Risk Nexus

Urgent case for recovery: what we can learn from the August 2014 Karnali River floods in Nepal

Contents

As part of Zurich's flood resilience program, the post event review capability (PERC) provides research and independent reviews of large flood events. It seeks to answer questions related to aspects of flood resilience, flood risk management and catastrophe intervention. It looks at what has worked well (identifying best practice) and opportunities for further improvements.

This PERC analysis was written by ISET International, ISET-Nepal, Practical Action Nepal and Zurich. It uses a combination of two complementary conceptual frameworks: the ISET Climate Resilience Framework (http://training.i-s-e-t.org) and the Zurich flood resilience alliance framework (https://www.zurich.com/en/corporate-responsibility/flood-resilience).

Cover: Villagers evacuating during flooding in Rajapur.

Foreword

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The publication of this report coincides with a large relief effort underway in Nepal following the devastating earthquake that struck the country in April, followed by a serious aftershock in May. We recognize the huge toll these events have taken on this country where many live in poverty. A crisis often affects especially the poorest, hitting them the hardest. In particular, in rural environments, the very minimal infrastructure means that loss of a road, bridge or cell tower can have devastating impacts on lives and livelihoods. These communities now face an arduous task to recover. Rebuilding will take years and perhaps decades.

But even as recovery begins, some communities in Nepal might be facing a new threat: the monsoon season, and the potential for deadly floods. This study focuses on findings and observations specifically related to some of the worst flooding in recent memory that struck Karnali and Babai River basins in August 2014. Based on what we learned, we have identified entry points where action can be taken to build human and organizational capacities, structure institutions, and increase the resilience of critical systems. There is much potential for improvement.

It is now doubly important to follow through after the most recent quake disaster in Nepal. But our efforts extend beyond improving overall disaster resilience in a single country. Helping to make communities more resilient, no matter where, gets at the heart of the solution. We believe a wider disaster management system can mitigate and perhaps even help to avoid some of the worst impacts of particular natural events.

Since 2013, the Zurich flood resilience alliance has developed a number of post event review capability (PERC) reports. Based on earlier PERC studies about floods in central, northern and eastern Europe and a report by the Institute for Social and Environmental Transition-International (ISET-International), 'Floods in Boulder: A Study on Resilience', we find that a global narrative is emerging, with similar points of failure, successes and capacities during floods across geographical, social, political and economic contexts.

Studies such as 'From Risk to Resilience' by the ISET network, 'Ecosystem Based Climate Adaptation Planning at the Sub-watershed Level of Panchase Mountain Ecological Region Nepal' by ISET-Nepal, and 'Understanding Disaster Management in Practice with Reference to Nepal' by Practical Action highlight the importance going beyond just mitigation as a means to reduce disaster risk. Rather, adaptation needs to be included in the frame of disaster risk reduction and mainstreamed into development.

We hope that the lessons learned and recommendations derived from this study can be applied not only nationally, but globally. We do not need to wait for major (flood) events to catalyze action. We can save lives, reduce losses and bring communities together through such means, hopefully making them less dependent on oft-times unpredictable sources of aid and well-meant charity that, however, might only restore the status quo.

We would especially like to thank the project team of ISET International, ISET-Nepal, and Practical Action Nepal, supported by the Zurich team. We also want to thank all the others who willingly contributed and made it possible to produce this report. If it can in any way help to speed recovery in Nepal, and encourage changes that can save lives and protect communities in that country and elsewhere, it will have served its purpose.

Executive summary

In mid-August 2014, three days of torrential monsoon rainfall led to the widespread Karnali floods in Western Nepal. The floods killed 222 people and had a major impact on 120,000 others, damaging infrastructure and property and displacing households.

What happened during these floods is not a new story, nor is it a story that is limited to the developing world. Previous Zurich post event review capability (PERC) reports highlighted similar issues in Europe and so did ISET-International in the U.S. Flood resilience, and disaster resilience in general, are not only about resource and economic capacity. Rather, there are social and institutional barriers that restrict resilience. Better planning and regulatory processes and more equitable policies are needed. Nations across the globe need to improve their resilience to potential hazards by learning from past disasters.

Focusing on the disaster management landscape as a whole – disaster risk reduction, preparedness, response and recovery – this post event review examines the Karnali and Babai Rivers in the area of Nepal affected by the floods. We examine the events, impacts, responses, and recovery to understand what happened, what could have been done differently, and where there are opportunities for action to reduce future flood risk.

Worst event ever recorded

In 24 hours, nearly 500 mm of rain fell across the plains and foothills. Rivers rose rapidly in the middle of the night. Flooding was perhaps a one-in-1,000 year event and exceeded the previous largest flood by nearly a meter. Downstream flooding was intense. Floodwaters flowed over banks, broke embankments, and flooded irrigation canals. Floodwaters came from unexpected directions, inundating previously safe areas and taking residents by surprise.

The new early warning systems saved lives

Beginning in 2008 Practical Action worked with local, regional and national stakeholders to implement early warning systems on both the Karnali and Babai Rivers. In spite of complications and points of failure, these systems were instrumental in saving lives and assets during the 2014 floods. There is a clear opportunity to strengthen and scale up these systems country-wide.

Local response was effective

Government and INGO response was slow and poorly coordinated. Political pressure complicated response and beneficiary selection, ultimately leaving the most vulnerable behind. Community Disaster Management Committees (CDMCs) were instrumental in responding to community needs amid the chaos and confusion of external response, helping organize and distribute relief, assisting district security personnel with search and rescue, and conducting health campaigns to minimize the spread of diseases.

Recovery support has been minimal

The Nepali government has largely focused on public infrastructure in its recovery efforts: rebuilding roads and bridges, and repairing and upgrading river control and irrigation systems. Seven months after the flood, most recovery activities had not yet begun. Most people have essentially been left to recover on their own. Households must primarily rely on support from friends and family, and on remittances sent by relatives who migrate to India and other countries for seasonal labor.

The protection systems are increasing risk

Flood protection systems currently reduce short-term risk while increasing long-term risk. Embankments are being designed without considering the rate at which sediment is deposited, safe failure modes, or the increasing trend in rainfall intensities observed over the past two decades. They are also designed in ways that will attract development and with little thought given to maintenance, control, and lifecycle management. Embankment design combined with poor land use regulations will increase development adjacent to embankments and exacerbate long-term flood risk.

The national disaster management system needs improvement

Nepal's disaster management system, on the whole, has many shortcomings. This increases the dangers posed by natural events, including earthquakes and floods. In the Karnali floods, there was poor coordination across and within state agencies and government departments. Systems designed to streamline response broke down and supplies were delayed in reaching people. News reports coming out about the April 25 and May 12, 2015 earthquakes clearly reveal that the responses currently underway in Nepal are not much different from those during the Karnali floods (except on a much larger scale) in 2014. We anticipate that past failures will be repeated in managing the earthquake disaster. Yet there is an opportunity to make well-informed choices. At the same time, there is immense political and financial pressure on Nepal, pressure only intensified by the recent earthquake. And it is evident that there is substantial capacity at the local level to prepare for, and address disasters. The fastest way to strengthen the national disaster management system would be to harness and scale up these local capacities.

The global context

Although developed nations have more resources at their disposal than developing nations, both have similar gaps in their resilience. This suggests that there are social and institutional barriers – including perception of risk, regulatory processes, and systemic discrimination – which restrict resilience. In poorer cities and countries, social and institutional changes can be made without great economic input. For wealthier cities and countries, this serves as a reminder that resource and economic capacity is not everything. Money alone cannot prevent a hazard from becoming a disaster. Better planning and regulatory processes, and more equitable policies are needed. While the Karnali floods could have been less devastating in a nation more developed than Nepal, this does not change the fact that nations need to improve their resilience to potential hazards. In an increasingly globalized world, it is important to analyze disasters to learn important lessons on where and how resilience can be built.

Floodwaters in Rajapur

Introduction

The World Bank (2005) has classified Nepal as one of the global 'hot-spots' for natural hazards. Sharp contrasts in physiography and climate along with geologically unstable, steep and rugged mountain topography and intense monsoon rainfall make the country prone to floods, landslides, soil erosion and earthquakes.*

Disasters cost the government about six percent of its annual development expenditure (MoHA, 2010). Floods are among the most recurrent and devastating of these disasters, having been responsible for USD 130 million in losses between 2001 and 2008 and nearly one-third of disaster-related deaths in Nepal (DWIDP, 2011; MoHA, 2010).

In this report we deconstruct the Karnali Floods of August 2014 and identify opportunities for improving flood risk and disaster management as a whole in Nepal. It may seem odd that we are focusing on floods in light of the recent, devastating earthquakes in Nepal. But increased flood risk, greater vulnerability and tight resources post-earthquake make it extremely important that Nepal builds back in ways that are well-focused, better and more resilient.

Continuous monsoon rainfall across the foothills of western Nepal in from August 14-16, 2014 led to widespread flooding of the Karnali and Babai Rivers, resulting in infrastructure and property damage and loss of life. On August 17, 2014, the International Federation of the Red Cross and Red Crescent Societies (IFRC) reported:

"A total of 34,760 families (173,800 people) have been affected, of which 5,936 families (29,680 people) are displaced. 53 people confirmed dead. The floods and landslides have damaged roads, bridges, local markets, transport vehicles as well as livestock, crops and daily consumables. More than 1,240 houses destroyed and 435 houses damaged."

Despite the size of the flood and magnitude of damage to physical infrastructure and the environment, the loss of life compared with prior floods was small.

This post event review examines two rivers and two districts in the area affected by the flood – the Karnali and Babai Rivers in Kailali and Bardiya districts (Figure 1). Focusing on the disaster management landscape as a whole, including disaster risk reduction, preparedness, response and recovery,[1] we evaluate the flood events, impacts, response and recovery to understand what happened, what could have been done differently, and opportunities for action.

It must be noted that the Karnali Basin is more advanced than most regions in Nepal in terms of its disaster preparedness. Substantial NGO intervention in the basin has included setting up early warning systems (EWS), community disaster management committees (CDMCs) and other formal disaster preparedness structures; these exist in combination here but not necessarily elsewhere in Nepal. It is likely that a similar flood elsewhere in the country might have had a different and potentially more severe impact.

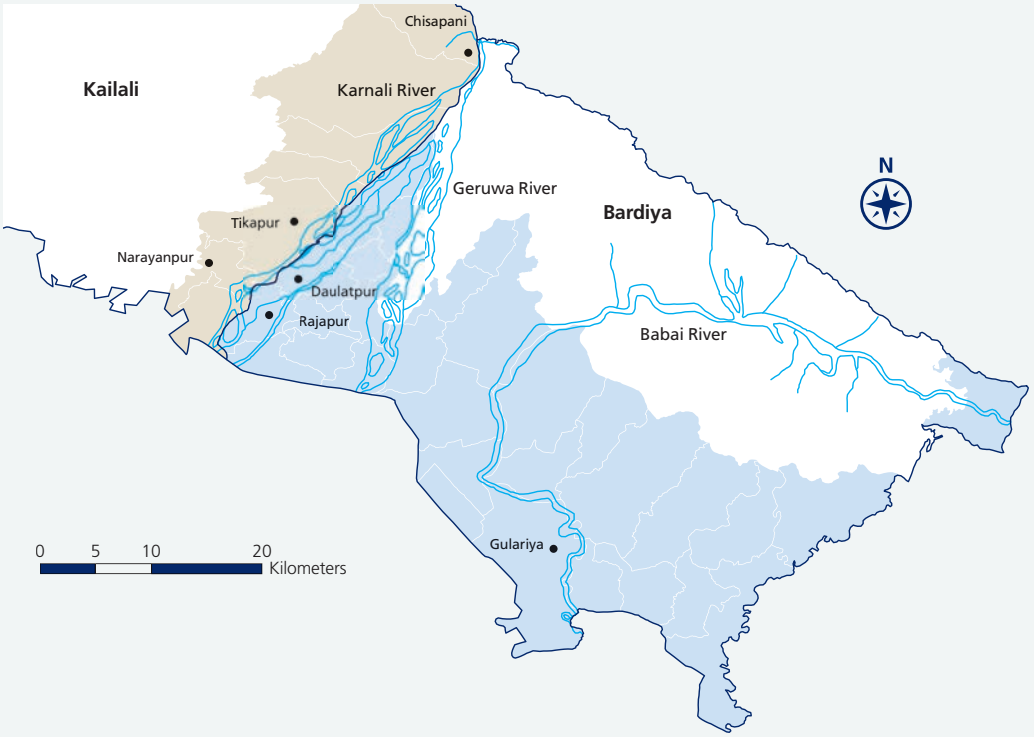
Section 1 provides a review of the weather events responsible for the floods in August 2014. A description of the socio-economic landscape of the Tarai follows in **Section 2**, helping set the stage for why the flood's impacts, response and recovery unfolded as they did. **Section 3** reviews what happened. The analysis follows the disaster management cycle – prevention and risk reduction, structural measures, mitigation of loss potential, early warning, coping and response, as well as recovery and outlook for the future. Information in these first three sections was obtained from the Nepal Government's Department of Hydrology and Meteorology (DHM), by reviewing literature and through a series of interviews with local, regional, national and international actors.

Section 4 summarizes key insights in this study, and **Section 5** identifies opportunities and offers recommendations for action. The paper concludes with a short discussion of the relevance of these findings at the regional and global levels in **Section 6**, putting the findings from this review in context with other post event reviews by Zurich and ISET.

*A list of Nepalese acronyms used in this report can be found on page 40.

[1] Though we consider preparedness to be a component of risk reduction, we address risk reduction and preparedness separately because risk reduction tends to focus more on infrastructural change and preparedness focuses much more on community or localized awareness and action.

Figure 1: Affected VDCs



Legend

- Towns and villages
- Rivers
- VDCs in Kailali District
- VDCs in Bardiya District

Map showing Kailali and Bardiya districts, the Karnali and Babai Rivers, and VDC and major towns and villages that were directly affected by the 2014 floods. (Source: ISET-Nepal and Practical Action Nepal)

Overview

Nepal is located in the central Himalayas, bordered by the Indian plains to the south and the high Himalayan mountains to the north. The country is divided into five physiographic regions increasing in altitude from south to north (Figure 2):

- **Tarai**, a band of agricultural plains lying at elevations of 100 to 500 meters.
- **Siwaliks**, the foothills of the Himalaya, comprised of shallow, erodible soils and rising to elevations of 1,500 to 2,000 meters.
- **Middle Hills**, rising to elevations of 3,000 meters.
- **High Mountains**, up to 4,200 meters.
- **High Himalaya**, rising to over 8,000 meters.

The north-south elevation gradient, an increase of more than 8,000 meters over a distance of 200 kilometers, creates a complex, steep and fragile topography (NPC, 2010) with extremely varied climatic regions ranging from subtropical in the Tarai to alpine in the high Himalayas. The Himalayan massifs from extending east to west in the north and the monsoonal alteration of wet and dry seasons greatly contribute to these variations (NCVST, 2009).

This report focuses on flooding in the Tarai plains of the Babai and Karnali Rivers. The Tarai is an alluvial and fertile plain that occupies about 17 percent of the land area of Nepal and is primarily devoted to agriculture. In recent decades, the region has experienced significant social and development changes. There have been increases in the number and quality of roads, improvements to and creation of new irrigation projects, construction of flood control embankments, and access to electricity. Connectedness has increased with the increase in number of mobile phones and greater access to motorized transportation. These changes are rapidly expanding access to technology, information and markets.

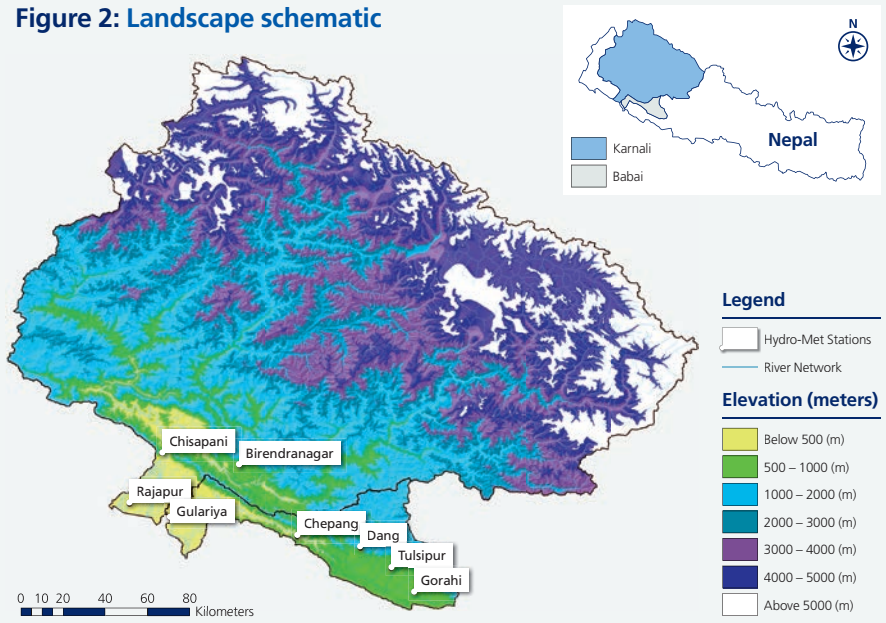
Yet vulnerability in the Tarai remains high, and flooding has particularly devastating effects in the area. Intense monsoon rainfall and unstable, steep, rugged slopes in the mountains mean high rates of soil erosion and landslides; rivers carry a high sediment load. When these rivers enter the broad, flat plains of the Tarai they slow, spread out, and deposit sand and gravel.

The beds of many Tarai rivers are rising by 10 to 30 cm per year (Eckholm, 1975; Eckholm, 1976; NCVST, 2009). As a result, several communities in the Tarai are at lower elevations than the river. These communities are frequently flooded during rainy seasons (Dhakal, 2013).

Besides its hazard-rich natural landscape, the socio-political landscape in the Tarai has contributed to low disaster preparedness and management awareness. Efficient mechanisms and capacity to deal with disasters are lacking. Rapid population growth, weak land use management, slow economic development, deforestation, poor building practices, and encroachment into floodplains are increasing vulnerability to hazards and destabilizing land resources. This has recurring, severe impacts on the lives of people, property and economy at large.

Global climate change is likely to further intensify these trends. Over the past several decades, the intensity and magnitude of precipitation events in Nepal have increased, as have flooding and landslides associated with these events. Planning and land use, disaster preparedness, response and recovery must be significantly improved to make things better for the people of the Tarai.

Figure 2: Landscape schematic



The Karnali and Babai River basins and location of the primary hydro-met stations on those rivers. (Source: ISET-Nepal and Practical Action Nepal)

Section 1

Flooding in the Karnali Basin, Nepal

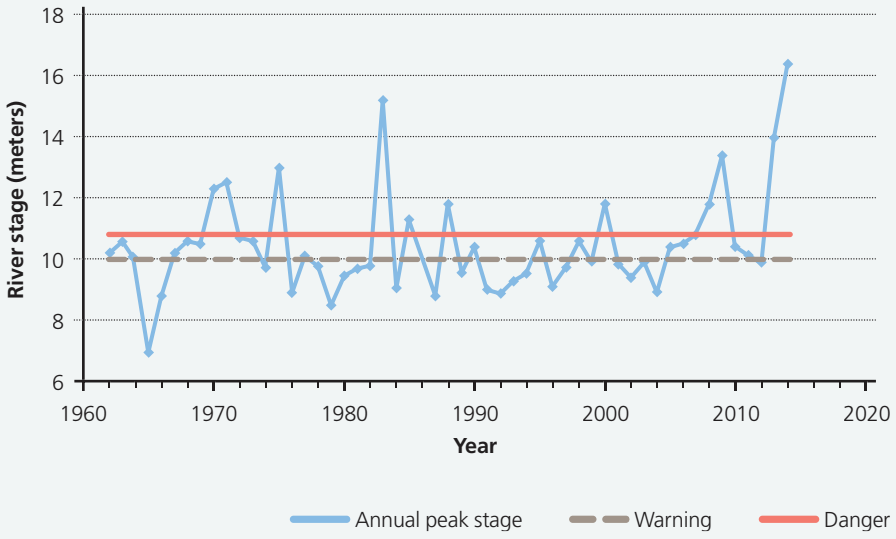
During extreme floods, waters cut across the oxbows, damaging structures and fields, scouring the land, and depositing sediments."

Floods and landslides are among the most common hazards in Nepal, causing significant loss of life every year. Floods also damage and destroy property. Infrastructure, roads, houses, hydropower plants, irrigation and drinking water facilities, agricultural lands, ecosystems, and essential services are all at risk.

Flooding is primarily caused by intense rainfall. Annual precipitation over the Tarai and Siwalik regions generally ranges from 1,000 to 2,000 mm; annual precipitation in the Middle Hills ranges from 2,000 to 3,000 mm (ICIMOD, 1996). About 80 percent of this precipitation falls between June and September during the South Asian monsoon (Kansakar et al., 2004). During this period, river flows can increase by a factor of one hundred or even one thousand,[2] and flooding is ubiquitous in all river basins.

Recent catastrophic flood events in Nepal include the devastating 1993 central Nepal floods, the 2008 Koshi embankment breach, the 2008 floods in western Nepal and the 2013 Mahakali disaster, which caused immense losses. On the Karnali River, there have been three major flood events in the past six years. Significant floods occurred in 2009, 2013, and 2014, as can be seen in Figure 3. The most comparable earlier flood was in 1983.

Figure 3: Flood history for the Karnali River



Flood history for the Karnali River at Chisapani based upon maximum annual river stage in meters. The warning and danger levels used in the early warning system are shown for reference (data obtained from DHM).

[2] For example, the winter discharge for Karnali is on average 500 m^3/second, whereas the peak monsoon discharges during floods is greater than 15,000 m^3/second. For rain-fed rivers such as the West Rapti, the winter discharge is 11 m^3/second, while the peak monsoon discharge hovers around 8,000 m^3/second.

The Karnali River enters the Tarai plains from a narrow gorge at Chisapani (see map on pages 22-23 for details). About one kilometer downstream, the river splits into the Geruwa and Karnali branches, creating an island. About 22 kilometers downstream, after crossing the Nepal-India border, it converges again as the Ghagra River. The river is gravel-bottomed; bifurcation and convergence, and the amount of water that flows in each branch, are determined by sediment deposits and local topography.

Despite being one of the largest rivers of Nepal, with a catchment size of 45,000 km^2, little is known about the river's structure and behavior. Indeed, the best-studied river in Nepal is the Koshi, and the data for it is still minimal. The network of meteorological and hydrological measurement stations in the Karnali Basin is sparse, particularly given the geographic and climatic complexities of the region. Flow data are available from 1962 onward, but were manually collected prior to 2010. There is very limited flood modeling of the region. Existing flood models are low resolution and have not been tested on the ground.

The Babai River originates in the Mahabharat Hills, flows northwest enclosed by these hills on either side for about 100 kilometers, and then exits onto the Tarai plain and flows southwards into India. As the river enters the Tarai, its straight path changes to numerous ox-bow formations, dictated by local slope conditions and changes in sediment load. During extreme floods, waters cut across the oxbows, damaging structures and fields, scouring the land, and depositing sediments.

Genesis of the 2014 Karnali floods

Though the 2014 Nepal monsoon arrived slightly later than normal, by early August 2014 West Nepal had already received moderate monsoon rainfall. On August 14 to 15 a large, slow-moving weather system deposited record-breaking rainfall in the foothills of the Babai and Karnali River catchments. Rainfall depths of 200 mm to 500 mm over a 24-hour period (Table 1) were recorded at the eight meteorological stations in the region.

The highest recorded rainfalls were at Chisapani: 493 mm of rain fell between 9 p.m. on August 14 and 6 a.m. on the morning of August 15. The previous 24-hour rainfall record was 367 mm in 1981; 200 mm rainfall in 24 hours has only been exceeded at Chisapani 13 times in the past 50 years. The 2014 torrential rains, not just at Chisapani but across the region, caused the Babai and Karnali Rivers to rise rapidly.

By 1 a.m. on the morning of August 15, the Karnali River at Chisapani had risen to over 10 meters, triggering the first level of a two-stage alert to warn people about potential for flooding. At 2 a.m. the radar sensor measuring the water level at Chisapani stopped working; power had failed earlier in the evening and by 2 a.m. the backup batteries were exhausted. This meant that further gauge measurements had to be made visually and communicated in person by the gauge reader.[3] By 3 a.m. the river had risen to 11 meters and was still rising, triggering the second alert level, indicating that conditions were now dangerous and that people should begin evacuating to higher ground or safe

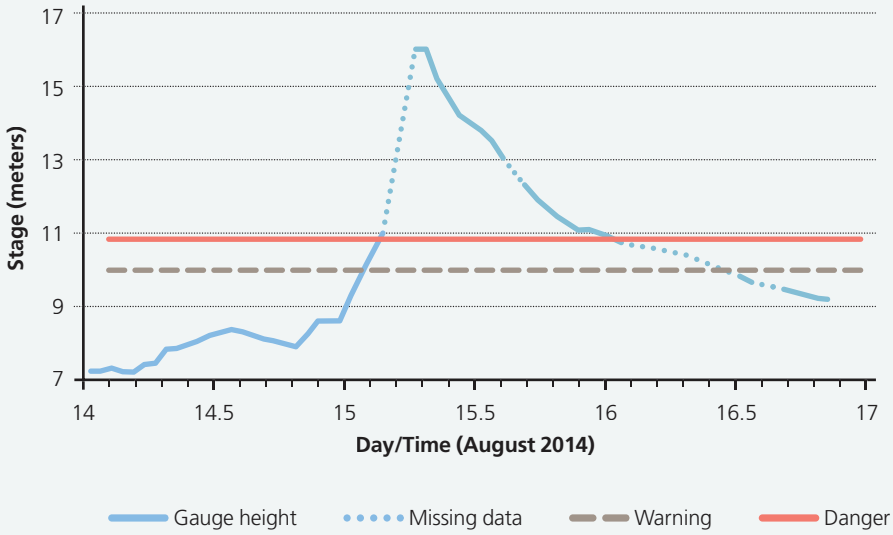
Table 1: Precipitation recorded during 24-hour period

Station	Rainfall (mm)	Station	Rainfall (mm)
Rajapur	233	Beljhundi, Dang	346
Birendranagar	423	Chepang	326
Nepalgunj	184	Tulsipur	299
Gorahi	298	Chisapani	493

Source: DHM, http://www.mfd.gov.np/content/?id=77 *Rainfall ending at 8:45 am

[3] The Chisapani station is outfitted with both a radar sensor and a manual staff gauge. When the radar sensor is running, data are automatically transmitted to Kathmandu, where they are posted on the DHM's web portal at www.hydrology.gov.np, and to digital boards at the Kailali and Bardiya district headquarters. Manual staff gauge readings are made hourly during flooding and are the only measurements when the radar is down. Manual measurements are transmitted by the gauge reader via cell phone to DHM in Kathmandu and to the CDOs, NRCS, police, army, and CDMC members in Kailali and Bardiya.

Figure 4: Flood hydrograph for the Chisapani station



Dotted lines indicate missing data. 'Warning' and 'danger' levels correspond to the two-stage alerts used in the Karnali early warning system. (Data obtained from DHM)

locations. Between 3 and 4 a.m., landslides and torrents blocked the trail to the gauge station. By 6 a.m., when access was re-established, water levels had risen to 16.1 meters, well beyond the 15-meter maximum measure for which the manual staff gauge had been designed.

At the Chepang gauge station on the Babai River, the last recorded gauge height for the Babai River was 5.15 meters at 5 a.m. on August 15; the warning level at Chepang is 6.5 meters and the danger level is seven meters. Shortly after the last reading, the river rose rapidly and washed away the gauge station. We can thus only speculate about the Babai River's levels at Chepang after 5 a.m.[4]

Preliminary analysis suggests that the 2014 Karnali floods may have been a one-in-1,000-year event: there is a 0.1 percent probability of such a flood occurring in any given year. Water levels at Chisapani exceeded the previous record of 15.2 meters in 1983 by nearly a meter. The flooding on the Babai may have been a 1,000-year event as well; lacking data, it is impossible to tell. The rapid rise in water levels on both rivers was also unusual, an indication of how extreme the rainfall was in the catchments upstream of the Chisapani and Chepang gauge stations.

By contrast, the 1983 flood was a roughly one-in-200-year event, the 2013 flood a roughly one-in-75 year event, and the 2009 flood a roughly one-in-50-year event. However, these values, and those for the 2014 flood should be treated with caution. Hydrological data is subject to uncertainty even in ideal conditions. Extreme flow data are particularly unreliable as stream gauges are hard to calibrate for extremes, and in Nepal, river sedimentation and erosion rates can dramatically influence gauge accuracy in a single high-flow event.

The intensity and magnitude of precipitation events in Nepal have increased over the past few decades. Consequently, what constitutes, for example, a 1-in-100-year flood is changing, with larger floods becoming more frequent events.

[4] The radar sensor at Chepang may have failed earlier than 5 a.m. Records show water levels rising steadily until midnight on August 14. The gauge then holds steady for 5 hours at 5.15 meters. Given that 300 mm of rain fell at Chepang on Aug 14, and an additional 193 mm between midnight and 5 a.m., it is likely that the river was rising rapidly all night and that the electronic river gauge failed or couldn't record meaningful values due to water turbulence in the early hours of August 15.

Timeline of important events

1982
Natural Disaster Relief Act (aka Natural Calamities Act) ratified; led to establishment of CNRDC, RDRC, DDRC, and LDRC and made MoHA lead implementation agency

1983
Major flooding in Karnali

1996
National Action Plan for Disaster Risk Management (deals with different stages of disasters)

1999
Local Self Governance Act (advocated devolution of responsibility to lower levels of government hierarchy, but this has been largely unsuccessful in its mandate)

2002
Disaster Management Programs first included in the National Plan (10th National Plan, 2002 – 2007)

2005
Adoption of Hyogo Framework for Action (2005 – 2015)

2006
DIPECHO programmes in Nepal (2006 – present)

2007
Disaster Management Policy and Act

2008
Major flooding in Kosi and Karnali

2009
National Strategy for Disaster Risk Management approved

Instigation of Nepal Risk Reduction Consortium and the associated flagships

Major flooding in Karnali

2011
National Emergency Operations Center operationalized

2013
District Emergency Operations Center established in 36 districts

Major flooding in Karnali

2014
Cluster system handed over to government

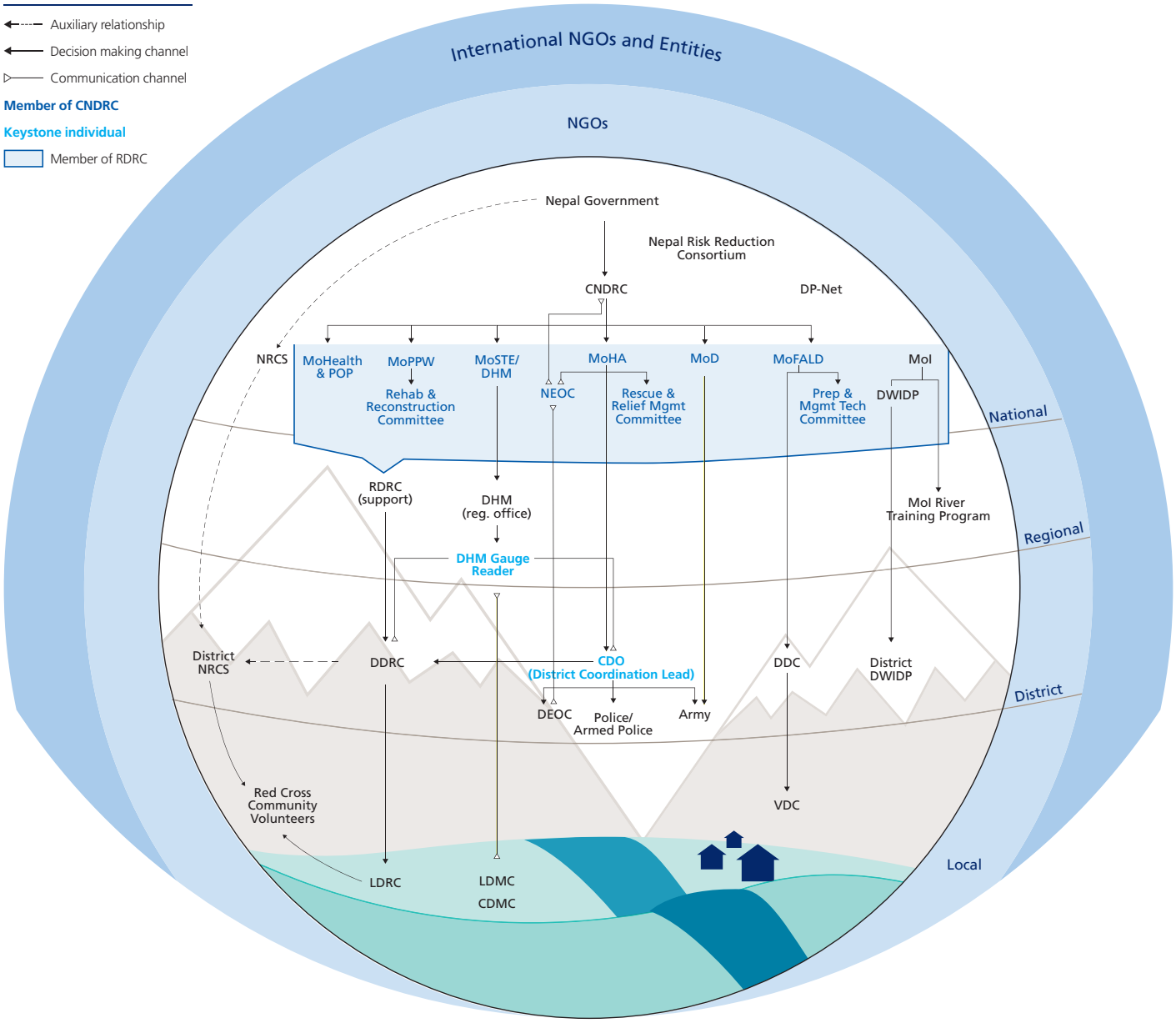
Major flooding in Karnali

Disaster Management Act is in development (based heavily on the 2009 approved National Strategy)

Section 2

Socio-economic disaster landscape

Nepal disaster institutional landscape map



Flood-prone homes and fields by the Babai river in Bardiya.

Risk and vulnerability

Nepal is a disaster-prone country, ranked 23rd in total natural hazard-related deaths globally (MoHA, 2009).[5] Nepali people face a variety of life-threatening hazards resulting from a wide range of physical, social, political, and economic factors. Over the past two decades, hazards and the resulting disasters have increased in frequency and intensity. This has had severe impacts on the lives of people, their property, and the economy. Low levels of development, a growing population, unplanned settlements, poverty and social exclusion, fragile infrastructure and weaknesses in institutional capacities and processes, have intensified the impacts of disasters and further exacerbated vulnerability.

Vulnerability in Nepal can largely be attributed to:

- settlement in hazard-prone areas
- hazard-prone livelihoods, particularly subsistence farming in floodplains
- lack of access to funding, information, resources
- lack of land ownership
- Poor 'core' systems (i.e., housing, power, transport, communications)
- an unelected government
- men often migrate for work, leaving women behind to cope with disasters
- dependency on imported money (i.e., remittances), food and goods
- systematic discrimination and inability to influence decision-making.

Marginalized groups are the particular focus of systematic discrimination. In the Tarai, these groups include: the elderly, the disabled and women (especially pregnant or nursing women and single mothers), children, 'Kamaiyas' (recently-freed bonded laborers), 'Dalits' (lower caste, formerly the 'untouchables'), and indigenous peoples. The 'landless' (those without land) are particularly vulnerable. They do not own the land they live on and are often exploited for labor. They are frequently (and violently) evicted, and lack access to traditional resources, water and food, security, and overall weakened coping mechanisms. They have few tangible assets and are excluded from government support post-disaster (Wickeri, 2010).

Floodplains are among the most vulnerable locations in the Tarai. Rapid population growth means people are increasingly encroaching on these marginal lands. 'Landless,' poor migrants are especially likely to be pushed into marginal lands as these lands tend to be unregulated. Unlike the indigenous, or even multi-generational transplants, new residents are frequently unaware of local hazards and risks, and are unlikely to take measures to address risks.

Poor infrastructure , planning and regulation are also exacerbating flooding. In Kailali and Bardiya Districts, most roads are dirt and are built up several meters, so that during floods, they are above flood waters. However, this means they act as barriers for floodwaters. They block drainage, causing floodwaters to rise behind them until they are overtopped. Once this happens the roads become impassable or damaged, hindering transportation. Breaches in these roads can divert floodwaters to unexpected places.

Embankments are poorly designed and maintained and prone to breaches during floods, putting lives and productive land at risk. Lack of regulation has resulted in both legal and illegal building in the floodplain, and an increase in river sediment mining. Dams like the Girijapur Barrage in India near the border have resulted in waterlogging for prolonged periods on the Nepal side.

New infrastructure is likely to further intensify flooding issues. India is constructing roads on its side of the border. These roads will lead to further 'waterlogging' and slow floodwater drainage from Nepal across the southern border (The Kathmandu Post, 2015a). There are also plans for hydropower development in the upstream reaches of the Karnali River system. The Upper Karnali Hydropower Project, the first of many planned projects to be approved, is expected to begin operating in 2021. However, in regions characterized by geologic instability, subject to intense rainfall, and constant erosion, restricting flow, building tunnels and access roads, and development related to existing hydropower projects has certainly led to a higher number of landslides and more flooding (as in Uttaranchal; see Circle of Blue, 2014, CNN, 2013).

[5] While hazards are natural, disasters are socially constructed (Cannon, 1994). Disasters result from a combination of natural hazards and the social, economic, and political vulnerabilities of and processes in an area (Blaikie et al., 1994; Oliver-Smith, 2004).

While there is a well-developed policy and regulatory framework for disaster management, the government's capacity to effectively reduce disaster risk is limited."

Constraints on reducing risk and vulnerability

Years of political instability and internal conflict, lack of human and financial resources, and insufficient technical and institutional capabilities have constrained the smooth and effective exercise of government at a national level as a series of short-term governments have come to power (Jones et al., 2014). These governments have often been challenged to provide even the most urgently-needed basic services for the people.

Poor access to services means that Nepal has to import food, goods, and money through remittances. Lack of access to information and technology, limited transportation and communication infrastructure, and poor agricultural extension services have contributed to low agricultural production in Nepal. Lack of reliable electricity has made manufacturing many goods prohibitively expensive. Overall, Nepal imports more food and goods than it exports, reducing employment opportunities and undermining livelihood security. As a result, temporary male migration to foreign countries for work has increased. Family members left behind are dependent on remittances to purchase daily needs, perpetuating the cycle.

This situation becomes especially problematic after floods:

- The migration of men leaves women – a historically marginalized group with little access to resources, education, and opportunities – to manage the home, maintain farming and agriculture, and cope with the risk and impacts of floods.
- The country's high dependency on imports leaves many Nepalese reliant on systems in other countries over which they have no influence/decision-making power, (e.g. food, power and employment in India).
- As the Tarai region modernizes, it must increasingly depend on local systems including transportation, communications, and financial networks to maintain daily life. If these systems fail, people are left without access to critical assets and goods, sometimes for extended periods.

While there is a well-developed policy and regulatory framework for disaster management the government's capacity to effectively reduce disaster risk is limited. Often, coordination is lacking, causing confusion over roles and responsibilities, leading to duplicative and/or countering initiatives. Laws, policies and government programs are not consistently enforced, implemented and/or monitored. For example, District Preparedness and Response Plans (DPRP) and Local Disaster Risk Management Plans (LDRMP) exist, but they tend not to be implemented in the locations where they are formulated.

In the face of these challenges, individuals must act autonomously to reduce their flood risk. They may raise their homes above flood levels or build 'Thatis' – elevated wooden boxes – inside their homes to house people and assets during floods. These efforts, however, offer only temporary and partial solutions. They do not reduce underlying vulnerabilities in any meaningful way.

External involvement

Lacking coordinated national and local resources and financing, Nepal is highly dependent on external assistance and financing from NGOs, INGOs and humanitarian agencies to implement and maintain risk reduction activities and assist with emergency response (Jones et al, 2014).

Internationally-funded risk reduction initiatives in Bardiya and Kailali Districts include:

- raising flood awareness and building capacity to adapt to and mitigate risks
- setting up formal structures such as Community Disaster Management Committees (CDMCs), to coordinate disaster management at the community level
- establishing an early warning system implemented by stakeholders, ranging from communities to government to NGOs
- diversifying livelihoods outside of farming by making use of opportunities for employing both skilled and unskilled labor
- mainstreaming disaster risk reduction (DRR) into development.

While these activities have profoundly reduced the impact of disasters in both districts, dependency on external agencies is a double-edged sword. External agencies are expected to fill the gaps where government services fall short. This includes social services such as training in skills to earn livelihoods, and basic services such as power, water, and communications. However, external agencies cannot make long-term commitments to communities, leaving communities dependent on new systems, but with no means to maintain them. Furthermore, care must be taken to ensure that international involvement does not discourage the government from stepping in where gaps exist. This can leave communities dependent on new systems but with no means to maintain them.

Section 3

What happened

Because of the advance notice, no lives were lost in Kailali along the Karnali River. Without any warning, the floodwaters would have caught villagers asleep in their beds."

Early warnings

The Chisapani gauge on the Karnali River and the Chepang gauge on the Babai River are the backbone of the community-based early warning systems (EWS) for this region. The Chisapani gauge was first installed in 1962, and the Babai gauge sometime after. These gauges were incorporated into an EWS beginning in 2010 as a means to provide water level data that can be used in flood warnings for communities, districts, and national-level agencies. Gauge readers are provided with a cell phone and are trained to record gauge data and transmit flood warnings.

On the Karnali River, starting with the onset of the intense rainfall at 9 p.m. on August 14, 2014, the Chisapani gauge reader was in regular communication with downstream stakeholders. The EWS warning level was triggered at 1 a.m. on August 15 when the river rose to over 10 meters. The gauge reader began calling the DDRC, the police, the army, and CDMC members to issue the warning and activate initial evacuation procedures. At 3 a.m. the water reached danger levels. There were two major challenges in communicating the alerts: gauge levels were rising in the early hours of the morning when people were sleeping, making it hard to contact communities; and, the gauge reader, who is responsible for contacting all CDMCs, was at the same time receiving phone calls from community members asking for updated information, which rapidly drained her cellphone battery. She was ultimately able to borrow phones and use land lines, but this slowed communications, especially after land lines went down at 6 a.m.

Nonetheless, EWS sirens were sounded fairly soon after the warning and danger alerts went out. Community members woke and responded as trained. Communities in Tikapur, for example, received warnings 2.5 hours prior to the flood. In many cases with the help of CDMCs, NGO personnel, and the army and police, people were able to move to safe ground with their larger livestock and other movable assets. Because of the advance notice, no lives were lost in Kailali along the Karnali River. Without any warning, the floodwaters would have caught villagers asleep in their beds. Loss of life and damage would have been much worse. Even with advance warning, however, some people were temporarily trapped on roofs and in trees, either because rising floodwaters caught them as they attempted to move possessions, or because the water rose so high that it overwhelmed even locations presumed to be safe. The CDMC emergency rescue teams, army and police, equipped with life jackets and boats, were able to ferry people to safety.

The early warning procedure went less smoothly along the Babai River. The Chepang gauge reader was unable to access the gauge station in the early morning hours. From 9 p.m. to 6 a.m. conditions forced him to retreat to higher ground where cell coverage was weak and his cellphone was damaged by water. He eventually contacted district security personnel and NRCS at 6 a.m. They passed on the news to the police in Gulariya via radio that the gauge had washed away; at this point, the river was already above danger levels and floodwaters had engulfed villages just downstream of the gauge. Unfortunately, the communication chain via radio was not clearly established. The police did not know whom to contact next, leading to delays. The CDO eventually received the gauge reader's warning, but did not understand its implications. Ultimately, sirens in Bardiya only sounded to indicate warning levels had been reached, but the sirens did not sound to communicate danger levels.

The warnings that did reach communities along the Babai River were not well heeded. Those who thought they were not in the path of the flood judging, by previous experience, did not move to safety. For others, it had been over six years since the last large flood and they were skeptical that significant flooding was imminent.

In Bardiya and Kailali, floodwaters flowed from unexpected places. This was a result of three factors: embankment failures and breaches; floodwaters being transported via irrigation canals; and roads blocking, disrupting and shifting flows. Due to a major embankment breach upstream of the Babai bridge, unusual flood patterns were particularly prevalent in Bardiya. This resulted in deep, fast-flowing overland flooding and breaching of the main Babai Irrigation Project canal: Floodwaters flowed throughout the irrigation network. This caused Babai River 'safe' shelters, evacuation routes and other places considered flood refuges to be inundated.

Table 2: Losses caused by the 2014 Karnali floods

Station	Deaths	Injured	Full-damaged households	Partially-damaged households	Displaced households	Affected populations
Kailali	7*	8	114	2,223	767	20,223
Bardiya	31	9	3,023	11,512	4,056	80,860
Surkhet	166	25	1,950	1,151	1,951	15,195
Dang	18	42	80	27	85	1,302

Source: DDRC. *These deaths were not along the Karnali, but along smaller rivers and streams in western Kailali.

Impacts

To some extent, Bardiya National Park, as well as embankments, and 'preparedness' activities protected dwellings, infrastructure, and agricultural land. But the floods still caused major losses (Table 2). Bardiya suffered greater losses than Kailali due to problems that arose in communicating warnings, people's perception of their flood risk, the presence of embankments on the western side of the Karnali River that shunted floodwaters into land and communities in Bardiya on the eastern side of the Karnali, and a major embankment breach upstream of the Babai bridge. Loss of life in Kailali and Bardiya Districts, however, was minimal, particularly considering the scale of the event.

This outcome can be partly attributed to the EWS. By contrast, although the affected populations in Surkhet and Dang districts were smaller than in Kailali and Bardiya, the deaths in these locations were proportionately similar or substantially higher. Some of this may be due to the lack of an EWS, though the risk related to intense rainfall is somewhat different in these districts.

Many people lost their homes and agricultural lands in the flooding, though on the Karnali River, where EWS alerts were received in a timely fashion, most households were able to save large livestock. Fields along riverbanks, especially those near irrigation canals, were badly affected by sediment deposits. Households affected by the flood lost stored food. Floodwaters contaminated water supplies, leading to diarrhea outbreaks. Fortunately, cholera outbreaks were few and quickly contained.

Infrastructure in both Kailali and Bardiya was significantly affected. Damage to roads and bridges hindered transportation, forcing people in some cases to take multi-hour or day-long detours. Many culverts were washed out, further damaging roads. Embankments and control structures along streams were damaged, increasing the potential for future flooding. Irrigation channels were damaged both by floodwater erosion and deposits of sand and silt. Downed transmission lines affected access to electricity. But, electricity access was already intermittent, particularly during the monsoon.

Infrastructure damage and loss of earnings hit businesses hard. Businesses suffered direct flood damage, lost goods and customers due to damaged roads, and lost revenue because households had less money to spend.

Response

Agencies at the national level were informed of the floods through the NEOC. Because these floods were classified as major, the CNDRC became involved. The national response to the floods was carried out through the 'cluster system' first piloted in Nepal in 2008 during the Koshi floods. The cluster system, originally a UN system, divides various elements of disaster response and the response agencies involved into clusters (i.e., emergency shelter, health, food security, etc.[6]). This helps to provide a structure for the response to avoid duplication and increase efficiency. The UN transferred coordination of the cluster system to the Nepal government in 2014.

[6] For more information, see: http://un.org.np/coordinationmechanism/cluster

The 2014 flood was the first major disaster in which the Nepal government took control of response. Due to lack of experience, the government waited for the UN and humanitarian organizations to respond. At the same time, these organizations were waiting for the government to take the lead. This created confusion and delays in response.

National disaster response funding is provided through the Prime Minister's Fund, an emergency fund designed to be mobilized through the DDRC within seven days after a disaster occurs. In practice, accessing funds is a lengthy and bureaucratic process. Instead of drawing on these funds, the government usually turns to the international community – particularly the IFRC and UN – to provide resources. After the 2014 floods, the Nepal government was hesitant to formally request international assistance. Without such a request, international partners (i.e., the IFRC, UN, and others) could not launch an international appeal and mobilize funds.

A hierarchical decision-making process further hindered response. Especially where major disasters are concerned, district-level disaster response bodies such as the DDRC cannot independently decide what to do; they must implement the decisions made by national-level agencies. The added layers of communication prevented rapid response by local bodies. Decisions at the national level failed to take into account the needs, conditions, and capacities on the ground. Thus, opportunities were lost, and some resources wasted.

Political interests complicated beneficiary selection. The NRCS conducted an initial rapid response assessment. However, major national politicians were concerned that the impact of the flood had been underestimated. Government staff were sent to communities to reassess the damage. Humanitarian aid organizations were concerned that there were multiple, conflicting sets of numbers, and conducted their own evaluations with their own definitions of 'impacted' and 'partially-impacted' households.[7] Some of these evaluations and beneficiary selections were based on the effects of the initial flooding; others reflected both initial and subsequent impacts due to additional rainfall Selection of beneficiaries largely took place before floodwaters had completely receded, leaving out inaccessible communities and households whose homes collapsed in post-flood rains.

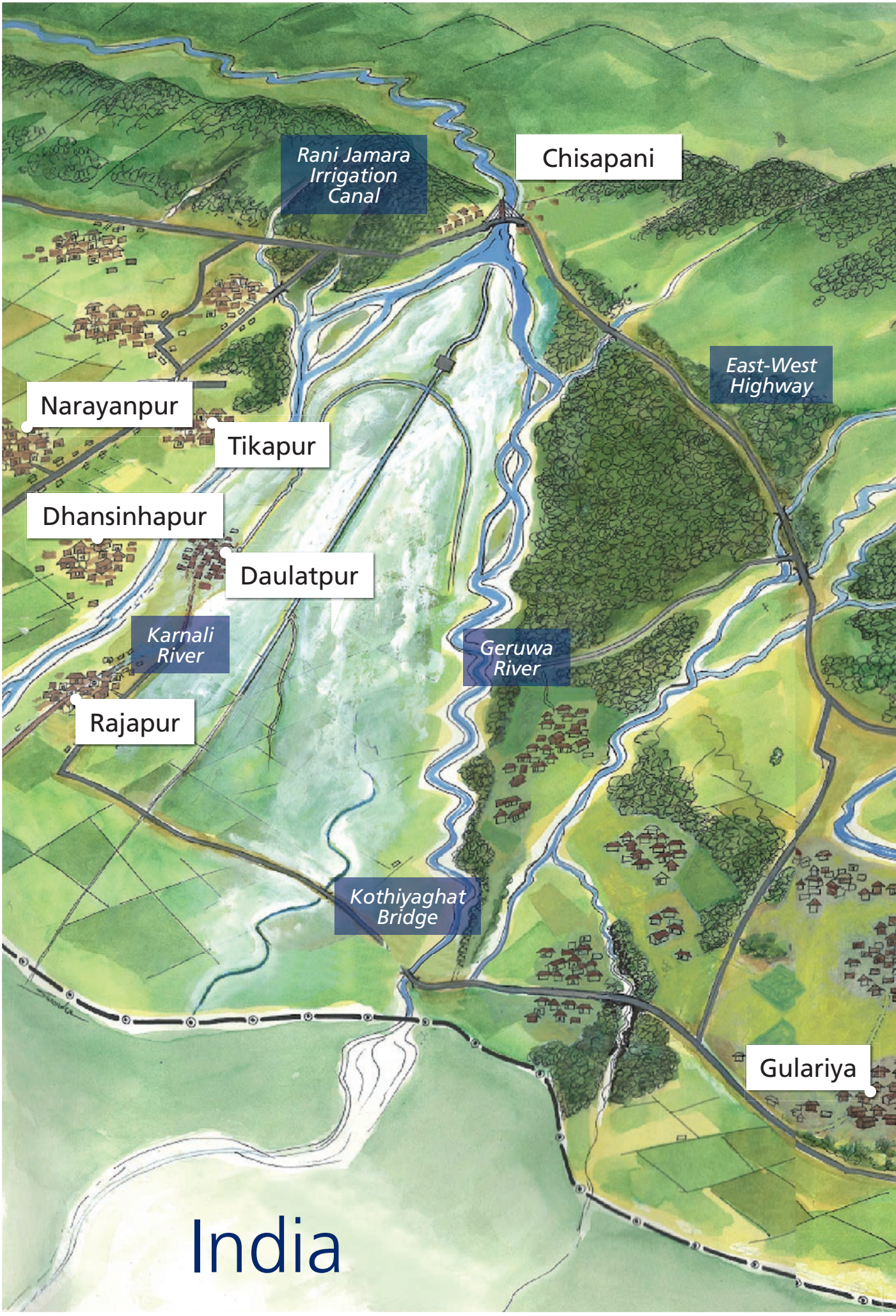
Aid distribution was similarly problematic. Politicization of response, lack of information and lack of communication led to a breakdown of the one-door aid policy.[8] Relationships between the organizations and agencies in each cluster had been neglected since the previous major disaster, meaning trust was lacking. This resulted in poor coordination within and among clusters. Organizations began to distribute their own relief to beneficiaries they had chosen. Relief kits were not standardized and, in some cases, were split to reach more beneficiaries, leading to disputes between households over unequal distribution of relief. Due to the lack of disaggregated census data, organizations were unable to tailor relief kits to household needs. Appropriate training was not provided alongside relief kit distribution; for example, people continued to use contaminated water because they did not know how to use the chlorine tablets they were given. Households that had not been affected by floods claimed that they, too, on the basis of poverty, were entitled to relief, further complicating distribution. At the same time, the government prohibited aid organizations from distributing shelter packages to the 'landless.' Ultimately, those most in need were left with insufficient or no external relief.

Amid the chaos and confusion of external response, the CDMCs were instrumental in responding to community needs. CDMCs helped their community members organize and distribute relief (primarily dry food) using the CDMC emergency fund.[9] CDMCs also assisted district security personnel with search and rescue and conducted health campaigns to minimize the spread of disease. In many areas without formal disaster response groups, local volunteers formed 'emergent' (ad hoc) groups that provided assistance to households and individuals, speeding response and bypassing a potential seven-day wait for external assistance.

[7] The NRCS designates homes that have lost their roofs as 'impacted'; damaged houses with intact roofs are considered 'partially impacted.'

[8] The one-door aid policy mandates that the NRCS is responsible for all non-food relief distribution.

[9] The CDMC funds are community disaster-related finance collectives. Households contribute 50 to 100 rupees (0.5 to 1 USD) per month depending on their available financial resources. The VDCs provide some amount of seed funding or matching funds.


Rani Jamara Irrigation Canal
Chisapani
East-West Highway
Narayanpur
Tikapur
Dhansinhapur
Daulatpur
Karnali River
Geruwa River
Rajapur
Kothiyaghat Bridge
Gulariya
India


N
Babai River
Nepal
Babai Irrigation Canal
Bardiya National Park

Temporary shelters on flood-damaged infrastructure in Rajapur.

Recovery/Rehabilitation

While emergency relief is critical in addressing the immediate needs faced by households and communities following a disaster, it cannot address major, long-term flood impacts. The floods caused the loss of important assets (property, crops, food, shelter) and severely damaged fields. Following the floods, early recovery support, training on alternative income-generating activities, longer-term food security, and resettlement are urgently needed.

Government support, however, is rarely available for these activities. The Nepali government focuses largely on restoring public infrastructure: rebuilding roads and bridges and repairing and upgrading river control and irrigation systems. Even these activities tend to be delayed. Seven months post-flood, only temporary repairs have been made to roads and bridges, the Chepang gauge is still missing and the Chisapani gauge still damaged, and most of the necessary infrastructural recovery work has not yet begun.

The government is trying to branch out into social recovery. The Bardiya CDO has allocated a small budget to rebuild schools, community roads, and the community center in Gulariya. In addition, the government (with the support of INGOs) is planning to build low-cost housing for people who have been displaced and are currently living in tents set up by INGOs. However, these efforts are limited, poorly funded, and 'landless' people are excluded.

Most people have essentially been left to recover on their own. The government provided NPR 5,000 (USD 50) to households that suffered total damage, NPR 3,000 (USD 30) to partially-damaged households, and an additional NPR 2,300 (USD 23) for clothes and Dashain.[10] For recovery needs beyond these, households must rely primarily on support from friends and family, and on remittances sent by relatives who migrate to India and other countries for seasonal labor. Those without land or other assets to borrow against cannot get bank loans. Instead, very small loans are available from the CDMC emergency fund and community finance collectives.

In a few communities, NGOs have provided people with seeds and tools, organized vocational and livelihoods training (i.e., making snacks to sell), supported families that have opened small shops, and provided families with food in exchange for work done to rehabilitate critical facilities (i.e., roads to markets, local irrigation systems). However, it is unclear if these activities are still going on. In addition, the scope of these activities tends to be small compared with the overall need.

Businesses, by and large, have not been included in recovery efforts. In some communities, banks are not providing loans to small businesses. These businesses are moving away. Some severely-affected businesses have obtained loans for recovery. Businesses that haven't suffered physical flood damage but lost customers, such as small local restaurants and shops, have few options.

[10] A major 15-day Hindu festival in Nepal.

Section 4

Key insights

Poor infrastructure planning and design is exacerbating flooding and waterlogging across the Tarai. Despite recurring damage, most new structures and upgrades replicate past design problems."

Challenges in implementing an urgently-needed, formal disaster policy in Nepal

The lack of a formal National Disaster Act has made it difficult to mainstream disaster management initiatives. What initiatives there are focus mainly on response. Preparedness and DRR are relatively new inclusions and recovery, especially social recovery, is not yet a part of the disaster management landscape.[11]

Unique networks such as the Nepal Risk Reduction Consortium and DPNet have been formed in Nepal to advocate for, and assist the government with disaster management. Most advocacy has focused on building policies that incentivize and/or formalize preparedness, mitigation and prevention and require incorporating disaster risk reduction into development work.

However, even where policies exist, implementation is weak and there is little monitoring or evaluation. This makes it difficult to ascertain that activities are carried out, and which ones succeed. Government and organization protocols and plans were not implemented in response to the 2014 Karnali flood; response was largely ad hoc.

Ad hoc response, poor in any situation, is particularly ineffective in Nepal where local staff and community members are not included in decision-making. Decision-making is hierarchical such that policies and actions are directed from Kathmandu. But the national government NGOs, and other agencies may not have a complete understanding of local conditions and capacities. Information exchange both from the top down and the bottom up is slow or lacking. At the district and local levels, it can be unclear who has decision-making power in an emergency.

A top-down approach also limits the ability to innovate, especially at local levels. Instead, those in the districts often depend on their superiors at the national level to come up with solutions. Lacking knowledge of the local context, the solutions devised may fail to take advantage of local strengths and capacities or address local realities.

Poor infrastructure increases risk

Poor infrastructure planning and design is exacerbating flooding and waterlogging across the Tarai. Roads and bridges are built in locations and ways that turn them into de facto dams. Despite recurring damage, most new structures and upgrades replicate past design problems.

While this type of construction in Nepal is blocking and shifting how floodwater flows, construction in India just over the border is similarly problematic. Downstream dams in India are causing chronic waterlogging in Nepal. Ongoing construction of a three-meter high road located five to 25 meters from the no man's land on the Indian side of the border is causing floods to inundate villages in Nepal (eKantipur.com, Feb 4, 2015). Plans for additional infrastructure will further exacerbate the damage caused by floods and waterlogging. There is no master plan for the region that takes into account the potential combined impact that construction in Nepal and India will have, and Nepal's government has been slow to take these issues up with India's government.

Proposed construction of upstream hydropower dams on the Karnali River is also likely to intensify the impact of floods. The changes in land use associated with the construction of dams – roads, infrastructure, neighboring settlements – results in road cuts, bare ground and over-steepened slopes that increase the likelihood of river-blocking landslides. Landslides temporarily damming rivers have caused many catastrophic floods in Nepal. Hydropower installations with storage reservoirs have the potential to cause even more damage unless there are clear, enforced procedures in place to design, build, operate and maintain the dams in ways that mitigate downstream flooding and related damage. In many countries, hydropower dams fail to include additional purposes e.g., serving as a flood retention basins, etc., and are operated solely for optimum power generation. This can result in release of water from reservoirs in emergencies during floods, further inundating downstream communities.

[11] This is a disaster management trajectory that is common all over the world. First, countries focus on response. DRR and preparedness eventually get added in; then, early recovery and, eventually, long-term recovery. In this sense, Nepal is likely to implement early and long-term recovery mechanisms at some point, but it is unclear whether this will take years or decades.

Poorly-planned physical protection exacerbates flood impacts

In Nepal there is a major push to build embankments along rivers as the main element to prevent flooding. These embankments, however, are not a part of a wider integrated flood risk management program. Communities and other local bodies are consulted only minimally when planning embankments and spurs. There is little upstream-downstream and right-left bank coordination. This is a problem because many of these projects are expected to take several years and the construction process will significantly influence interim flood patterns and the potential risks communities along the river face. Sedimentation rates and 'safe failure' principles are not being addressed. What was learned in other regions and disasters, such as the Koshi embankment failure in 2008, is not being incorporated into the designs.

Embankments are being designed to have roads on top of them, even though the embankments are only being built for a lifespan of 20 to 25 years. The embankment roads will attract settlement and development that is heavily dependent on the roads. The roads will likely increase the speed of degradation and attract more, and unintended activity on embankments, reducing the protection level. Embankment maintenance and upgrades are not included in the current planning, nor is funding. Potential risks due to poor maintenance are further exacerbated by not designing embankments to fail safely when floodwaters threaten to overtop them. All these factors increase the chances that the embankments will breach in at least one location at some point in their lifespan. When they do fail, it is likely to be with catastrophic consequences.

Flood impacts can spread beyond the floodplain

The Karnali floods didn't stay in the floodplain. Embankment breaches, obstacles like bridges and roads, flooded irrigation canals and unexpectedly large flows that exceeded bank capacity and overflowed the river channel contributed to flooding in unexpected places. Particularly on the Babai River, 'safe' locations and evacuation routes were inundated.

The early warning system saved lives

The EWS was instrumental in saving both human lives and large livestock during the 2014 floods. The system worked because it used existing community structures[12] and had extensive stakeholder buy-in. However, it was less effective than it could have been for several reasons:

- The entire EWS system is dependent on a single person, the 'gauge reader,' at each gauge. The gauge reader must access the gauge and communicate water levels to downstream stakeholders. This failed at both the Chispani and Chepang gauges for periods of several hours.
- Communication protocols failed. During the flood, the power sources for the telemetry system[13] were not reliable or sufficient. The Chepang gauge reader was only able to communicate via radio and the police were not trained to communicate a warning received by radio.
- The CDO in Bardiya was relatively new, not from the region and unaware of local flood hazards. He didn't understand the urgency and magnitude of the flood event communicated by the gauge reader and did not trigger the appropriate EWS alerts quickly enough.
- CDMC members were difficult to reach in the middle of the night. In some areas, trained members were not in the community because they had left the area to work elsewhere. New members have to be recruited and trained. This turnover poses challenges to the long-term sustainability of these groups.
- Lead times were very short. On the Babai River, EWS alerts were delayed. On the Karnali, lead times were shorter than in previous floods. It is not known if this was due to the intensity of this particular flood, or because of changes in river dynamics. Along both rivers, many people were only able to save themselves. They could not do much to save their livestock or property.

[12] The community-based early warning systems for flood incorporated existing systems that were being used to warn households when wild animals were in the area. Data collection structures such as the gauges and telemetry stations needed for flood warnings [were] set up by the DHM.

[13] Telemetry refers to an automated process in which data are collected and transmitted to a monitoring station. It is generally used for monitoring in remote and/or inaccessible locations.

Poor coordination hampered response

Coordination in responding to the disaster was poor within and across all levels and sectors. The government is still learning how to respond to disasters, and there is no clear leadership to deal with the response. Weak relationships between and within response organizations contributed to the cluster system breaking down, impeded distribution of relief and made the overall response less efficient.

Relationships are a critical part of ensuring multi-organizational coordination systems work effectively. Without strong relationships, a lack of trust among different agencies during the response hinders coordination and communication. Within organizations, hierarchical structures that leave regional and district staff out of the decision-making process make it difficult to exchange information. In terms of coordinating response, the CDO can be the single weakest link leading to system failure. CDOs are the main coordinators at the district level. They are appointed in Kathmandu and are frequently transferred from place to place. As a result, they may lack local knowledge, have poor local connections, and no 'institutional memory.' Therefore, CDOs are often unable to fulfill their roles in risk awareness, preparedness and response, leaving district governments unable to adequately coordinate response during disasters.

Lack of local government capacity on the ground and poor coordination and disaster management capacity at the national level slowed response, and meant efforts were often cumbersome and not well-tailored to local conditions. Coordinating response and recovery with government ministries and departments was a significant challenge for NGOs and clusters.

The politicization of flood response further complicated coordination, particularly in Bardiya. It played a major role in the breakdown of the cluster system and subsequent relief distribution. A government ban on distributing shelter relief to 'landless' people constrained humanitarian organizations' ability to provide aid. Overall, the most vulnerable were left behind, with insufficient or no relief.

Response funding is a major constraint

Government relief funds (i.e., the Prime Minister's Fund) are limited and can be difficult to procure. National funding allocated at the local level is limited and can only be used for relief. There is not enough government support for preparedness initiatives. Overall, the government relies on the international donor community to fill funding gaps.

What is learned from events isn't being incorporated into policy and action

Formal learning from flood events in general has been poor. Assessments of the 2014 flood response are being conducted by several groups, but are not being publicly shared. There is no evidence that what was learned from prior events, such as the 2008 Koshi floods, has been incorporated into disaster management practices. The lack of monitoring and evaluation by the government makes it especially difficult to track activities and generate reports on lessons learned. The fact that district and local level staff are not included in decision-making also significantly hampers institutional learning. There is lateral learning at the local level (i.e., community to community), but this learning is not being transferred to higher levels.

Data are needed to support preparedness, response and recovery

Hydrological and meteorological data in Nepal are not widely available. There are very few measuring stations, particularly in view of the complex nature of the landscape. Many stations depend on manual measurements. There are gaps in data and the data tend to be inaccurate and unreliable. Extreme events are particularly problematic; the sparse data network means there is rarely backup data from nearby stations.

Historic flood maps and descriptions of flood severity are not available. There is little or no data on river sedimentation rates for the Karnali and Babai Rivers, even though this information is crucial to the design of flood protection structures. Flood scenario maps – potentially powerful planning tools – are rare, of poor resolution, and out of date.

> Community recovery and rehabilitation are left to community members, which undermines resilience and exacerbates vulnerability."

Socio-political implications can make data difficult to obtain. For example, flood scenario maps have not been publicly distributed due to the potentially negative implications these might have for land values. Where data do exist, the information is rarely transferred to similar systems elsewhere in the country. For example, extensive research on flood vulnerability, river dynamics and sustainable river management has been conducted in the Koshi basin. But little of this information appears to have been extrapolated to, and applied in the Karnali Basin.

People are left to recover on their own

The government's recovery efforts are largely focused on rebuilding damaged infrastructure. Community recovery and rehabilitation are left to community members, which undermines resilience and exacerbates vulnerability; communities do not have access to the resources needed to build back better. Given the lack of government response and early recovery funding, CDMC funds were a key source of funding for affected communities. But the amounts are small. Many households are paying for recovery primarily through remittances from male family members. This leaves women, who have been historically marginalized, to cope with the impacts of floods and recovery while managing households.

Flood recovery and resilience actions underway:

- Building flood-protected grain storage at the household level.
- Training communities to treat water post-flood.
- Building additional flood- and earthquake-resilient community safe shelters.
- Building additional flood-resistant community evacuation routes and walkways.
- Re-establishing the Chepang gauge station on the Babai River.
- Installing additional telemetry stations upstream of both Chepang and Chisapani to allow for about two hours advance warning as part of a larger strategy to continue strengthening the EWS.
- Advocating for the government to allocate five percent of its budget for DRR.
- Developing an approach to mainstreaming DRR with the government.
- Creating standards and plans for urban DRR.
- Linking border communities in Nepal and India to create a grassroots information-transfer network.
- Setting up a training program for government staff to help retain information that is otherwise lost when employees are transferred.

Planned flood recovery and resilience actions:

- National government: create a master plan for future disasters. This plan will deal with three issues: river control embankments; shelter for, and resettlement of 'landless' people; and strengthening existing early warning systems.
- Practical Action/DIPECHO: Improve and expand the EWS system by including rainfall forecasts; increasing the number of people involved in early warnings, rescue, management response groups; providing backup power for gauge stations and gauge reader cell phones and installing land line phones at gauge stations.
- DHM: expand the network of gauges and telemetry stations.
- DHM: build DHM flood forecasting capacity.
- INGOs: Provide livelihood training as part of longer-term recovery programs, especially for 'landless' people.
- Building a bridge between Rajapur and Tikapur across the Karnali and paving the road from Nepalgunj to Tikapur, providing a backup to the East-West Highway.

Section 5

Recommendations

Based on the insights gained through research on the Karnali Basin 2014 floods, ISET-International, ISET-Nepal, Practical Action Nepal and Zurich recommend the following for Nepal and nations globally to improve flood resilience:

a. **Make planning iterative, inclusive and flexible.** Disaster management and infrastructure planning cannot be developed solely at the national level – local stakeholders with knowledge of local context, needs, and constraints, must be an active part of the planning process. Plans should allow for the development of local innovations and solutions. Plans need to remain relevant under a wide range of conditions and contexts. Such flexibility will allow for better use of local resources and capacity, and greatly speed up disaster response.

b. **Incorporate extreme scenarios and uncertainty into planning.** Planning in Nepal is reactive; plans are updated to include new developments but not used to structure and direct development. Rarely does planning take into account the potential impacts of proposed new development, particularly across multiple combined projects, and consider how to mitigate the potential impact before construction begins. To reduce risks in Nepal, this type of planning needs to become formalized.

   Planning also needs to address not only what is expected to happen, but also the unexpected. The intensity of the 2014 flood underscores the danger of unexpected events. Even in cases where there may be a great degree of uncertainty, planning needs to take into account scenarios above a 100-year, or similar design return period. In particular, flood planning should include the possibility of protection failures. Current assumptions that protection levels are adequate and failure scenarios do not need to be incorporated into planning are highly flawed and dramatically amplify current risks.

c. **Build redundancy and safe failure into critical systems.** All 'core' systems (i.e., food, water, shelter, power, communications, transportation) need to have built-in redundancy so that they can continue to work during and after extreme events. For example, key communication nodes should have reliable backup power systems. But all systems will eventually fail. Core systems need to be built so that when system components fail, they fail in safe, predictable ways, preserving as much functionality as possible.

d. **Design, install and maintain protection systems in ways that don't ultimately exacerbate risk.** Flood protection systems in the Tarai currently reduce short-term risk while increasing long-term risk. Embankments need to be designed considering sedimentation rates, the possibility of safe failure, and accounting for the increasing trend in rainfall intensities that has been observed over the past two decades, by adding safety marings. They also need to be designed in ways that will not attract undesired development near or on the protection structure that undermines the protection level (i.e., embankment roads, agricultural activity on dams, etc.), and for longer lifespans – beyond 25 years – and allow financing and staffing for maintenance, control, and lifecycle management. The presence of embankments and their ability to prevent low-intensity flooding, together with poor land use regulation, can lead to a false sense of security and increased development in adjacent areas; this is known as the 'levee effect.' Furthermore, it is unlikely that this development will be built to withstand floods. The likely embankment failures will then be catastrophic, as was the case in the Koshi embankment breach in 2008 (Dixit, 2009). Protection systems need to be designed to give space to the river. This means allowing rivers to flood, keeping key assets outside of the flood zone, and protecting lives within the flood zone.

e. **Further develop existing EWS and replicate the systems in other regions.** Even though they didn't function entirely as planned, the EWS in Kailali and Bardiya Districts dramatically reduced loss of life and property. The EWS should be further strengthened by addressing single points of failure (e.g., battery backups, gauge-reader backup), improving communications protocols, and increasing local awareness of risk. The Karnali Basin EWS should be replicated throughout Nepal wherever there is flood risk, where upstream gauge data are available, and where it is feasible to set up a communications structure to transmit warnings. To provide additional lead time, the EWS should also be linked to precipitation forecasts, real-time precipitation measurements and river flood forecasts. Current real-time precipitation, which is measured at more locations than river flow, could be used to 'pre-alert' first responders to potential danger so that they are ready if danger escalates.

   Early warning can be further strengthened by linking upstream and downstream communities. Given lack of flood forecasting, the lack of EWS in much of Nepal and the potential for EWS delay or failure where they do exist, this will allow for transfer of warning information and will build redundancy into the warning system. It offers an alternative way to transmit information where there are no warning systems. Links can also be used to encourage social learning and help with preparation, response and recovery.

f. **Build and maintain relationships within and across sectors.** For multi-organizational response mechanisms such as the cluster system to work efficiently, relationships need to be built and maintained with and between organizations and government stakeholders, between sectors, and across scales and levels of authority. Engagement cannot wait for disasters; relationships must be built in a systematic, ongoing way that allows members to familiarize themselves with each other's strengths and weaknesses, builds trust, and promotes cooperation.

g. **Maintain institutional memory.** The fact that government staff (i.e., CDOs, army, police) are frequently transferred poses major problems for response; 'institutional memory' is not retained within districts. Mechanisms need to be created to maintain knowledge. They must be put in place so that all district-level activities can be sustained and enhanced despite high levels of staff turnover. This could be achieved either by pairing up CDOs with a counterpart with extensive local experience, or by hiring CDOs locally and bringing them to Kathmandu regularly for capacity building and networking opportunities.

h. **Allocate ongoing, dedicated funding for disaster management.** Current government disaster management allocations are inadequate. There should be more consistent and substantial funding allocated to disaster preparedness, livelihoods development and support, and resilient recovery. While livelihoods development does not contribute directly to disaster risk reduction, it provides households and communities with the resources and livelihoods security needed to better cope with and recover from disasters.

i. **Incentivize dissemination and application of lessons learned.** Following the flood, many government departments, INGOs and NGOs conducted assessments and workshops to review the lessons that were learned. However, the lessons identified in these workshops need to be learned and implemented. Previous mistakes must not be repeated or amplified. In the aftermath of major disasters, it is of importance that all those involved conduct a critical review of actions and results. People need to be prepared to substantially restructure those approaches, plans and policies that proved problematic. Opportunities to learn must span national, regional, district, community levels, and include all organizations and sectors. The people involved need to be transparent, open-minded and willing to act on what is learned. This can be incentivized by introducing mechanisms that promote accountability and transparency.

j. **Generate reliable, usable data and make the data available.** To better conduct relief efforts and distribution, better data is needed on national and local demographics. Other existing data such as risk assessments, scientific data and flood maps should be available upon request or via public platforms (i.e., the internet). Having access to data at no cost and educating data users helps people make better, more informed decisions.

   In particular, hazard maps should be created and distributed so that the people in Nepal have a better understanding of the risks they face. This would also allow private and public sectors to take risks into consideration during planning and development. It is becoming increasingly feasible to crowd-source disaster impact data. This could provide a relatively straightforward way to create initial maps, such as flood hazard maps, based on past events. This would bypass the need to wait for improved topographic data and extensive modeling efforts.

k. **Support recovery.** For many Nepalese, daily survival takes precedence over long-term recovery, especially in the aftermath of a disaster when resources are scarce. There is a need for social recovery mechanisms that allow households to begin recovery while tending to daily needs. Such programs could include making it simpler for households and small businesses to access loans. These programs could also provide short-term employment opportunities (i.e., repairing and rebuilding damaged infrastructure). They might also offer livelihood and skills-based trainings that take into account the market for the skill, the raw materials needed, and whether those materials are locally available.

   Recovery initiatives also need to take into consideration the core systems and services upon which local livelihoods depend (i.e., roads, communications, water). For example, it is not enough to merely provide farmers with a more reliable water supply. Farmers also need training on crop diversification, as well as access to markets, and a way to package and transport crops. 'Secondary systems' could include communication services that enable market tracking and the ability to store non-perishable crops until market prices rise. Not only people in urban areas, but also those in rural ones depend on such systems.

   Recovery support needed for households and core services will vary by location; local residents need to also have input on the recovery approach that best serves them. Combining recovery efforts for households with core service provision, and providing what is needed based on input from local communities, will support both short- and long-term recovery. It will encourage re-building in a better, less vulnerable and more flood resilient way.

Motorcyclists use a flood-damaged bridge in Rajapur.

Section 6

Conclusions

Nepal context

The 2014 Karnali floods, along with the major earthquakes on April 25 and May 12, 2015, underscore the danger such unexpected events pose, and the need for an effective disaster management system. Our research on the Karnali floods indicates that Nepal's disaster management system, on the whole, is weak. News reports about the earthquakes clearly reveal that the responses underway in Nepal are not much different from those during the Karnali floods (except on a much larger scale): coordination across and within state agencies and government departments was poor, systems designed to streamline response broke down, and there were delays in relief supplies reaching people (The Kathmandu Post, 2015b; The Guardian, 2015; Indian Express, 2015; Nepali Times, 2015; The Kathmandu Post, 2015c). We anticipate that, in managing the earthquake disaster, past failures will be repeated. As disaster funds are depleted in the coming months, it will become critical for Nepal to spend the remaining money in ways that maximize the recovery of the millions of people affected by the earthquake and the country to build back in a better, more resilient way. This makes it especially urgent that our recommendations be adopted.

Regional context

Learning about disasters on a regional basis is extremely important, especially as climate change intensifies rainfall events over semi-arid mountainous regions. The 2014 Karnali floods were small in comparison to the 2013 Uttarakhand floods, the 2010 Indus basin floods, and the 2008 Koshi floods. Yet the underlying physical flood drivers, social vulnerabilities, and way infrastructure amplified hazards were common to all four events. The 2013 Uttarakhand floods in India, for example, were caused by a combination of intense rains in the Middle Hills and existing infrastructure (CNN, 2013). Ill-conceived upstream hydropower dams, in particular, and subsequent intense riverbank erosion heavily exacerbated flood impacts. The floods caused extensive loss of life, property and agricultural fields. The damage to and destruction of multiple dams during the event reduced access to electricity, which posed a setback to the economy and recovery from the disaster. Nonetheless, major hydropower projects similar to those in Uttarakhand are planned across the Himalayas in geologically unstable areas subject to high erosion, and prone to intense, and intensifying, monsoon rainfalls. It is safe to assume that these hydropower dams will eventually have similar, devastating consequences in future floods. Lessons from the Uttarakhand floods and similar historical events need to be learned and applied to planning throughout the region.

Learning and applying these lessons, however, is challenged by poor basin-level understanding and management. Most of the Himalayan river basins extend across administrative, national, and geographical boundaries. Basic data and information for these rivers are lacking; where data and information are available, they are frequently treated as a national security issue and are difficult or impossible to access. Basin-scale management within nations is minimal and across national borders even scarcer. The Karnali Basin, for example, extends into the Indian Tarai. Dams and road construction on the Indian side of the border have exacerbated flooding and waterlogging on the Nepal side. At the same time, irrigation systems and embankment construction are likely to change the timing and volume of flows into India. Actions on both sides of the border are being undertaken with little understanding of the potential changes these actions will cause. Clearly, strategies in one area can cause major problems in other areas, especially without adequate knowledge of basin dynamics, knowledge/information transfer across borders, and collaborative trans-boundary planning.

Nepal has an advantage in this regional context as it occupies the headwaters of these major rivers and, for the most part, these rivers remain undammed and uncontrolled. Whether, and if so how and where, structures are added to these rivers is still open to debate. There is an opportunity to make wise, well-informed choices. However, there is also immense political and financial pressure on Nepal, pressure only intensified by the recent earthquake. In this environment, Nepal and surrounding countries should be supported and encouraged to think carefully about infrastructure investments in the Himalayas. As part of this, there is the opportunity to develop international, cross-boundary collaboration around learning, planning, and management. This could ensure that plans do not have negative cross-boundary impacts.

Global context

Including disaster preparation and resilience in development can lead to real, lasting improvements. Providing more resources to address risks prior to disaster events can minimize damage and enhance recovery. We can make disasters less traumatic and reduce the resources needed for repeated post-disaster relief. What happened during the Karnali floods is not a new story, nor is it a story that is limited to the developing world. PERC analyses

Money alone cannot prevent a hazard from becoming a disaster. Rather, better planning and regulatory processes, and more equitable policies are needed."

conducted for floods in central and eastern Europe and the UK, and a study of the September 2013 floods in Boulder, Colorado indicate (Zurich, 2014a; Zurich, 2014b; Zurich 2015; ISET-International, 2014) have highlighted that:

- flood planning needs to be participatory and integrated with land use, development and other planning efforts
- critical systems need to be modular and/or redundant and assessed at an effective risk-and-consequence basis
- river hydrology needs to be better understood and action should be coordinated at the basin-level, not stop at administrative or political boundaries
- levees can only mitigate flood risk to a point, and therefore, they need to be designed to fail safely and people need to remain aware of the residual risk
- settlement around levees and more generally in floodplains needs to be regulated
- building regulations should be fully enforced
- while pre-event risk reduction and protection can often be cost-effective and easy to carry out, incentives and knowledge need to built to implement these measures
- flood planning needs to take cascading failures into consideration
- risks should be better communicated to communities to ensure that households undertake preparedness actions
- accurate, up-to-date, and unbiased flood maps are a critical component of preparedness and must be publicly available
- shelters need to be flood-resilient
- Acknowledge emergent groups that often form to fill gaps in formal disaster management
- improve relationships – within communities, between organizations, between government and organizations, etc. – to enhance access to resources, services, and information, and build efficiency in all parts of the disaster management system.

In all of these post-event analyses, the government's role in disaster management, and the part played by autonomous bodies, is a divisive subject. Who is, and who should be responsible for doing what? The answers are changing as the risks and costs of disasters escalate.

Most significantly, we are seeing globally that where response and recovery are concerned, the marginalized, most vulnerable communities are falling through the cracks. This is to the detriment of the broader economy and society. In the Karnali Basin, the 'landless' affected by the floods have been denied relief in the form of shelter and bank loans. As a result they have had to turn to exploitative landlords for high-interest loans to support recovery, pushing them deeper into poverty. In Colorado, 'undocumented' immigrants affected by floods have been unable to access government recovery funds and have also been left out of ongoing flood resilience discussions. Yet, these marginalized groups provide services vital to the economy and society. In the Karnali, the 'landless' work primarily on farms, and are therefore vital for Nepal's overall food security and agricultural economy. In the U.S., communities of undocumented immigrants work in a variety of jobs in construction, manufacturing and services.

Flood resilience, and disaster resilience in general, are not only about resource and economic capacity. Although developed nations have more resources at their disposal than developing nations, both have similar gaps in their resilience. This suggests that there are social and institutional barriers – including perception of risk, regulatory processes, and systemic discrimination – which restrict resilience. For poorer cities and countries, this is a good thing – social and institutional changes can be made without great economic input. For wealthier cities and countries, this serves as a reminder that resource and economic capacity is not everything. Money alone cannot prevent a hazard from becoming a disaster. Rather, better planning and regulatory processes, and more equitable policies are needed. While it may be true that the Karnali floods would have been less devastating in a nation more developed than Nepal, this does not change the fact that nations need to improve their resilience to potential hazards. A detailed analysis of disasters globally can provide important lessons learned for where and how resilience can be built.

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Interviewees

National Level

1. Atma Ram Ray, PM, Karnali River Control Program, DWIDP
2. Dharma Raj Pandey, Head of Department, Disaster Management, NRCS
3. Deepak Poudel, Treasurer, DP-Net
4. Dayaram Shrestha, Section Officer, NEOC
5. Ritva Lahti, Country Representative, IFRC
6. Binod Parajuli, Flood Forecasting, DHM
7. Dinanath Bhandari, Climate Change and DRR Program Coordinator, Practical Action
8. Gopal Dahal, Emergency Response and DRR Manager, Lutheran World Federation Nepal
9. Christophe Belperron, Country Representative, Mission East
10. Jean Louis Van Belle, Head of Resilience Unit, UN World Food Programme
11. Kurt Burja, Head of Flood Security Monitoring and Analysis Unit, UN World Food Programme
12. Alejandro Bárcena Berzosa, DRR Flagship 4 Coordinator, IFRC
13. Bishnu Kharel, DRR Coordinator, Care International Nepal
14. Shree Bhakta Basnet, Senior Programme Coordinator, Urban Risk Management Programme, Oxfam

Regional/district levels

1. Ek Prasad Adhikari, Assistant Chief District Officer, Gulariya
2. Krishna Gautam, Nepal Red Cross Society District Officer, Gulariya
3. Lok Pokhrel, Practical Action, Nepalgunj
4. Sambhu Pandit, Project Manager, Karnali River Training Project Office, Rajapur
5. Engineer, Babai Irrigation Project, EW Highway at Babai River
6. Prakash Khadka, CSDR, Rajapur
7. Shobhakar Sharma, Rural Self-Reliance Center, Rajapur
8. Govinda Jha, Hydrologist Engineer, DHM Karnali Basin Office, Nepalgunj
9. Topendra Sundar Malla, Civil Engineer, Irrigation Office, Nepalgunj
10. Karmidanda CDMC, Tikapur
11. Mahadevtole CDMC, Tikapur
12. Female shopkeeper near new bridge across Geruwa River
13. Lautan Chaudhary, Social Mobilizer, CSDR, Rajapur
14. Dinesh Chaudhary, CSDR, Rajapur

Community Level (conducted by local interviewers)

1. Raju Chaudhary, Rajapur-12, Shangarshnagar, CDMC President
2. Jir Prasad Tharu, Rajapur-12, CDMC member
3. Surathiya Tharu, Rajapur-12, CDMC member
4. Tek Bahadur Budamagar, Tikapur-3, Karmidanda, CDMC president
5. Jung Bahadur Budamagar, Tikapur-3, Karmidanda, resident
6. Sher Bahadur Thapa, Tikapur-3, Bankatti, CDMC resident
7. Rekha Thapa Magar, Tikapur-3, Bankatti, resident
8. Usha Pariyar, Dhansinghpur-2, Suryapur, CDMC member
9. Bidhya Chaudhary, Dhansinghpur-2, Banjaria, CDMC President
10. Bhikni Devi Chaudhary, Dhansinghpur-2, Banjaria, resident
11. Kala Dhami, Narayanpur-8, Dhamitole, CDMC Secretary
12. Gopendra Dhami, Narayanpur-8, Dhamitole, resident
13. Nareshwor Dhamala, Narayanpur-8, Mahadevtole, resident
14. Nanda Devi, Narayanpur-8, Mahadevtole, CDMC member
15. Laxmi Chaudhary, Pathabhar-9, Sunkatti, CDMC President
16. Maya Chaudhary, Pathabhar-9, Sunkatti, CDMC Secretary
17. Kiran Chaudhary, Rajapur-6, Tighra, CDMC First-Aid Coordinator
18. Rupak Chaudhary, Rajapur-6, Tighra, resident
19. Bal Krishna Chaudhary, Rajapur-10, Chakkapur, resident
20. Karuna Chaudhary, Rajapur-10, CDMC President
21. Ram Nath Gautam, Khairichandanpur-7, CDMC President
22. Gyan Kumari Chaudhary, Kharichandanpur-7, resident
23. Angaram Chaudhary, Khairichanpur-1, Lalpur, CDMC member
24. Birendra Bahadur Bista, Rajapur-13, Bhimmapur, CDMC Secretary
25. Narendra Gurung, Rajapur-13, Laljipur, CDMC member
26. Anju Chaudhary, Rajapur-14, Bhimmapur, resident

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About the Zurich flood resilience alliance

An increase in severe flooding around the world has focused greater attention on finding practical ways to address flood risk management. In response, Zurich Insurance Group launched a global flood resilience programme in 2013. The programme aims to advance knowledge, develop robust expertise and design strategies that can be implemented to help communities in developed and developing countries strengthen their resilience to flood risk.

To achieve these objectives, Zurich has entered into a multi-year alliance with the International Federation of Red Cross and Red Crescent Societies, the International Institute for Applied Systems Analysis (IIASA), the Wharton Business School's Risk Management and Decision Processes Center (Wharton) and the international development non-governmental organization Practical Action. The alliance builds on the complementary strengths of these institutions. It brings an interdisciplinary approach to flood research, community-based programmes and risk expertise with the aim of creating a comprehensive framework that will help to promote community flood resilience. It seeks to improve the public dialogue around flood resilience, while measuring the success of our efforts and demonstrating the benefits of pre-event risk reduction, as opposed to post-event disaster relief.

International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

Wharton University of Pennsylvania

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List of acronyms and definitions for Nepalese and other institutions

Army/police – at the district level, coordinated by the DDRC for search and rescue and immediate disaster response.

Assistant CDO – Assistant Chief District Officer; often a local hire, the unofficial point-person for local disaster response.

CDMC – Community Disaster Management Committee; established through the DIPECHO project.

CDO – Chief District Officer; nationally appointed, responsible for coordinating disaster response at the district level.

Cluster system – founded by the United National Office for the Coordination of Humanitarian Affairs (UNOCHA); defines and coordinates groups of humanitarian actors working in similar sectors.

CNDRC/CDRC – Central Natural Disaster Relief Committee or Central Disaster Relief Committee. A 36-member committee chaired by the Hon. Home Minister and mandated to formulate and review national policy regarding relief, rehabilitation works, and required programs for preparedness, response and recovery.

CSDR – Center for Social Development Research.

DDC – District Development Committee; under the Ministry of Federal Affairs and Local Development, led by the Local District Officer (LDO), controls all development activities in the District.

DDRC – District Disaster Relief Committee; under the authority of the Central Natural Disaster Relief Committee.

DEOC – District Emergency Operations Center; located at the district headquarters, mobilizes when disaster is imminent or has struck.

DHM – Department of Hydrology and Meteorology; responsible for installation and maintenance or stream gauges and meteorological stations nationally, data collection and distribution, verifications of data in emergency situations, and communication with MoHA and NEOC.

DPNet – Disaster Preparedness Network; a multi-stakeholder policy advocacy group formed in 1996 to strengthen coordination and communication between risk management and disaster preparedness organizations in Nepal.

DWIDP – Department of Water Induced Disaster Prevention; part of the Ministry of Irrigation, responsible for building flood control structures including large, national embankment projects.

IFRC – International Federation of the Red Cross/Red Crescent Societies.

MoD – Ministry of Defense; responsible for mobilizing and overseeing national-level army response in disasters.

MoFALD – Ministry of Federal Affairs and Local Development; oversees the District Development Committees (DDCs), Village Development Committees (VDCs), and Local Development Committees (LDCs).

MoHA – Ministry of Home Affairs; appoints and oversees the Chief District Officer (CDO), responsible for disaster preparedness, response and recovery.

MoI – Ministry of Irrigation; responsible for building both irrigation and river control infrastructure, home to DWIDP.

MoSTE – Ministry of Science, Technology and Environment; mandate is to help achieve national sustainable and broad-based economic growth contributing to employment generation and poverty reduction in Nepal. Home to the Department of Hydrology and Meteorology, runs the climate change portal, oversees the National Adaptation Plans for Action.

NEOC – National Emergency Operations Center, located in Kathmandu.

Nepal Risk Reduction Consortium (NRRC) – a unique arrangement that unites humanitarian and development partners with financial institutions in partnership with the Government of Nepal to reduce Nepal's vulnerability to natural disasters.

Nepal Risk Reduction Consortium (NRRC) Flagship Program – 5 sectoral areas of disaster preparedness and response, based on the Hyogo Framework and Nepal's National Strategy for Disaster Risk Management. Hospital safety, emergency preparedness and response, flood management in the Koshi River basin, community-based disaster risk reduction, policy and institutional support for disaster risk management.

NRCS – Nepal Red Cross Society; auxiliary to the government, serves as the primary disaster response organization in Nepal.

VDC – Village Development Committee; under the District Development Committee (DDC).

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