-Stricken Communities

Lena Dominelli

9.1 Introduction

Social work is a human rights and social justice based profession that intervenes in people's lives to promote personal well-being and equality in community life. This value-based orientation legitimates green social workers' concern with a holistic, transdisciplinary, systems-based approach to disaster risk reduction, resilience building and environmental crises, including those exacerbated by poverty in fulfilling this mandate. Green social work is a form of disaster intervention that

> focuses on how the social organisation of relationships between peoples and their interaction with the flora and fauna in their physical habitats creates the socio-economic and physical environmental crises that undermine the well-being of human beings and planet earth. Its practitioners argue for profound transformations in how people conceptualise the social basis of society, their relationships with each other, living things and the inanimate world (Dominelli 2012:25).

Green social work (GSW) is embedded in daily life routines in local communities (as depicted by the woman in Fig. 9.1). Its remit is to develop

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_9

Fig. 9.1 Older woman engaging in local ritual (Source: Author's own)

locality-specific, culturally relevant practice that encompasses micro-, meso- and macro-level practice; decision making and political governance structures; and alternative socioeconomic development models and cultural traditions. It considers the impact of these issues not only on people's livelihoods and survival chances but also on the physical environment/ecosystem's capacities to sustain itself and all life now and into the future (Dominelli 2012).

Green social workers link environmental justice to social justice discourses. In these, environmental justice means caring for the planet to ensure that people, plants and animals enjoy the right to a healthy physical environment. In addition, green social workers recognise interdependencies among people, plants, animals and the ecosystem; argue for the equitable distribution of the earth's resources; and promote green energy and technology transfers to reduce carbon footprints in meeting daily needs. Moreover, transdisciplinary GSW is evidence based. Its activities are community oriented and participative. Participatory approaches are embedded throughout its action and research processes. Research provides crucial evidence in linking policy and practice to analyses that support communities in co-producing social action plans that grow resilience and achieve transformative social change.

This chapter considers the use of the green social work model of disaster interventions by the Nepal School of Social Work (NSSW) following the 2015 Gorkha earthquakes. It explores the strengths and weaknesses of this approach in the different phases of the disaster and concludes with the lessons learned, and their resonance elsewhere.

The World Bank statistics of 2015 locate Nepal among the low-income countries – 187th out of 216, with a purchasing parity international dollar rating of 2500. Consequently, recovering from the earthquake presents Nepal with both serious setbacks and developmental opportunities. Humanitarian aid and foreign assistance flowed into Nepal to enable victim-survivors to start the long journey back to normalcy. The sums involved were significant. The staff and students at the NSSW, themselves victim-survivors of the Gorkha earthquake, were determined to engage local communities in mitigating risk and enhance resilience throughout the different stages of the disaster cycle. These included prevention, immediate relief and recovery, along side sustainable reconstruction and are considered in this chapter.

9.2 Green Social Work Values and Processes

Green social work seeks to transform public understanding about social workers' roles in disaster interventions by co-partnering with local organisations that act as entry points to local communities. These local organisations have links with local actors, including government officials and important professionals such as doctors, teachers, civil servants and village elders, who facilitate engagement with external donors. Green social workers engage these actors in partnerships based on mutual respect, dignity of the person, egalitarian power-sharing and distribution of social resources and empowering approaches that acknowledge the significance of local cultural traditions. Green social workers draw on bottom-up approaches to meet communities' self-identified practical needs, plan strategic developments, coordinate multistakeholder involvement and co-formulate sustainability as a current and future ambition. Local stakeholders make available social networks, social capital and resources that green social workers employ to provide practical assistance to victim-survivors in evacuation centres, reunite children with their families, enforce child protection measures, rehouse people and coordinate activities across diverse agencies and systems.

Green social workers facilitate community-based strategic thinking and planning; the development of resilient communities; the exchange of knowledge between scientific experts and local experts, founded on information rooted in daily life; and the engagement of local people in co-building their communities in more empowering, sustainable and egalitarian directions. They also help with the formation of communities that take care of both their residents and their physical environment, which provides their homes and the animal, plant and mineral resources that sustain life. Becoming embedded in local contexts and systems occasionally requires compromises that can feel uncomfortable—for example, protecting individual identities and confidential information, especially in cultural contexts that favour top-down governance structures or compliance with military authorities (Hoogvelt 2007).

Another difficulty arises when human development needs are so pressing that physical environments become a means to meeting human ends. Green social workers search for alternative models of socioeconomic development that do not cost the earth. They follow GSW's more holistic approach that asks people to consider themselves custodians of the natural environment and its riches, not exploiters, who will use and abuse these resources until nothing remains. The processes for achieving these goals can be difficult and sometimes perplexing.

Empathy for those in trouble is a key social work value used to build rapport and empowering relationships with victim-survivors and co-produce resilient action plans for future reconstruction. Empowerment is a process of sharing power with people. Its realisation depends on establishing trusting relationships between green social workers and scientific experts, and these two groups and the local population; actively listening to local people and their narratives; creating safe spaces for discussion; accepting the validity of local residents' views, skills and knowledge; engaging local people in decisions that affect them; and co-producing action plans to develop resilience in people, communities and infrastructures. Safe spaces are usually associated with places that community residents are familiar with and include their homes, schools or religious institutions. These places provide meaningful, locality-specific and culturally relevant spaces.

Practice that follows green social work empowerment processes is socially inclusive, reaches out to all residents, is fully participative and engages everyone in proactive problem-solving, planning and action. Once needs assessments have been completed, each person seeks reassurance about receiving their fair share of available aid, through orderly

distribution processes whereby each awaits his or her turn. Equitable redistribution of resources is absent in many disaster situations, allowing many unaffected by disasters to receive aid (Dominelli 2014). Oxfam (2015) argues aid recipients suffer indignity and unfair resource allocations because donor countries do not supply the aid funds they can and should. To this, local residents would add that governance processes are equally relevant (Dominelli 2014).

Green social work practice also understands and engages with a variety of disaster experiences to acknowledge the uniqueness of each person's involvement in and reaction to an event. Addressing these sensitively necessitates an awareness of the varied vulnerabilities and specific needs of disabled people, women and children. Mobility is particularly challenging for disabled people in disasters generally and becomes more difficult in mountainous environments. Research into the Great East Japan earthquake revealed that disabled people were 2.5 times more likely to die than able-bodied people. The figures for women were 8 times and for children 15 times higher (Doshishi University 2015). Women have specific needs as women—for example, sanitary towels/napkins. Babies need safe milk, water and other food as well as a plentiful supply of diapers/nappies. Emergency bags must cover such differentiation.

Risk is defined as either a hazard that is a non-malicious event or a threat or malicious event. Risk is deemed to have three phases: contextualisation, risk evaluation and risk mitigation or action aimed at reducing risk. Green social workers, like others, consider risk assessments as a tool for mitigating risk and assessing its impact. Risk assessments aim to reduce risk individually and/or collectively by encouraging community residents to think about their preparedness (or non-preparedness) for dealing with unexpected events whether embodying natural hazards or social risks. Moreover, risk reduction endeavours help to build resilience. Traditional risk reduction measures for individuals focus on their abilities without reference to their social position, resources, support networks or knowledge. This denies their differentiated experiences of a disaster. Thus investigating and assessing individual and community needs, capacities and resources make up the crucial first stage in GSW interventions.

Delivering aid and promoting resilience or adaptability are based on needs assessments. Individuals and communities adapt to changing circumstances, but they may do so at different rates. Green social workers realise that adaption varies according to:

- Who defines adaption.
- What issue(s) is(are) being addressed.
- The vulnerabilities to be overcome.
- The available resources.
- Local and national policies and legal remits.
- Individual and community strengths and structural barriers.
- Individual and group actions that contribute to collective action and political will.

Mitigating vulnerability and enhancing resilience are inherent to green social work practice. The United Nation defines vulnerability as 'the inability of an individual to respond effectively to events that threaten equilibrium in their environment'. Its twin concept is its opposite, resilience. The UN International Strategy for Disaster Reduction (UNISDR) defines resilience 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'. The Department for International Development (DfID) defines disaster resilience as 'the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses—such as earthquakes, drought or violent conflict, without compromising their long-term prospects' (DfID 2011:6).

Green social workers define vulnerability and resilience as more dynamic, fluid and emerging properties that are not linear or inherent in particular situations (Dominelli 2012). Instead, both are negotiated capacities utilised to enhance skills, knowledge, resources and activities that promote coping, as in the case of resilience, or not, as in the case of vulnerability, by which skills, knowledge, resources and coping activities are curtailed by social situations that are not tailored to meeting their needs (Dominelli 2012). Thus, resilience in GSW becomes the capacity that residents have to shape their political, economic and physical environments; to influence their social standing; and to adapt to changing situations or take action to improve their condition/status in life. This can replace notions of building back better, which can entrench existing inequalities with ones that shift prevailing social relations. This occurred in Sri Lanka where a women's income-generation project resulted in women planning their own trip to the Temple of the Tooth in Kandy, an outcome unthinkable before the 2004 tsunami disaster.

Capacity building in GSW is the process of equipping people with the knowledge and skills required to make decisions about their lives, how to access the resources they need and how to take action that improves their

current position. This may include incorporating personal and structural change into their routines and networking and campaigning with others to achieve change or implement agreed action plans. Capacity and resilience building strategies can be individual and/or collective. Capacity building can help transcend poverty and should be incorporated into reconstruction plans postdisaster. Building community resilience capacity relies on

- Valuing people.
- Holding egalitarian values.
- Mobilising communities and engaging all members.
- Understanding community dynamics and players and the relationships between them.
- Forming egalitarian partnerships, especially between local and overseas players.
- Building alliances to promote egalitarian social justice.

Capacity building is a constantly evolving process that threads through the entire disaster cycle. This evaluation is based on a needs-assessment carried out at the beginning of any intervention and revised continuously, particularly after each evaluation point.

9.3 Engaging the Nepal School of Social Work in Green Social Work

NSSW[1] is a newcomer to green social work and first applied it following the Gorkha earthquake. To do this, NSSW drew heavily on external support from other schools of social work across the world for funds, teaching support and personnel to assist victim-survivors.

Practising GSW became possible by focussing on transferable generic skills acquired by social workers during qualifying programs of study (Dominelli 2012). These include the skills of compiling both needs- and risk assessments, action planning, coordination of systems and people, action plan implementation and evaluation, risk mitigation and prevention. Their actions are housed within community engagement processes, participatory action research (Langan and Morton 2009; Gouin et al. 2011), co-producing solutions to build infrastructural resilience (Lane et al. 2011), reconstructing communities and ensuring sustainability (Wisner et al. 2004).

The Nepal School of Social Work GSW Gorkha initiative illustrates how social workers move out of evacuation centres when the cameras have

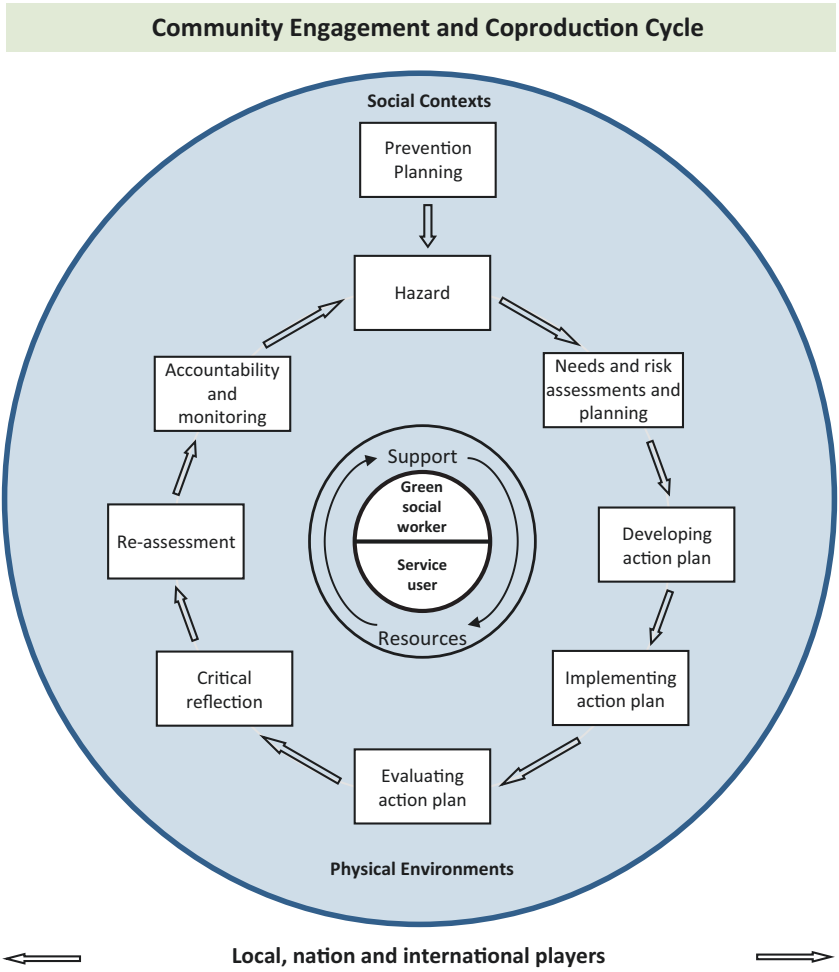

Fig. 9.2 The role of social workers in community engagement and coproduction in disasters

gone to serve communities in rebuilding their hopes and dreams through the rubble and detritus left behind when the ground stops shaking. Figure 9.2 illustrates the processes whereby green social workers and community development workers from NSSW worked in their communities. The next sections outline the evolution of GSW in NSSW's postdisaster activities.

9.3.1 Shock and Crisis Response Phase

The first earthquake struck on 25 April 2015. Staff and students at the Nepal School of Social Work in Kathmandu found parts of their building damaged. They also became victim-survivors of the earthquake, and like their family, friends and neighbours, a number of them experienced loss of lives, property and a sense of *in*security. Psychosocial and counselling social work skills were required for responding to those affected, including themselves. The importance of extending personal and community-based capacities and resilience building in the short term quickly became apparent. NSSW staff and students received support, affirming their confidence in their potential to intervene through the International Association of Schools of Social Work (IASSW). As social workers, they offered practical help and psychosocial support during this phase.

9.3.2 Virtual Helpline

Lena Dominelli,[2] chair of the Disaster Intervention, Climate Change and Sustainability Committee of the International Association of Schools of Social Work (IASSW), established the Earthquake Virtual Helpline, which was accessed via email and Skype. Through this initiative she offered NSSW support within two hours of the Gorkha earthquake occurring. The interventions followed guidelines Dominelli created after the Christchurch earthquake of 2011 (Dominelli 2012) and focussed largely on supporting those in the field; on fund raising; and on training, which included self-care.

9.3.3 Immediate Relief and Recovery Phase

On 28 April 2015, victim-survivors from NSSW—three students and three faculty members, met to discuss a crisis response and prepare an action plan to assist other victim-survivors. They determined to go to Village Development Committee (VDC) Sipa Pokhare in the Sindhupalchok area to assess needs, find resources, develop social capital and capacity and deliver aid. They chose this area because its communities were heavily devastated and because NSSW had existing links through students who had been previously placed in local rural camps to undertake practice placements as part of their qualifying programme in social work. Moreover, villagers in these locations had received no government aid.

To do this work, the NSSW team drew on core social work skills embedded in interviewing people to conduct needs assessments, crisis

interventions and community development models covered in their preliminary training in GSW the week before the earthquake struck. Once in VDC Sipa Pokhare, they identified 913 households in nine wards that required immediate aid. Each family received a tent, mattress, blanket, groceries (rice, lentils, biscuits), toothpaste and toothbrushes, soap and mosquito repellent. The second earthquake on 12 May 2015, stretched the NSSW team's meagre resources, but they decided to extend their assistance to the new victim-survivors. Ultimately, those using the GSW model in the field reached 12,000 individuals.

Meanwhile, the NSSW staff continued to receive help from various organisations, including Galkot Samaj Japan, the Mahatma Gandhi Memorial Foundation, Jhapa Marwadi Samaj, the Vishal Group and the Institute of Hazard, Risk and Resilience (IHRR) and School of Applied Social Sciences (SASS) at Durham University. Several schools and departments of social work in IASSW responded to calls for funds to purchase, package and distribute materials. Some, such as the Tata Institute of Social Sciences (TISS), which had been developing expertise in disaster interventions since 1947 (Desai 2007), sent social work staff and students to support NSSW's initiatives in Sindhupalchok, especially VDC Sipa Pokhare, by delivering aid to villagers and supporting training in GSW alongside that offered through the Earthquake Virtual Helpline.

Local people including schoolchildren assisted in aid distribution endeavours from the beginning. Schoolchildren became especially crucial in raising awareness about earthquakes. Many had been traumatised by the earthquake, and this provided a way of making sense of their experiences. Moreover, keeping them active and focussed, reduced their fears. During this phase, NSSW staff and students also identified needs that still had to be met: sanitation facilities to reduce the spread of diseases, schools for children to resume normal routines quickly, psychosocial counselling to address trauma and rebuilding communities back better, as local residents wished.

9.3.4 Reconstruction Phase

By the time NSSW staff and students returned to Sipa Pokhare following the moonson season and having sat their examinations in Kathmandu, they faced a number of reconstruction challenges, such as transportation difficulties, shortages of financial resources and skilled personnel with community-based disaster risk reduction (CBDRR) knowledge and personnel who were unfamiliar with interdisciplinary approaches to CBDRR. In

addition, the idea of building back better was limited by socioeconomic models of development that stretched the physical environment to its limits and cultural norms that hindered people from thinking outside the box.

9.3.4.1 Intervention Site

The NSSW team chose Semjong village, Dhading District, as the intervention site, using GSW to respond to practical concerns, devise coping strategies to reduce poverty and vulnerability and enhance future resiliency because local residents prioritised addressing pressing development challenges.

9.3.4.2 Demographic Characteristics

The ethnic composition of Semjong was 95% Tamang, a local indigenous group, and 5% Dalit. Their poverty and low social status were counteracted by large numbers of Tamang men working in the Indian Army, and Dalit men employed in the Nepalese Army, providing externally sourced incomes for some community members. The large number of men working abroad and sending remittances were unavailable for local self-help initiatives. Thus, those on the spot had to develop alternative ways of supporting each other before, during and after a disaster. Moreover, the working-age village men were absent from discussions about what kind of community should arise from the detritus of the old. Nonetheless, Semjong's demographic composition provided psychological strengths and a keenness to utilise self-help to normalise their situation quickly. Self-help is crucial in CBDRR for developing mitigation and preventative strategies that reduce or eliminate hazard risk and for responding to disaster victim-survivors before emergency services arrive (Twigg 2009). In poor mountainous terrain, where flights are difficult and/or scarce, having a capacity for self-help may mean the difference between surviving and dying. Resilience cannot be taken for granted, especially among the more vulnerable segments of the population, such as older people, children, disabled people and women.

9.3.4.3 The Survey

NSSW's green social work team of staff, students and residents developed a survey to identify specific needs and seek funds to promote income generation as the pathway to a more sustainable future. In 2016, a survey of 174 villagers in Dhading District returned 170 questionnaires. Most villagers expressed a willingness to engage in collective action rooted in

self-help to 'make things better' (152 of 170) and 'manage future earthquakes more successfully' (127 of 170). To achieve their objectives within a two-year time frame, 131 of 170 were prepared 'to work with NGOs', despite a degree of mistrust over their intentions. Villagers claimed they could 'not forget the 2015 earthquakes' (139 of 170), but stated that they 'had coped well at the time' (145 of 170) and 'after the earthquake' (135 of 170) to reveal extensive resilience. The literature evidences a drop in confidence in the capacity to deal effectively with the aftermath arises when the enormity of the losses strikes victim-survivors. In some disasters, individuals utilise religious rituals to strengthen their psychological resolve and enable them to move on (Sibley and Bulbulia 2012).

Moreover, children were of particular concern, with 160 of 170 saying they should 'remain together with family'. This finding reflects the literature, which emphasises family reunification as the best protection for children (Bragin 2007). Nonetheless, villagers thought that, children were 'dealing less well with the consequences of the earthquake than adults' (109 of 170). Many children had continuing emotional difficulties, including nightmares, bed-wetting and fear of losing family members. These trends, villagers felt, undermined development and deprived children of a sustainable future.

Although endeavouring to uncover better socioeconomic models of development for Nepal, survey results on this point were disappointing. Some villagers were concerned that contemporary resilience discourses locked them into the Western forms of modernisation and urbanisation that had created overcrowded, polluted cities and underdeveloped rural areas. Others wondered whether the earthquakes could provide Nepal with opportunities for transformative, sustainable models of development. However, these questions took second place to more pressing concerns about survival, acquiring housing, ensuring schooling for children and having sustainable employment prospects. Thus these were prioritised.

9.3.4.4 Children's Vulnerability

Children are vulnerable to various forces that exploit their dependence on adults and responsibility for contributing to the family's well-being. These vulnerabilities can be exacerbated following a disaster, as appears to be the case in Nepal. According to Nikku (2016), trafficking of women and children has increased significantly in this country since the disaster. Its gendered dimensions were also evident. Nongovernmental organisations (NGOs) reported substantial increases in child trafficking and prostitution,

especially of girls (Brülisauer 2015). Girls and young people were more susceptible to being trafficked, sold into prostitution or being sexually exploited to provide funds for poor families (Nikku 2016). Some families became complicit in these developments by encouraging girls to sell their bodies to enable the family to survive and thus contribute to its well-being (Nikku 2016). Many children remain unaware of trafficking transactions or its growth as a global business that makes substantial profits for organised crime (Craig 2013). To protect children, green social workers also focus on these kinds of issues.

9.3.4.5 Income Generation

The poverty found in some villages and social groups before the Gorkha earthquake was exacerbated by the postdisaster devastation. Semjong villagers chose income-generating schemes to overcome poverty. NSSW's green social workers followed inclusive principles, involving all poor people in a variety of schemes, including the formation of a community kitchen in Chautara School, growing vegetables in a kitchen garden, organising a midday meal for students attending the school and supporting a mothers' group to develop livelihood projects.

Following discussions with women villagers, a number of traditional activities were identified as possible income earners that might ensure long-term sustainability—for example, knitting woollen bags, sewing materials, drying amala (a fruit), making dalle khursani (pickled chilli) and growing coffee. The coffee bushes, provided by an NGO, would ensure a long-term crop, whereas the fruit and chillies were considered cash crops with quick, but limited returns. In addition, the women wanted to link up with the Fair Trade Organisation and other social enterprises to get a decent return on their labour and products. Nikku and Dominelli provided the relevant information to facilitate these endeavours.

Concern over long-term sustainability led to further discussions about alternatives, and traditional culture again provided a suggestion that the women adopted. This was to raise livestock, in particular goats, which women traditionally reared to earn money of their own. The other attraction of this option was that local breeds of goats could provide sufficient meat for sale. Dominelli pointed out that goats could be environmentally destructive and cause extensive soil erosion if not managed properly or their numbers restrained. The women's group is currently considering how to control their goats to mitigate environmental damage, and advice will be sought from local agricultural experts. This indicates how local and

external knowledges interact and highlights the importance of good communication if local people are to access scientific information. Another issue surfaced around the distribution of goats. At the time of this writing, NSSW had funds to purchase 10 goats, but 20 families needed them. At 1 goat per family, another 10 would cost £2000, and raising these funds was proving problematic. If the requisite funds do not materialise, another challenge will be devising strategies that share 10 goats among everyone. Raising them collectively and equitably sharing funds from their sale is one solution worth exploring.

9.4 Future Capacity Building

Green social workers have responsibility for facilitating future developments in risk mitigation utilising capacity-building strategies, preventative measures and a variety of approaches in co-producing these with local residents. NSSW is endeavouring to develop capacity-building skills.

9.4.1 Prevention

Green social workers promote preventative initiatives, including capacity building in communities and among professionals throughout the disaster cycle. Contemporary disaster risk reduction activities focus on these after a disaster, particularly during the reconstruction stage. Thinking turns to prevention to protect lives, infrastructure and ecosystems when previous activities and infrastructures have been evaluated. Developing preventative strategies can provide entry points for communicating the science of earthquakes and the earth's seismological movements to people. In Nepal, the National Society for Earthquake Technology—Nepal (NSET) has a lengthy history of communicating the science of earthquakes and construction of earthquake-proof houses, including devising building codes for new structures and retrofitting older buildings. NSET and NSSW as members of Earthquakes without Frontiers (EwF) are working together. The week before the 25 April disaster, the EwF Project Meeting was hosted by NSET in Kathmandu. An earthquake tour around the city and visiting schools that had been retrofitted provided occasions to evaluate the measures that had been taken. During that week, Dominelli provided NSSW with initial GSW training, which included minor suggestions about fixing furniture to walls and floors and protecting books. However, there was insufficient time to undertake these precautions before the earthquake.

Further prevention strategies currently include early warning systems (EWSs), especially in evaluating earth movements that might contribute to landslides. Such landslides are secondary earthquake-related hazards where slope stability is undermined. Monsoon rains intensify slope vulnerability by increasing erosion. During July 2016, monsoon-related landslides blocked roads and prevented the NSSW team from reaching Semjong for months. Floods in the Terai—the fertile plains between the Madheri and Pahadi hills—diverted the NSSW team's energies away from supporting local victim-survivors, forcing them to wait four months for Himalayan roads to become passible.

Back on the road to Dhading, NSSW's inadequate preparations became evident. Vehicles failed to navigate the inhospitable terrain, so the NSSW team faced an additional two-day walk to Semjong. This exposed them to other challenges, including being bitten by leeches when crossing swollen rivers. This hazard, which could have been easily mitigated with prior planning, became a source for acquiring preventative knowledge. It also highlighted the importance of GSW's holistic approach to disaster risk reduction and resilience building, which covers simple health measures to avoid unpleasant environmental encounters.

9.4.2 Self-Care

Self-care, although poorly enacted, is central to practitioner well-being (Cronin et al. 2007). It involves looking after oneself emotionally, practically and intellectually. Emotional needs can be discussed with supervisors, team leaders, peers and trainers on the Earthquake Virtual Helpline. Practical considerations include thinking about preparing family and friends for departure, arrangements for leaving one's residence, acquiring cultural knowledge and some local words, getting any necessary health treatments (such as vaccinations, malaria pills, insulin) before departure and making adjustments to insurance coverage. Wearing appropriate clothing and carrying salt are effective known antidotes to leeches. The NSSW students will remember these lessons and incorporate them in future self-care preparations.

9.4.3 Interdisciplinary Cooperation

Interdisciplinary cooperation was evidenced during the EwF meeting, as different experts shared state-of-the-art knowledge about Nepal's fault lines and social science responses. Social science questions involving culture

arose during the earthquake walkabout. Wandering through narrow alleyways and crowded buildings that lacked earthquake proofing made Dominelli realise the vulnerability of the whole of Kathmandu, and with it her own. She asked whether there were discussions about cultural barriers contributing to housing vulnerability posed by providing each male with a share of the family home. The question was greeted with a shrug and the statement, 'It is difficult to do anything about culture'. This concern, shared by NSSW, revealed that interdisciplinary teams could raise complex and difficult issues. Responding to them requires research exploring people's willingness to reassess cultural practices given their experiences of loss from this devastating earthquake. Preventative and capacity-building initiatives are essential, given that the 2015 Gorkha earthquake was not the big one expected to hit the south of Kathmandu, according to EwF co-investigator John Elliott. Cultures are not static entities. They adapt and change to new eventualities, ideologies and material circumstances. NSET and NSSW are working together to devise and administer surveys that establish benchmarks around peoples' knowledge of earthquakes and their commitment to engaging in preventative risk mitigation strategies to develop stronger communities and build back better, at least as far as housing is concerned.

Communicating the science—or asking people what they know, what they want to know and how science should be communicated to them—is another important aspect of CBDRR, and is significant in co-devising capacity-building, preventative and/or preparation strategies. When engaging people in the acquisition of scientific expertise, treating them as active learners who have agency in responding to what is being communicated and who hold their own local expertise offers a positive way of engaging local people (Lane et al. 2011). If they become active participants in building the knowledge base and recovery processes, the co-production of new data and ideas is more likely.

9.5 Conclusions

The NSSW team of staff and students are an inspiring example of how victim-survivors of a disaster can engage in self-help and draw on their social networks to develop social capital and stretch limited resources to the maximum to develop activities, capacities and livelihoods to meet future needs. The NSSW team also revealed the importance of training in developing professional skills that serve people in devastated communities

for short- and long-term endeavours. Developing transdisciplinary approaches that link the sciences (physical and social) to community expertise in the co-production of solutions that enhance prevention, preparation and resilience are indispensable in building back better. Along with NSSW's achievements, the task of developing CBDRR from a green social work perspective has substantial potential for further development. The roles that green social workers play are extensive because they engage in all aspects of aid delivery, risk mitigation and prevention throughout the disaster cycle. GSW champions active participation of local people in rebuilding their communities, with all the challenges and opportunities this provides, providing a message with the potential to resonate in other disaster-prone communities in Nepal and elsewhere. At the same time, there are enormous openings for future research, including longitudinal studies in how people co-develop resilient strategies that meet their needs.

Acknowledgements The staff, students and village victim-survivors who shared their thoughts for this chapter are gratefully acknowledged. Your experiences and energy remain sources of inspiration.

Notes

1. A member of the Earthquake without Frontiers (EwF) Project (http://ewf.nerc.ac.uk).
2. Co-investigator on the EwF project.

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CHAPTER 10

Look Down, Not Up: Protecting the Post-disaster Subsurface Heritage of the Kathmandu Valley's UNESCO World Heritage Site

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10.1 Introduction

Short-term environmental shocks can generate long-term social and economic impacts and although the Gorkha earthquake devastated large areas of Nepal and neighbouring regions, it also caused a cultural catastrophe, damaging and destroying parts of Nepal's cultural heritage, including the

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_10

Kathmandu Valley's UNESCO site. Not just beautifully ornate temples and palaces of wood, brick and tile, the structures represent a major source of income through tourism and play a central ritual role in the daily lives of thousands. This human catastrophe was not unique because Nepal is prone to seismic activity, with regular earthquakes recorded since the twelfth century C.E. (Gautam et al. 2015: 1–3; Mugnier et al. 2013; Sapkota et al. 2013; Schwanghart et al. 2015), and South Asia as a whole is at continued risk from environmental shocks. For example, the Gorkha earthquake caused an estimated 9000 fatalities and damage totalling over US$23 million, the 2004 tsunami killed 30,000 people and caused US$1.5 billion damage in Sri Lanka alone. Myanmar's 2016 Chauk earthquake showed that even when fatalities and damage are low, heritage can be significantly affected, with 400 shrines damaged at the tentative UNESCO World Heritage Site of Bagan.

International emergency responses meet immediate humanitarian and infrastructural needs, but the evaluation of heritage impact is rarely prioritised, despite the need to assess causes of damage and longer-term impacts on tangible and intangible cultural and economic growth. Subsequent rapid structural rehabilitation can exasperate inequalities, leading to cultural appropriation and irreversible negative impacts (Coningham et al. 2016a). Although many damaged monuments in Kathmandu are now subject to programs of reconstruction and conservation, most focus on standing architecture with negligible attention paid to the archaeological deposits below the ground (subsurface heritage) or the condition of the foundations. In response, a multidisciplinary team co-led by Durham University; the Department of Archaeology (DoA) of the Government of Nepal; and Stirling University undertook pilot post-disaster rescue excavations and surveys in 2015 and 2016, with funding from the Arts and Humanities Research Council (AHRC), UNESCO and the National Geographic Society and with field support from the Pashupati Area Development Trust (PADT) and Bhaktapur, Kathmandu and Lalitpur municipalities.

10.2 Post-disaster Destruction of Subsurface Heritage

The Gorkha earthquake dramatically altered Kathmandu's skyline in minutes on 25 April 2015, but damage was also caused by post-earthquake emergency operations. This is exemplified by the Kasthamandap's collapse,

Fig. 10.1 Clearance of debris from the Kasthamandap in the post-earthquake emergency phase

one of Kathmandu's oldest monuments, where bulldozers and JCBs assisted rescue efforts (Fig. 10.1). These machines cut through the monument's floor, destroying almost half of its historic footprint (Coningham et al. 2016b). Although emergency interventions are understandable, avoidable damage also occurred in the post-emergency phase. Some monuments were demolished to minimise the impact of their potential collapse (Fig. 10.2) but the undamaged foundations of others were dug into by architects and engineers. In each instance, no record of archaeological materials was made, and at Patan's Mani Mandapa, the foundations of the north pavilion were partly dug and the south pavilion was entirely removed. Its original foundations and soil fills had survived the collapse but the undocumented removal of what is referred to as 'trash' (KVPT 2016: 7) (Fig. 10.3) has led to the complete loss of its archaeological sequence (Coningham et al. 2016a).

Fig. 10.2 Military personnel deliberately collapsing a damaged shrine at Pashupati (Source: Image Courtesy of Pashupati Area Development Trust)

Many undamaged foundations were thus destroyed by undocumented and unscientific digging, with the loss of archaeological evidence and the historic record of their development and adaptation. Interventions were focussed on rapid reconstruction, with little thought for subsurface heritage or the evaluation of existing foundations. Irreversible interventions were not limited to subsurface remains, as other damaged monuments have had their authenticity compromised by the introduction of modern materials (Fig. 10.4). For example, the brick *harmika*, or platform above the dome of the Baudhanath Mahachaitya was dismantled with no record made of its construction details before it was rebuilt on a concrete and steel foundation (Weise 2015). Unfortunately, these practices have precedents as a number of pre-2015 renovations had already destroyed subsurface heritage and compromised superstructure authenticity (UNESCO 2015: 7).

Once inviolable monuments, Kathmandu's current environment offers a unique opportunity to focus rescue archaeology and survey on evaluating the condition of the foundations of historic structures and reconstructing their seismic adaptation. The need for such work is critical

Fig. 10.3 Post-disaster stages of subsurface interventions at the Mani Mandapa, Patan. The southern pavilion, with soil fills intact post-earthquake, November 2015 (*top left*). Clearance of soil fills in the southern pavilion, May 2016 (*top right*). Soil removed from the northern pavilion, with ceramics present within the soil, February 2017 (*bottom left*). View to the south showing complete removal of foundations of the southern pavilion and surviving brick foundations of the northern pavilion after removal of soil fills, February 2017 (*bottom right*)

because research has previously focussed on Kathmandu's standing architecture, mostly attributed to between the fifteenth and eighteen centuries C.E. (Gutschow 2011; Korn 2007, 2014; Hutt 1994), and little is known of the nature of earlier phases or foundations. Now that these are at risk from undocumented interventions, we need to look down, not up.

10.3 Post-disaster Rescue Archaeology Interventions

We focussed on Bhaktapur, Hanuman Dhoka and Patan, while conducting additional training activities at Pashupati, and our objectives were to

Fig. 10.4 Use of cement and steel frames visible within reconstruction of the Lakshmi Narayan Temple by KVPT in Hanuman Dhoka's Durbar Square (Photographed in December 2016)

Evaluate the subsurface archaeology of these UNESCO sites.

- Evaluate the nature and condition of the foundations of collapsed monuments to assist the preparation of plans for their reconstruction.
- Evaluate the cultural sequence and the phasing of collapsed monuments, including subsurface deposits.
- Scientifically date and characterise the cultural sequences.
- Characterise and protect the subsurface archaeology by developing archaeological risk maps for site managers to guide future development and infrastructure interventions for sustainable development.
- Offer training in the postdisaster analysis and evaluation of monuments.

10.3.1 The Durbar Squares

Kathmandu's Durbar Squares have long attracted attention as the settings for palaces and shrines, and their associated tangible and intangible practices, but there is debate as to their earlier configurations. They are attributed less historic value than are their current standing monuments, and sewers and services have been cut through them. Having witnessed the re-laying of services, we initiated a ground penetrating radar (GPR) survey. We had used more traditional geophysical magnetometry in the Terai, which identifies variances in the magnetism of subsurface soils and structures, but this was not possible here because the magnetism of the squares' paving blocks out identification of archaeology below. Our most striking results were at Bhaktapur, where we identified modern pipelines but also rectilinear anomalies. Some of these were the Lampati's foundations, a two-storied *sattal* (or rest house), which collapsed in the 1934 Bihar earthquake and was not rebuilt. Subsequent excavation exposed its walls below the paving (Fig. 10.5), demonstrating that the square was not always open but had a complex history of organic and opportunistic development (Coningham et al. 2016c).

In addition to identifying historic structures under the square, we confirmed that such structures had been damaged by modern pipelines. While we did not suggest the suspension of the re-laying of services, we did recommended the mobilisation of archaeological teams to undertake rescue excavations in advance of interventions. To aid this process, we co-produced archaeological risk maps to guide site managers. Using a traffic light system of red, yellow and green, we created designated areas with recommendations to help guide physical planning and to facilitate the development of an awareness for the protection of the subsurface heritage while not deterring the rehabilitation of essential services (Coningham et al. 2016a) (Fig. 10.6).

Bhaktapur was not the only instance of earlier phases of occupation below the current ground surface; we also identified a clay platform at Patan adjacent to the Char Narayan Temple (Coningham et al. 2016d). Confirming the presence of an earlier structural footprint, we noted that the platform also represents one of the few examples of construction in non-durable materials. Similarly, our excavations at Hanuman Dhoka's Maja Dega and Trailokya Mohan temples exposed earlier structures on different alignments. The former was represented by a monumental brick wall (Fig. 10.7), and the latter was suggestive of a domestic structure (Fig. 10.8).

Fig. 10.5 Earlier wall alignments below the current paving and post-1934 level of paving

Although we await scientific dates to phase these structures, we can confirm that Hanuman Dhoka was organic, reconfiguring over time, rather than conforming to a static preplanned cityscape. These findings reaffirm the need for subsurface archaeological assessments before reconstruction or intrusive interventions are undertaken across the UNESCO site and clearly demonstrate the need for the expansion of the process of risk mapping to protect subsurface heritage from destruction.

10.3.2 The Kasthamandap

Our second focus was the excavation of damaged and destroyed monuments to understand their construction, identify reasons for their collapse and record the state of their foundations before rebuilding. These included

Fig. 10.6 Provisional archaeological risk map of Bhaktapur's Durbar Square, based on results from GPR survey and excavation

Fig. 10.7 Earlier wall of a structure identified below the lowest plinth of the Maja Degu Temple, also illustrating intrusive cut for metal fencing

Fig. 10.8 Earlier wall of a domestic structure identified below the outer plinths of the Trailokya Mohan Temple, cut through by outer plinth (*right*) and built on top of by inner plinth (*left*)

Bhaktapur's Vatsala and Patan's Char Narayan as well as Maja Dega, Trailokya Mohan and Jaisidewal in Hanuman Dhoka, with a major programme at the Kasthamandap (Fig. 10.9). Kathmandu's eponymous monument, the Kasthamandap collapsed during the Gorkha earthquake and has become an icon of the valley's lost heritage (Fig. 10.10). Its collapse led to high fatalities and the government, Kathmandu Metropolitan City and local communities quickly pledged to rebuild. Although there have been many studies of its timber superstructure, nothing was known about its foundations. Our field seasons have provided new data for archaeologists and historians as well as for engineers and architects tasked with reconstruction.

The first step in studying the Kasthamandap involved the removal of rubble because the emergency mobilisation of machinery had damaged its southern half. We recorded this rubble because it contained historic and modern materials, including personal effects. The rubble also contained displaced structural elements, such as saddlestones, which formed the link between the foundations and the superstructure, that were salvaged for reconstruction (Fig. 10.11). Once the rubble was removed, we documented the damage to floors before excavating its foundations.

Fig. 10.9 The Kasthamandap before the 2015 Gorkha earthquake

Fig. 10.10 Post-disaster awareness mural of the Kasthamandap painted on a wall adjacent to the Maitighar-Babarmahal road, Kathmandu

Fig. 10.11 Saddlestone identified within the rubble of the Kasthamandap

Our research demonstrates that the Kasthamandap's foundations were laid in the seventh century C.E. These involved the construction of four massive brick piers at the centre of the building. These piers, constructed to support the timber superstructure, were surrounded by a square foundation wall enclosing an area of 12 m by 12 m. A monumental construction, it was subject to major remodelling within 200 years when bracing walls were added between the piers and the inner foundation wall (Fig. 10.12). Four saddlestones cut with mason sockets were laid above the piers and 16 double saddlestones were placed above the foundation wall, into which the timber superstructure was locked. These details indicate that the Kasthamandap can be attributed to a late Licchavi date, confirming Slusser's hypothesis that 'most of the principal national shrines, the temples and stupas, can be traced to Licchavi foundations' (1982: 39).

This pattern of a nine-celled mandala draws from the Kathmandu Valley's intangible traditions (Verardi 1988; Tiwari 2009) but also indicates adaptation to its seismic environment. Our excavations revealed that the 2 m deep foundations were set in mud mortar, offering flexibility during seismic events. It is probable that the mud mortar saved the building from greater stress, limiting damage to a few locations. As noted by engineers from Tokyo's National Research Institute for Cultural Properties, devastating collapses are prevented as joint failure precedes brick failure (TNRICP 2016: 58). The exposed foundations exhibited no major dam-

Fig. 10.12 Nine-celled mandala layout formed at the Kasthamandap by foundation wall, cross-walls and brick piers

age, although minor damage in the form of short vertical cracks in bricks was present below a double saddlestone (pers.com. Dr Paolo Forlin) (Fig. 10.13). Limited to the upper courses, such cracks provide evidence of seismic stress, as the pressure of vertical movement caused the wall below to be damaged by the weight of the saddlestone.

We also identified that while the foundations had survived undamaged since the ninth century, the superstructure was weakened during a 1960s conservation project. At that time conservators encountered a rotten tenon at the base of one of the central timber pillars and pushed this decayed element into the socket below and tiled over (Fig. 10.14). We also recorded evidence of this practice under other major structural elements, weakening the building's overall integrity. Contributing factors in the collapse, these pillars were freestanding, potentially moving at a different rate from the rest of the structure. Our report has been submitted to the panel charged with reconstruction, and we have made recommendations that the foundations should be retained as far as possible. We have further recommended that elements should be strengthened or replaced only if there is valid justification and that reused bricks of the same size and

Fig. 10.13 Vertical cracks below a double saddlestone in the east facing elevation of the western north–south foundation alignment of the Kasthamandap

Fig. 10.14 Major saddlestone concealed below the tiled surface of the Kasthamandap

strength be set within a traditional mud mortar to reconstruct the walls to their original heights and thicknesses; these recommendations were included in an archaeological watching brief. We also recommended that scientific analysis and dating of timber from unrecyclable elements be undertaken to develop a clearer understanding of past phasing of construction and maintenance, which would then guide the cyclical renewal of the monument in the future.

10.4 Conventions and Guidelines

Subsurface heritage and earlier foundations have been neglected in the pressurised environment to rebuild, even though they can offer evidence of historical development and adaption. This neglect extends to guidelines, planning and postdisaster assessments, such as the *Post Disaster Needs Assessment* (PDNA 2015) and the draft *Conservation Guidelines for Post 2015 Earthquake Rehabilitation: Conservation Guidelines 2015* (CGPERCG 2015), which lacked strength in protecting subsurface heritage. The PDNA provided a preliminary description of cultural damage from the earthquake and outlined 'an initial assessment of short, medium, and long-term intervention needs' (PDNA 2015: 1). It identified a six-year recovery period, during which the restoration and reconstruction of historic buildings would be completed (ibid.: 9). With costs of US$34 million per year, it recommended that the recovery plan 'should include substantial support to the DoA in financing necessary equipment and additional professional staff'. Furthermore, it advocated 'extensive training at all levels of project planning and restoration implementation' and that 'educational support also needs to be provided for advanced studies in conservation-related professions' (ibid.). Detail was also provided as to numbers of professionals to be recruited to assist DoA staff—namely 10 managers, 10 engineers, eight architects, 10 draftsmen, five accountants, five office assistants and two archaeologists (ibid.: 15). The focus on standing monuments is reflected in the low count of archaeologists, illustrating the low priority for safeguarding subsurface heritage despite the need to analyse the foundations of monuments. This priority is concerning because the report also noted that there had already been a shift in urban development programs from preservation to modernisation, with pressure on providing basic intrusive infrastructure (ibid.: 4).

A parallel paucity was present in the draft CGPERCG, although it did recognise the need for rescue excavations (CGPERCG 2015) and recommended that monuments be reconstructed in their original form by reusing

as much salvaged material as possible in their original location and function. Our reports have supported the guideline that monuments retain their original structural system, which should be improved only if there is valid justification. However, in view of the significance and vulnerability of Kathmandu's subsurface heritage, we also recommended that guidelines relating to subsurface remains be strengthened, including references to the protection of foundations. Such considerations were to be included in heritage impact assessments, with intrusive developmental interventions preceded by a watching brief and, if necessary, rescue archaeology (Coningham et al. 2016a).

Our fieldwork and recommendations are now influencing practice, and we were invited to co-direct rescue investigations at the Jaisidewal, Jagannath and Gopinath temples in Hanuman Dhoka before reconstruction and conservation began, with a watching brief at the Trailokya Mohan Temple in 2016. Furthermore, rescue excavations undertaken by the DoA in 2017 during Chinese-sponsored conservation at the Basantapur Palace stressed that they had been 'conducted in line with recent UNESCO recommendations concerning the restoration and rehabilitation of the monuments of the Kathmandu Valley (Weise 2015; Coningham et al. 2015)' (Kunwar and Gyawali 2016: 3). Their report also included reference to the requirement for understanding the condition of foundations as well as the need to protect and understanding sub-surface deposits (ibid.).

10.5 Protocols and Capacity Strengthening

Having uncovered earlier phases of monuments and settlements, which would have been lost without rescue excavations in advance of reconstruction, the events of 2015 illustrate the need for capacity strengthening and training. Although detailed archaeological rescue excavations are now being conducted in the nonemergency phase, there is a capacity gap in the protection of heritage sites in the aftermath of an earthquake. Indeed, it was observed that materials from different monuments became mixed after the Gorkha earthquake, including the removal and mixing of modern and archaeological material. Material was then removed en masse by trucks and dumped unsorted (Fig. 10.15). While humanitarian efforts are of paramount importance, this was a critical phase for heritage protection. Therefore, it is imperative that first responders are trained in the protection of heritage and recovery of historic materials. There is also an economic imperative to reuse materials because newly fired brick for heritage construction is in short supply and costs an estimated £1.31 each, let alone

Fig. 10.15 An army truck removing debris from Hanuman Dhoka's Durbar Square (*top*). Debris dumped at Tundikhel (*bottom*)

the environmental repercussions of firing thousands of bricks. This is a significant cost, considering the hundreds of thousands of bricks inadvertently dumped during United Nations Development Programme-sponsored clearing because the focus was on freeing communication networks not on reclaiming cultural heritage sites (Fig. 10.15).

As a result, we co-organised a live training exercise within the Pashupati Temple complex to pilot post-disaster heritage recovery methodologies. While most monuments at Pashupati survived, some sustained damage. This included the Guruju Sattal, a three-storey rest house at its western entrance that was badly damaged, and the unstable structure was demolished. The rubble spread over its foundations provided an ideal opportunity to train first responders and included participants from the Nepal Police, Armed Police Force and Nepalese Army as well as heritage professionals from the DoA, and officers from the site manager, PADT.

The Guruju Sattal's ruins allowed us to replicate a collapsed monument, similar to those encountered in a post-earthquake phase but in a safe training environment. It also offered first responders skills and knowledge of post-disaster archaeological methods and protocols to enable the protection of heritage sites alongside rapid response during search and rescue efforts. Because there was a lack of resources for the recording, recovery and sorting of archaeological material during the emergency response phase, especially among first responders, who were present on the scene postdisaster and who encountered archaeological materials during this very difficult and stressful phase of humanitarian recovery, we aimed to develop a simple methodology with three key requirements:

1. A method that could be quickly implemented at, and transferred to, any collapsed monument.
2. A method that could be implemented quickly and would not impede the recovery of trapped or injured people within a collapsed monument.
3. A method that could be implemented by nonheritage experts without specialised equipment.

Guruju Sattal provided an ideal monument around which to co-produce the methodology and protocols in a non-threatening environment, and the following methodology was devised. As speed is of the

essence, the size of the rubble spread from the collapsed monument should be quickly assessed and gridded into squares. The rationale behind the grid is that any rubble removed can be linked to a specific provenance in a particular locality. The grid therefore allows for the quick removal of material with a robust spatial location. A replicated grid is created near the site, mirroring the layout of the trench, with rubble moved into the corresponding grid square. This replicated grid can be constructed from bamboo or metal scaffolding or outlined with lime, depending on availability of materials in the immediate postdisaster period. In later processing, this means that artefacts, including structural elements, can be spatially reconstructed in the hope that salvaged material could possibly be reused in reconstruction and conservation.

Before debris clearance, a photograph is taken using a mobile phone, which is likely to be at hand to many first responders. To provide a quick scale, equipment such as a shovel can be utilised. Rubble is then removed from each square, exposing the surviving in-situ archaeology below (such as floors), which is also where the injured, trapped and dead would be located. To speed the removal of rubble, material can be shovelled into sacks. These sacks can then be labelled with a unique identifying number, linked to each grid square and then deposited in the replicated grid, to wait processing during the nonemergency phase. Furthermore, portable antiquities and fragments of sculpture can be given unique special find numbers and removed to locked storage. Undamaged brick and tile can be separated and stacked by each replicated square so that these can be reused. By salvaging bricks, the cost of reconstruction is reduced, saving money and time during the rebuilding phase. Indeed, the PDNA anticipated 'bottlenecks in the supply of timber and special bricks used for restoration' (PDNA 2015: 4) after a large amount of material was cleared from historic sites and dumped in localities around the valley. It is also suggested that surviving standing architecture and the foundations of monuments be assessed after the emergency phase to understand the causes of collapse. During the live exercise, photographs and records were uploaded to a closed Facebook group, allowing members to access material uploaded by others. Furthermore, the Facebook group allowed nightly discussions and communication during the live exercise. We are aware that Internet connections may fail and are currently developing an off-line app that can be used on a mobile phone.

10.6 Conclusions

The 2015 Gorkha earthquake was a human catastrophe, but emergency and post-emergency responses unintentionally intensified its longer-term cultural impact. Conventional disaster management within Kathmandu's historic fabric contributed to further destruction of UNESCO monuments and the mixing and dumping of material that had both economic and tangible value; furthermore, superstructure-focussed reconstruction resulted in irreversible damage to subsurface heritage material. Our two missions have demonstrated that despite the wealth of expertise on Kathmandu's architectural superstructures, little is known of their foundations, although they contain critical detail of structural development, resilience and adaptation. They offer evidence of the strengths of traditional design, such as the lack of earthquake distortion, as well as weaknesses, such as poor conservation and maintenance. The current focus on the rehabilitation of the architectural superstructure is irreversibly destroying this invaluable record and must be curbed.

Our two rescue missions have also demonstrated the presence of subsurface heritage underneath the Durbar Squares of the Kathmandu Valley through a combination of GPR survey and excavation. This suggests that their current configuration represents an organic development, rather than a static reflection of how the squares were originally conceived. Furthermore, geoarchaeological evidence and scientific dating programme have illustrated the deep time depth of occupation in the Kathmandu Valley and has pushed the development and adaptation of monuments, such as the Kasthamandap, back centuries. This rich but finite subsurface heritage is clearly at risk from intrusive activities. This is not to recommend the suspension of laying new services, such as sewers, water pipes or foundations but to advocate the mobilisation of archaeology teams to undertake rescue excavations in advance of proposed interventions. The continued creation of archaeological risk maps will help guide and mitigate such developments. Our missions have also highlighted the need to design and deliver awareness-raising programs to introduce the significance and vulnerability of Kathmandu's subsurface archaeological heritage. This will assist the development of a South Asian–wide ability to rescue archaeological sites and respond to regional cultural disasters and emergencies supported by multidisciplinary experts and in collaboration with structural engineers, geotechnical experts and engineers.

Taking a broader perspective, many UNESCO-inscribed monuments around the globe have been damaged by human conflict and natural disasters, leading to the creation of emergency preparedness and response protocols. While many aspects of these protocols relate to planned responses, the treatment of debris and the use of rescue archaeology to investigate the stability of foundations in such situations are poorly defined. Although faced with the aftermath of a human and cultural catastrophe, post-disaster archaeological interventions across the Kathmandu Valley UNESCO site have the potential to offer invaluable training for professionals in the scientific documentation and recording of destroyed heritage and subsurface deposits in advance of reconstruction and rehabilitation. The examples from Kathmandu thus offer the potential to pilot methodologies and techniques for those tasked with subsequent research, rehabilitation and rebuilding of damaged heritage, particularly in relation to global postconflict situations, especially the Middle East and North Africa.

Acknowledgements Our postearthquake field programme would not be possible without the support of many institutions and individuals, including Minister Jiwan Bahadur Shahi, Narayan Man Bijukchhe MP, Prem Suwal MP, Ashta Laxmi Shakya MP, Rajya Shree Shresth MP, Nabindra Raj Joshi MP, Bhesh Dahal, Bharat Subedi, Dr. Govinda Tandon, Ramesh Upreti, Dr. Roland Lin, Christian Manhart, Nabha Basnyat-Thapa, Nipuna Shresta, Saubhagya Pradhananga, Bhashkar Gyanwali, Dr. Armin Schmidt, Dr. Nina Mirnig, Dr. Keir Strickland, Patricia Voke, Anouk La Fortune-Bernard, Dr. Paolo Forlin, Dr. Jennifer Tremblay, Anie Joshi, the UNESCO Kathmandu Field Office, the Oriental Cultural Heritage Sites Protection Alliance and Officers from the DoA, PADT, Department of Archaeology, Government of Myanmar; Central Cultural Fund and Government of Sri Lanka as well as staff and students of Durham and Stirling Universities, the Austrian Academy of Science, M.S. University of Baroda, University of La Trobe and Lumbini Buddhist University. We are also grateful to all the first responders from the Armed Police Force, Nepal Police and Nepalese Army who undertook training in the live exercise at Guruju Sattal.

We would like to acknowledge the financial support from the AHRC for a Global Challenges Research Fund Grant (AH/P006256/1), the National Geographic Society for a Conservation Award (#C333-16) and UNESCO for two funded missions (Contracts 4500283215 & 4500318125). We are also grateful for the institutional and in-field assistance provided by the DoA, PADT, UNESCO and Durham and Stirling Universities. Finally, we would like to thank the Municipalities of Kathmandu, Patan and Bhaktapur as well as the communities of the Kathmandu Valley for their support and interest in our missions.

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CHAPTER 11

Looking and Moving Forward

T.R. Robinson, H.A. Ruszczyk, and L.J. Bracken

11.1 Reflections

This book is unique in that it brings together multiple disciplinary perspectives on the Gorkha earthquake just two years after the event occurred. In the aftermath of large earthquakes, there is always an outpouring of academic papers and disciplinary perspectives attempting to understand the event and to place it in a greater context. The physical sciences are especially quick to publish findings in the months and years after an earthquake, as the necessary data can be collected, processed and interpreted relatively quickly. Comparatively, social science perspectives take far longer to develop, because the sociocultural impacts take far longer to emerge and interpret. As a result, most reflections on earthquake disasters that cover both physical and social perspectives do not emerge until long after the earthquake has faded in memory and receded into the everyday.

Undertaking this book so soon after the earthquake is a deliberate attempt to bring together knowledge based on the perspectives from multiple disciplines. These disciplines are drawn from Durham University and long-term collaborating partners in Nepal involved in the earthquake and

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L. Bracken et al. (eds.), *Evolving Narratives of Hazard and Risk*,
https://doi.org/10.1007/978-3-319-65211-5_11

the aftermath of the major disaster. The chapters contained in this book purposefully span a range of perspectives, including five academic subjects across Durham University (anthropology, archaeology, human geography, physical geography and social work), practitioners from varied backgrounds and organisations in Nepal and Nepalese colleagues who are, or have been, Durham University scholars.

Throughout this book, we have highlighted the myriad impacts and consequences earthquakes cause and demonstrate that disparate efforts to understand the earthquake from individual disciplinary perspectives can, by definition, never truly comprehend the total impacts that result. This volume showcases the way in which viewing the consequences of an earthquake through the lens of inter- and multidisciplinary work, can contribute to a more holistic and nuanced understanding of the fuller impact of the event. We hope this approach can more fully inform the planning for, recovery from and rebuilding after future hazardous events.

Here, we reflect on the previous chapters and tease out what we see as the key emerging themes discussed from multiple perspectives. We briefly summarise and discuss these themes in an effort to shed some light on the true costs of the Gorkha earthquake with the hope that such costs may become avoidable, rather than inevitable. We highlight gaps in the book, and where future insights are required to better inform our current narrative of the earthquake. We conclude by looking towards the future.

11.2 Emerging Themes

11.2.1 Rural Earthquake in Urbanising Nepal

As in many earthquake-prone nations around the world, much of the planning and emphasis on earthquake risk reduction before the Gorkha earthquake focussed predominantly on the major urban centres—in Nepal this was the Kathmandu Valley. Previous planning efforts (Chaps. 2, 3 and 6) predominately focussed on the idea that the next earthquake would almost certainly cause devastating losses in Kathmandu Valley; consequently, most planning focussed on this area. However evidence documents that the effects of the Gorkha earthquake were felt most acutely in the rural regions north of Kathmandu. Two thirds of the total earthquake deaths occurred in four remote rural districts: Sindhupalchok, Rasuwa, Nuwakot and Dhading.

This predominantly rural impact presented a substantially different challenge to what had been expected and planned for. Key bridges in

Kathmandu remained standing, and the airport, for the most part, remained functional. Despite more than 1000 fatalities in the city, many areas escaped relatively unscathed; buildings swayed and cracked but did not collapse. The total devastation of Kathmandu that had been so meticulously planned for, fortunately, did not eventuate.

Instead, millions of remote, rural Nepalese citizens were impacted. Landslides wiped out roads, removing the only point of access and, in some locations, burying entire villages. Villages on ridgetops and valley bottoms were reduced to rubble, and avalanches in the high Himalaya struck and buried climbers and Sherpas. In the hours, days and weeks that followed, simply gaining access to the majority of affected people became an almost impossible task; some villages remained without aid for days. Despite significant efforts in road construction in the last 60 years, access remains difficult for much of the country. Only 43% of the rural population live within 2 km of a road that is useable year round (World Bank 2013). Emergency access to most of these locations depend on the use of helicopters, of which there are not many nationally.

Thus in considering and planning for future earthquake risks in Nepal, it is essential that the requirements of the rural population are considered alongside the urban centres. The impacts and response required for rural events are vastly different from those of an urban event, and the Gorkha earthquake provided an opportunity to better study and understand these differences. The potential scale of losses from a rural earthquake larger than the Gorkha event (Chap. 6) are similar to what has previously been expected for a direct hit on the Kathmandu Valley (Chap. 2). The Gorkha earthquake clearly demonstrated that large-scale losses from earthquakes are not necessarily centred in urban areas. It is therefore essential that earthquake preparedness simultaneously considers the needs and requirements of difficult to access rural populations living in areas of challenging terrain as well as needs in population centres now more frequently defined as municipalities (Chap. 3).

In a broader context, Nepal, similar to many parts of the world, is urbanising rapidly. The government of Nepal is in the process of reclassifying many rural areas and smaller towns as municipalities (Chap. 8). This is likely to result in confusion in the future if Nepal is described as an urban country; although there are 161 more municipalities in 2017 than in 2014, it does not mean they are urban. Despite the significant increase in the number of municipalities, Nepal continues to be a rural country, with the majority of its population living in small, remote villages. This

changing administrative environment, however, gives Nepal a unique opportunity to implement and enforce the building code in a more uniform manner throughout the country (Chaps. 2 and 8), especially post-earthquake.

11.2.2 Invisible Issues

The collection of perspectives presented in this book has made a range of topics visible. Some contributions have showcased old vulnerabilities, but others have opened new spaces for thinking and acting. For example, mental health and well-being are often overlooked in the focus on recovery and restoration of the built environment. We must not forget that women, the elderly, the young and the disabled bore the brunt of the earthquake and were left to rebuild (Fig. 11.1; Chap. 4). Mental health issues are difficult to address in a rural environment where many of the health facilities were destroyed in the earthquake. Supporting communities as they face their trauma and the task of rebuilding is tremendous and at times overwhelming (Chap. 9).

Fig. 11.1 With many men working abroad, many women are rebuilding communities (Source: NSET)

This book gave voice to those most heavily impacted by deaths, destroyed physical infrastructure and loss of livelihoods (Chap. 7). The Tamang were particularly devastated by the earthquake sequence. They not only lost their family members, homes and livelihoods but they are struggling to receive what has been promised to them by the central government. The voice of the Tamang community is not usually heard by people with power in Kathmandu. Lost access to electricity has caused a particular sense of loss of modernity for this ethnic group. The long-term impact from the earthquake will be felt politically, socially and economically in these rural mountainous communities.

Investigating Kathmandu Valley's UNESCO World Heritage Site post-earthquake (Chap. 10) shed light not only on visible cultural heritage damage but also on the invisible aspects of subsurface structural development, resilience and adaptation over time. Taking a broader perspective, many UNESCO-inscribed monuments around the world have been damaged by human conflict and natural hazard events, leading to the creation of emergency preparedness and response protocols. We hope in the future these protocols will support Nepalese first responders in knowing how to utilise post-disaster archaeological methods and protocols to enable the protection of heritage sites alongside rapid response during search and rescue efforts.

11.2.3 The Role of Science and Technology

Science and technology have been discussed throughout this book, with the majority of contributors highlighting the role they play in the before, during and after phases of an earthquake. Relatively simple but fundamental and widely available understandings of science and technology can be used to forecast earthquake hazards (Chap. 5) and make such knowledge part of everyday practice for development and resilience practitioners. There is no need for earthquakes to be considered as random and unexpected events. Instead, it is feasible to understand that earthquakes are inevitable and, although not predictable, most certainly foreseeable. Such basic and simple understanding is the first step towards better planning and preparedness.

The National Society for Earthquake Technology—Nepal's (NSET's) efforts (Chaps. 2 and 3) in mainstreaming earthquake awareness, preparedness, mitigation and response strategies showcase the long-term approach that incorporates new knowledge and available cutting-edge research with a dedication to supporting all aspects of society and government. In the long term, individuals and their local communities must

implement earthquake planning and preparedness and, ultimately, make decisions about the types of buildings they construct and live in. Oversight in terms of construction methods and building codes should come from the government, but this relies on having locally trained engineers to implement these codes and local people who are prepared to accept these standards and any associated costs. This requires everyone working together for a common goal—an earthquake-resistant society.

Both Chaps. 7 and 10 discussed how mainstreaming science and technology, including tried-and-tested approaches from other countries, can play an important role in supporting and growing cultural practices in-country. Science and technology are routinely seen as the antithesis to traditional cultural practices, but here it has been shown how modern approaches can be integrated into and, most important, owned by local communities. The aim is not to change and mask cultural practices but instead to help maintain and adapt these processes so they can continue to thrive following earthquake disasters, enhancing community resilience. For much of the population (Chaps. 7 and 10), reestablishing important cultural sites and temples is often as pressing an issue post-earthquake as is housing. Integrating science and technology into the recovery and restoration processes can ensure these important buildings and practices are not only saved but restored to their full glory.

The range of perspectives brought together in this book also illustrate ways in which science and technology can be drawn into planning and training to help limit and reduce the impact of natural hazards (Chaps. 5 and 6). Simulations utilising the latest understandings of physical processes can be embedded in examining likely impacts and consequences of physical hazards, supporting meaningful changes in governance and practice to save lives in future events. Such an interdisciplinary and agile use of knowledge is crucial in planning and preparation for natural hazards.

11.2.4 Multiscalar Approach to Emergency Response and Planning

The role of local communities, central government and international agencies in terms of emergency response and planning has been discussed in detail. The interactions among the different scales and the relative strengths and limitations of each scale are essential for understanding how future emergencies can be managed.

After a hazard event, it is the communities themselves that form the immediate emergency response. This will remain the case in any future disaster, regardless of any improvements made in accessibility. The local community is *the* essential lifeline in the immediate aftermath of the earthquake because it is these people who will form the initial (and perhaps only) response in terms of search and rescue, immediate medical care and temporary shelter. The preparation undertaken in Nepal to provide local communities with training in various aspects of emergency response (Chaps. 2, 3 and 6) doubtlessly resulted in thousands of lives saved in the Gorkha earthquake.

As time progresses, there becomes a need for outside help in terms of the provision of aid and the evacuation of the most vulnerable. Here the regional and central governments are essential. Government's role is to coordinate emergency relief, balance support with funding and provide essentials to the affected population. The central government has the ability to collect and distribute sufficient materials to help the multitude of affected communities and ensure the safety of the population. In pre-event planning, the government plays a vital role in developing and implementing policy and building nationwide capacity.

Despite efforts from a range of stakeholders to increase national capacity, Nepal remains relatively ill-equipped to deal singlehandedly with major disasters and therefore requires international assistance, as in the Gorkha earthquake. The international response is in the form of the United Nations, humanitarian aid agencies and international governments (militaries) with the aim of providing the resources Nepal lacks as well as the financial means to respond. This issue has been highlighted in multiple chapters and ranges from the obvious role of international militaries and search and rescue during the immediate response phase (Chaps. 3 and 6) to the preservation of cultural heritage (Chap. 10) to longer-term capacity building in areas such as social care (Chap. 9).

While able to influence large-scale change, such international responses are often slow and cumbersome and are always subject to international politics, which are often not concerned with the local intricacies on the ground after a major event. In this regard, the Gorkha earthquake in particular highlighted the issues facing Nepal with respect to its geopolitical position between the Asian giants of India and China. Despite both nations having a huge presence in Nepal during the response, neither actively participated in the subsequent multinational response exercise aimed at planning for a future larger earthquake (Chap. 6). Such international politics

are something over which Nepal has minimal control but that ultimately is likely to play a defining role in how effective current planning and future response to an earthquake unfold.

11.3 Gaps in the Book

There are a range of issues that the book does not cover. Some topics not considered here but that are important in living with and responding to earthquakes include the following. Politics has not been used as a lens/entry point for this book but is implicitly discussed in each chapter. Power and politics are discussed at a range of scales and focus on discreet relationships—for example, between local communities and representatives of the government, between different levels of government, between international interventions, and between non-governmental organisations (NGOs) and government. The National Reconstruction Authority, tasked with overseeing the reconstruction of Nepal post-earthquake, is not directly referred to. The issue of corruption also does not appear in the book. We are aware that corruption plays an important role in the socioeconomic response, but researchers involved in the book did not explicitly explore this in their research. Last, the outpouring of support from Nepalese people throughout the country to the disaster-stricken districts was mobilised within hours and days after the shaking began. The positive role of the Nepalese diaspora after the earthquake and the role of remittances after the event have also not been discussed in this book. For an even more comprehensive understanding of the earthquake, perspectives of politics, the roles of power, corruption and mobility also need to be considered.

11.4 Looking and Moving Forward

It is unclear how the earthquake will change Nepal in the long term. This book, written only 24 months after the event, cannot assess the impact in the same manner texts on previous earthquakes have been able to eloquently analyse. There is a balancing act between time passing to enable reflection versus the need to move on to more pressing issues and not attempting to learn from such events. It is difficult to anticipate what will be the long-term, lasting effects and consequences of the earthquake. As has already been presented, the earthquake allowed the constitution to be promulgated, which resulted in the unofficial economic blockade (Chap. 8). The earthquake will be changing not only the physical

landscapes but also political, emotional, social and economic landscapes. Aftershocks in all these areas are still occurring. For example, it is unclear what will be the ramifications on livelihoods, economic security and outward migration.

At the outset of this book, we highlighted that disasters do not occur in political, social or economic vacuums. International, national and local geographies of inequality, ethnicity, caste, gender relations as well as social and economic marginalisation all shape the response and long-term recovery for those who remain (Hyndman 2011; Sidaway et al. 2008) to rebuild their lives, communities and country. This book has tried to bring together some of those narratives to help shed light on the various impacts that occurred and the efforts that are ongoing to help Nepal recover and move forward from the Gorkha earthquake.

In the last 60 years Nepal has made tremendous leaps forward; literacy rates have tripled and levels of poverty have reduced by half. But this has not come easily, and long-term political instability remains a way of life in Nepal. To understand the risks posed to Nepal by hazards such as earthquakes, we cannot ignore this reality; instead it must be accounted for and integrated into the planning and understanding of hazard and risk in Nepal and in other countries with similar profiles. Slow and steady progress has been the hallmark of Nepal's development over the last decades, and this remains the only logical step forward from the Gorkha earthquake; rapid, paradigm-shifting changes are simply not feasible or appropriate.

This book highlights what can be gained from a more holistic, multidisciplinary perspective on the impacts of an earthquake disaster. Viewing the event disparately from the viewpoints of single disciplines masks the ability to notice intricacies of the event, and some aspects are missed or, worse, ignored. Instead, a consideration of multiple perspectives, each informing the other, helps develop new ways of thinking, and new ways of engaging and working in practice is the way forward. It is important to work with and empower local communities by providing them with the resources to use the knowledge they already have. Local knowledge is essential in planning for future earthquake disasters and is evident in communities throughout Nepal; however, the resources to put that knowledge to use is lacking.

It is essential that international researchers and practitioners support and continue this empowerment by engaging with national and local stakeholders. Through their collaboration with various international institutions, stakeholders such as NSET (Chaps. 2 and 3) have helped the government of Nepal build greater capacity in the government; update

building codes; and train local people in awareness, preparedness and emergency response activities. All of this has proved essential in minimising the impacts felt by the Gorkha earthquake.

Preparing for a future earthquake in Nepal cannot occur independently of or at the expense of the country's continuing development. On the contrary, it must be fully integrated into development, making earthquake planning and preparedness (Chaps. 2, 3, 5, 6 and 8) commonplace among all levels of society and government. Everyday issues such as food security, water and energy (Chap. 7) as well as economic security remain challenging and, understandably, often take precedence over considerations for hazard events that may occur many decades in the future. There is a need to consider the ongoing spectrum of hazards and risks and how they are interrelated. People care about livelihood, health (Chap. 4) and education for their children. If more consideration is given to everyday concerns and ways to address them, a space is also opened up for preparing for the future, including considering earthquake risk reduction and building earthquake-resistant structures. Empowering people, communities and local authorities (Chap. 8) and supporting the central government will not only increase resilience but also the well-being for all of Nepal.

Moving forward it is essential that we do not rest on our laurels but instead maintain momentum to create change and new understanding that can help strengthen earthquake resilience in Nepal and elsewhere. The Gorkha earthquake was a major event with substantial impact; however, far larger earthquake threats remain. It is thus important that experiences and knowledge from the Gorkha earthquake are embedded into future planning to prepare for such potentially devastating earthquakes.

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