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Nepal

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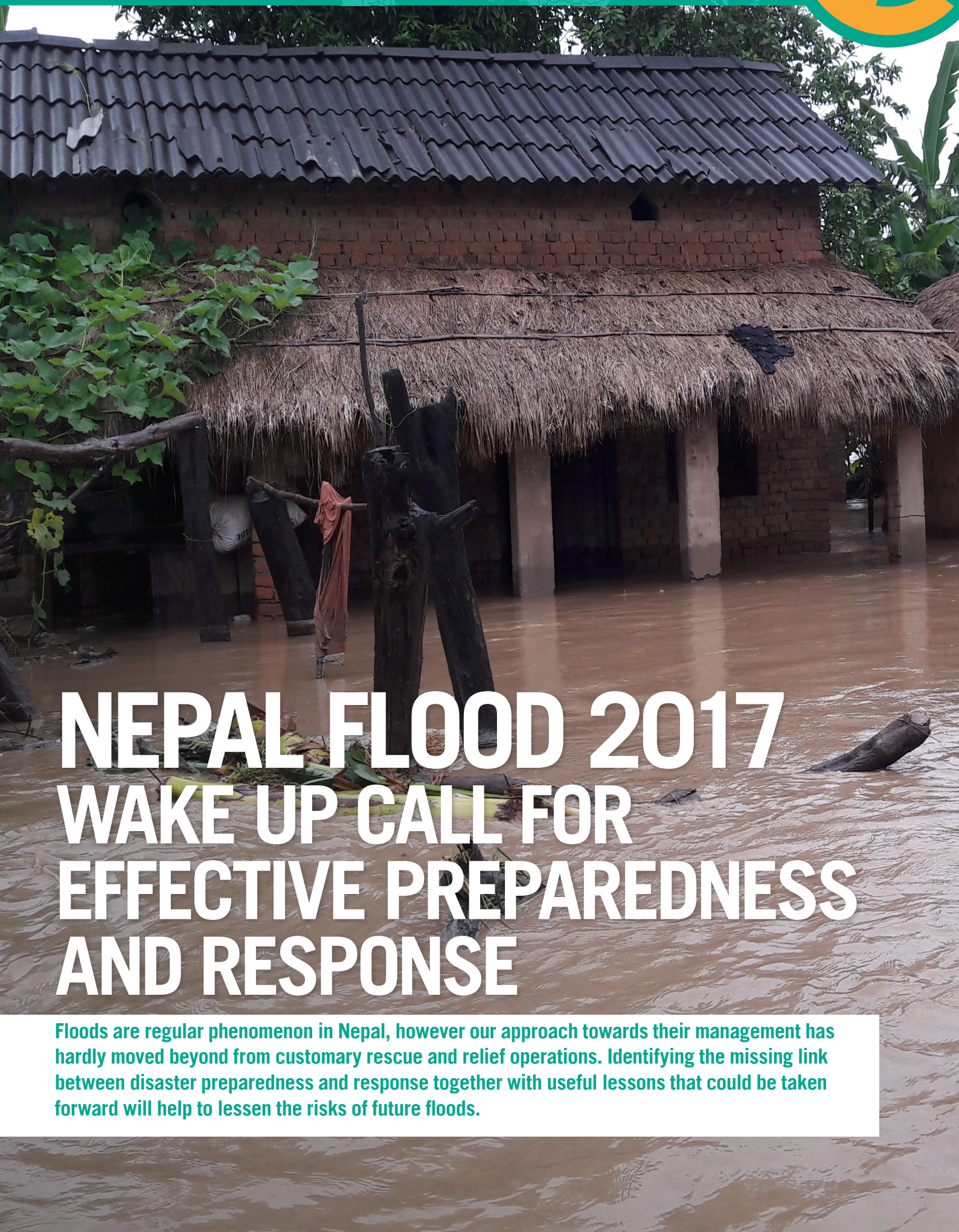

NEPAL FLOOD 2017
WAKE UP CALL FOR EFFECTIVE PREPAREDNESS AND RESPONSE

Floods are regular phenomenon in Nepal, however our approach towards their management has hardly moved beyond from customary rescue and relief operations. Identifying the missing link between disaster preparedness and response together with useful lessons that could be taken forward will help to lessen the risks of future floods.

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Front page photo shows Flooding in bardiya, 2017. Credit: Shankar Chaudhary, Field Mobiliser of Nepal Flood Resilience Project.

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Executive summary

Flooding is not new to the Terai districts of Nepal. Every year, the monsoon floods have caused significant damage and loss to human lives and livelihoods within these southern flood plains. Yet each time the rescue and relief operations seem slow and insufficient and the government comes under fire for not responding quickly enough. A critical review – that is, reflecting and building on lessons from past flood events along with institutional memory – is seriously lacking, particularly across the government entities. Identifying lessons and learnings from past events is critical in order to recognize the simple lapses that can be avoided and solutions that can immediately be put into effect.

This Post-Event Review Capability (PERC) report discusses the overall disaster management landscape, i.e. disaster risk reduction, preparedness, response, and recovery during the 2017 floods in Nepal. Focusing on the four river basins – Karnali, Babai, West Rapti, and Kankai – an effort is made to critically examine the flood event and impacts together with response and recovery measures undertaken by government and various other agencies in flood-affected areas of these rivers. Comparing the 2017 flood effects and impacts with previous flood response in the region, we try to identify the most useful lessons to take forward, and what could now be done differently to lessen the risks of future floods.

The scale and extent of the 2017 flood was severe

From 11 August 2017, heavy downpours started across the south of the Chure hills and continued relentlessly for several days, bringing widespread flooding across the region. This localized rainfall across the Churiya hills resulted in a series of flash floods in every other monsoon stream that drains through these hills into the Terai districts. Rivers from east to west swelled; many of them crossed the pre-defined warning thresholds with rainfall depths in excess of 200 mm in 24 hours recorded in over a dozen meteorological stations across the country from 10 to 13 August. The scale and extent of the flooding in 2017 was unusual and rare as the entire Terai belt, spanning from Jhapa in the east to Kailali in the west, was inundated at the same time.

Early warning systems were instrumental but inadequate for flash floods

Most of the major river basins like Karnali, West Rapti, Babai, and Kankai are equipped with an early warning system (EWS). These systems include a set of protocols on how to communicate early warnings and how to plan for emergencies, helping to save numerous lives and properties during the 2017 flood. However, the devastating flash floods in 2017 came from the small tributaries originating from the Chure hills rather than the large, more prepared perennial rivers. In this case, warnings and actions based solely on observations of the current situation of rivers and rainfall were inadequate as the impact of the floods was beyond people's expectations. Our usual practice of pre-monsoon preparedness and end-to-end disaster response mechanisms needs to be revisited in order to identify the missing link between our level of preparedness and response to disasters.

The system linking forecasts to preparedness was missing

The three-day rainfall forecasts from the Department of Hydrology and Meteorology (DHM) clearly showed huge and intense rainfall over the Terai region. The events were captured more than 10 days in advance by the global flood and weather forecast models but unfortunately neither of these forecasts were communicated in time. Even the flood alerts issued by DHM 24 hours in advance were hardly used by the disaster managers in their emergency planning and no action was taken to mobilize resources internally. Preparedness was replaced by disaster response as key stakeholders tried to reach flood victims whose villages had already been swept away, or those in areas that were completely cut off. The 2017 flood clearly highlights that weather and flood forecasting alone is insufficient. What is needed is a clear mechanism linking the science of forecasts to the existing humanitarian landscape, and a move from response-oriented to informed pre-emptive action.

Channelized rescue and relief operations could not be implemented effectively

Learning from past events, the government decided to distribute relief materials through one channel, which was coordinated by the District Disaster Relief Committee (DDRC) and distributed throughout each district by the Nepal Red Cross Society (NRCS). Although the initiative was a positive step, the strategy was adopted with minimal prior preparation, leading to a clear lack of coordination among the stakeholders and a delay in the rescue and relief process. In particular, there was a lack of adequate warehouse facilities and trained human resources in the NRCS chapters, while other agencies poorly supported NRCS in the carrying out of relief works. This one-door policy for rescue and relief could not be implemented and was later halted while the aid agencies continued with their usual process of relief distribution. A clear lesson to be taken from this process is the need for a properly coordinated mechanism to be built and strengthened prior to flood events rather than on an ad-hoc basis.

Local capacity is crucial in an emergency

As a newly elected local government had recently been put in place prior to the 2017 flood following a two-decade gap, hardly any of the elected officials were aware of or engaged with early warning or response measures during and after the flood. The overall operation of flood response was still carried out at the central and district level, although every cluster later acknowledged the negative impact of having no effective coordination at local level. Local capacities are considered more crucial than national and regional capacities due to the greater level of local knowledge and linkages. One outcome of the 2017 floods was that local governments gained increased authority and responsibility to undertake disaster risk reduction (DRR)-related activities. This could create a favourable pathway to increasing local capacities to cope with these kinds of disasters in future. It also provides an opportunity to improve effective response and recovery at local level and in a more decentralized way.

Photo 1.1 Flood waters in Tikapur, Kailali (Credit: Centre for Social Development and Research)
Source: CSDR (Centre for Social Development and Research)

Mainstreaming of DRR into development is necessary

Each year the Chure region is being exploited at an alarming rate for gravel mining, sand, timber and other raw materials. The entire region is under threat due to this gradual surge in the mining of sand, gravel and limestone, and stone quarrying, not to mention haphazard and poorly engineered construction of physical infrastructures such as dams and embankments along the streams. Deforestation and environmental degradation have already increased the amount of sediment flowing through the Chure region via the intermittent streams. The incessant rainfall in August 2017 therefore worsened the extent of the flooding as it carried more loose sediment. Lack of any national action plan to facilitate the implementation of coordinated land-use planning has resulted in haphazard urban development and settlement across the flood prone areas in the Terai. This in turn has led to increased exposure of infrastructures and communities to floods. Floods in Biratnagar, Birgunj, Itahari, Janakpur, and several other municipalities were actually due to poor drainage and waterlogging. Urban services need to be gradually improved in the emerging cities of the Terai plains, taking into account sustainable development practices and promoting integrated settlements in low-risk areas to mitigate the impact of floods.

Public awareness on flood risks and warnings is crucial

Several casualties were also due to the sheer negligence of the public, coupled with lack of awareness of flood risk. Many ignored the flood warnings, which included mobile text messages (SMS), and behaved in illogical ways (such as fishing and gathering wood in swollen rivers), eventually paying the price with their lives. People died when vehicles attempting to cross the flooded river were washed away, and these examples highlight the insufficient awareness of flood risks and preparedness at the local level. In addition, there are issues regarding the extent to which communities comprehend SMS texts as most of the population residing in the Terai belts are of low socio-economic status, are illiterate, and do not generally understand the content of text messages. Communication with communities, stakeholders, and local government, including the DHM, is important in order to increase the effectiveness of SMS in delivering alerts and warnings.

Introduction

Nepal is the second highest country at risk of floods in South Asia (UNDP, 2009). Regular flooding, predominantly in the monsoon season, results in significant loss of life, property, and livelihoods (NCVST, 2009). Between 1971 and 2011, floods in Nepal caused 3,329 deaths, affected 3.9 million people and caused economic losses of about US$5.8 billion. On average, 300 people were killed annually (MoHA and DPNet, 2015; UNDP, 2009). The 1993 floods in Central Nepal, 2008 Koshi embankment breach floods, and 2013 and 2014 floods in the mid- and far-western regions caused not only immense loss of human life and property but also had a devastating impact on development (MoHA and DPNet, 2015).

In this report, we discuss the overall disaster management landscape, i.e. disaster risk reduction, preparedness, response, and recovery, during the 2017 Floods in Nepal and try to identify the key lessons and opportunities for reducing flood risks and improving disaster management as a whole in Nepal. The monsoon in Nepal was normal until mid-August 2017 when a low pressure system that formed in parallel to the foothills of the Churia range brought a significant amount of rain in the southern Terai belt. Every stream and river that originated from the Chure hills brought widespread flooding across the entire Terai plains, spanning from Jhapa in the east to Kailali in the west. Although this report incorporates the overall scenario of the 2017 flood event throughout Nepal, a more detailed reflective study on the flood event has been carried out across four specific river basins, namely Kankai, West Rapti, Babai, and Karnali, where there are operational early warning systems and substantial NGO interventions. It is highly likely that the 2017 flood event might have had a different and potentially more severe impact elsewhere, particularly in places where there are no such early warning systems and fewer DRR activities.

Section 1 provides a review of flood scenarios in Nepal together with the weather events responsible for the 2017 August flood. A brief overview of study basins (Kankai, West Rapti, Babai, and Karnali) is also provided. Section 2 discusses the socio-economic landscape of disaster management in Nepal and sets the stage for examining the inherent institutional and social barriers towards flood preparedness and response. Section 3 reviews flood preparedness in 2017 at various governance levels, i.e. national, district, and local level, and presents the level of readiness of various stakeholders, including vulnerable communities, before the flood event. Section 4 reviews what happened during the 2017 flood. The analysis covers the early warnings and flooding event together with the loss and damages caused by the floods across the studied basins. There is an overview of the response, relief, and recovery measures undertaken across these basins, followed by a critical comparison with previous floods in the regions in terms of geographic scale and extent, together with perspectives on overall disaster management undertakings. Section 5 summarizes the key insights of the study and lessons to be learned from the 2017 flood. Opportunities and potential action points for the future to lessen flood risks are identified and discussed in Section 6. Section 7 concludes the PERC study by framing the findings and key lessons from Nepal in a broader context.

Section 1: Flooding in Nepal

1.1 Nepal's river systems and flooding scenario

Located along the Himalayan Arc, Nepal is highly susceptible to a range of hydro-meteorological and geophysical hazards, including floods, landslides, glacial lake outburst floods, and earthquakes. Steep and rugged mountain topography together with fragile geology, active tectonics, and extreme weather has made the country prone to multiple natural hazards. The Ganga flood plains in the south are the recipients of all the water that flows through these mountain corridors. Floods and landslides are the most recurrent natural disasters, causing significant material and human losses every year. Socio-economic activities, particularly the deforestation and mining of gravel and sand, rapid land use change, and erosive agricultural practices across the young and fragile hill slopes, have increased sediment load in the rivers, thereby exacerbating the scale and extent of flooding events. The ultimate effect is in the Terai plains where numerous communities are located well below the river bed level due to sedimentation, and hence are displaced by floods in every monsoon season (Dhakal, 2014). In recent years changing precipitation patterns (MoHA, 2009b) have increased the magnitude and frequency of floods in Nepal.

Nepal has three distinct types of rivers. The first type includes three big perennial rivers – Koshi, Narayani, and Karnali – originating from the high Himalayas, with some of their tributaries entering from Tibet. The Mahakali River in the far west is a border river between Nepal and India in many major stretches. These rivers are fed by the glaciers, snowmelt, and rainfall in the Himalayas and flow down to India through the lower hills and Terai plains of Nepal. The second category rivers are also perennial but originate from the middle mountains of Nepal that flow down to the lower plains of Nepal and India. These kinds of rivers flow with very high variation between the dry and rainy seasons. The third category of rivers, often referred to as torrents or streams, originate from the Chure hills and Siwalik hills. These rivers are fed by the monsoon rains from June to September. These small rivers only flow during monsoon and soon dry up after the rainy season is over; many are only active within a single rain storm. These small intermittent streams are responsible for the most destructive flash floods that bring lots of debris flow, thereby raising the river beds and breaching into the settlements in many stretches. Major River System of Nepal is presented in Figure 1.1.

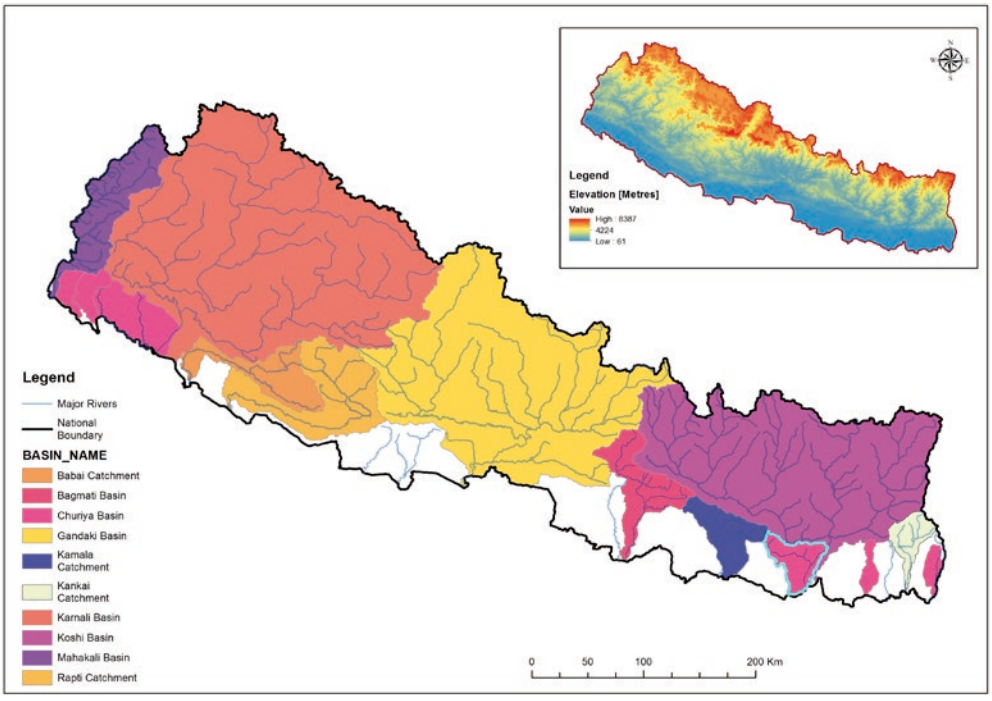

Figure 1.1 Major river basins in Nepal (inset: elevation profile)

1.2 Genesis of Nepal flood 2017

Normally Nepal receives heavy rainfall during the monsoon months, so extreme precipitation and flooding in the southern plain regions are not unusual during this season. Despite being a regular phenomenon, the 2017 floods did surpass the historical records in terms of extent and scale, and the entire Terai belt spanning from Jhapa in the east to Kailali in the west was inundated simultaneously. At the beginning of August, the monsoon troughs of low pressure started developing parallel to the foothills of the Nepal Himalayas (see Figure 1.2). From 11 August, the heavy downpours started across the south of the Chure hills and continued relentlessly for several days, bringing widespread flooding across the region. Unlike some other major flood events of 2008, 2013, and 2014, in which the devastation was mainly caused by flooding in perennial rivers such as Koshi, Mahakali, and Karnali, this time the localized rainfall across the Churiya hills caused a series of flash floods in every one of the monsoon streams that drains through these hills into the Terai districts.

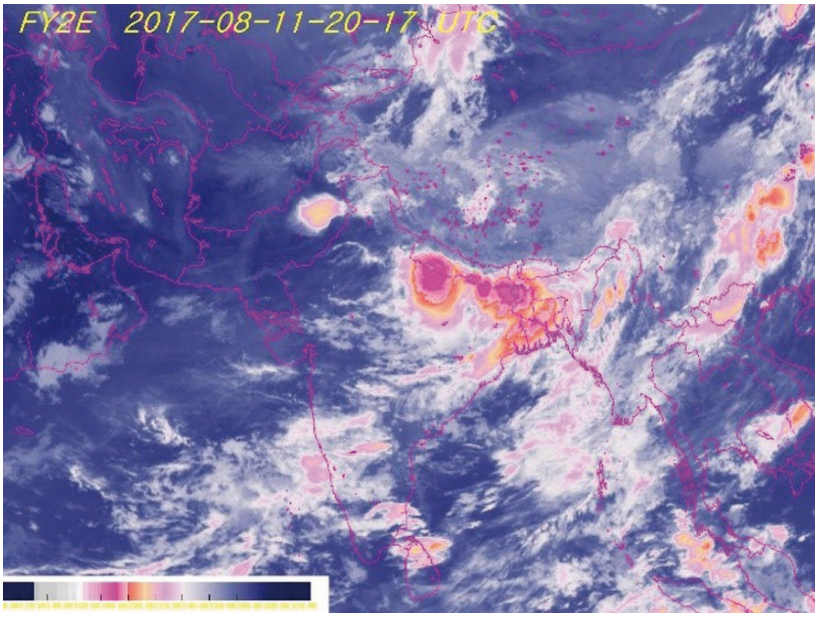

Figure 1.2 FY2E satellite image of monsoon trough over Nepal Terai on 11 August 2017
Source: http://mfd.gov.np/satellite/

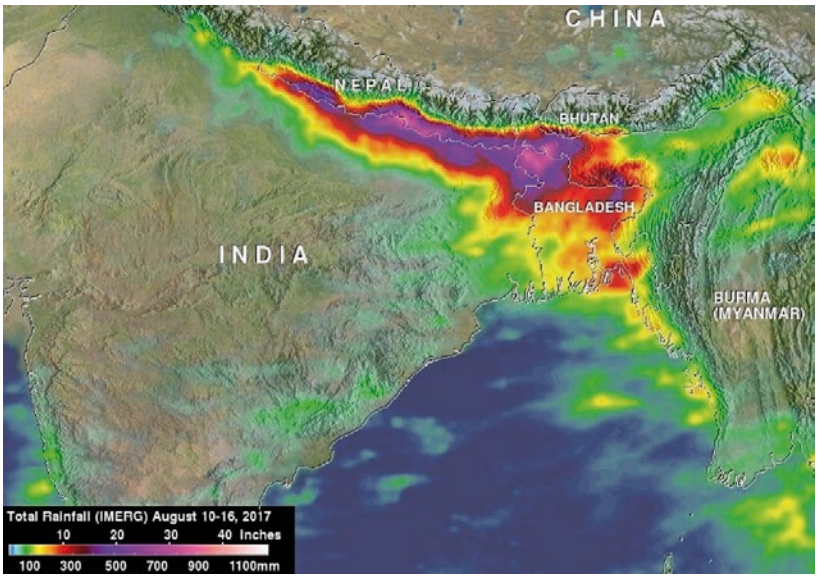

Figure 1.3 Nepal floods measured by NASA's Integrated Multi-Satellite Retrievals (IMERG)
Source: *https://pmm.nasa.gov/extreme-weather/deadly-southern-asia-flooding-rainfall-measured-nasas-imerg*

In West Nepal, the Kusum station of the West Rapti River recorded 380 mm of rainfall between 11.00 p.m. on 11 August and 3.00 a.m. on the morning of 12 August. This caused the West Rapti River to rise rapidly up to 8.88 metres in the Kusum hydrology station, exceeding the 5-metre danger level at around 4.00 a.m. on 12 August. The subsequent floods destroyed 3,000 houses and displaced more than 9,000 people in Raptisonari, Duduwa, Narayanpur, and different parts of the Khajura Rural Municipality of Banke district. Similarly, the heavy rainfall in the Dang, Surkhet, and Bardiya districts led to widespread flooding across several parts of Bardiya district, including in the villages of Jamaniya, GhorPittal, Kamadaha, Jhapkipur, Beshattpur, Dhungrahi, Lathahuwa, Bhaisakhani, Ranipur, Barbata, Goranwa, Jamjhi, and Khuntipur. The Jabdighat bridge over the Babai River also caved in and the district headquarters of Guleriya were submerged under flood waters. Precipitation recorded by various rainfall stations during 12 and 13 August at the Babai and West Rapti River basins have been provided in Table 1.1.

In Central Nepal, Riu Khola, a small river originating from the Churia hills, rose rapidly to cross the danger level of 3.8 metres several times, rising up to 4.8 metres as the nearby rainfall stations at Charchare, Bankatta, and Govindbasti recorded rainfall in excess of 700 mm, 400 mm, and 500 mm respectively in the three days from 11 to 13 August. This caused massive flooding in the Chitwan and Nawalparasi districts. Several villages of Madi, Chitwan were affected by the Riu Khola floods, while a sudden surge of the East Rapti River left several tourists stranded in Sauraha – a famous tourist destination in Chitwan. Similarly, Susta of Nawalparasi district also became engulfed by floods due to a swollen Narayani River in the downstream areas. Floods in the Sirsiya River and Gandak Canal swamped several wards of Birgunj Metropolitan City while the Lalbakaiya River submerged dozens of villages in Rautahat. Almost all areas of the Dhanusa, Mohattari, and Siraha districts were also flooded. Precipitation recorded by various rainfall stations from 11 to 13 August in Central Nepal is provided in Table 1.2.

In Eastern Nepal, Janakpur Sub-Metropolitan City was under water from 11 to 13 August due to the floods in the Jhalad and Dudhmati rivers. As many as 10 urban municipalities and five rural municipalities of Mahottari were inundated due to the flood in the Ratu, Jangaha, Aankusi, and Bigdi rivers.

Table 1.1 Precipitation recorded during 24-hour period (West Nepal)

Babai River Basin			West Rapti Basin		
	Rainfall (mm)			Rainfall (mm)	
Stations	Aug 12	Aug 13	Stations	Aug 12	Aug 13
Chepang	225.8	199.6	Kusum	436.2	0
Tulsipur	172.4	128.2	Nepalgunj	145.6	57.2
Ghorahi	158	46.8	Lamahi	96.6	148.6
Rampur	73.4	246.8			
Padampur	166.6	226.4			
Ambapur	283.2	298.8			
Ranijaruwa	95.4	262.6			

Data Source: Department of Hydrology and Meteorology (DHM)

Table 1.2 Precipitation recorded during 24-hour period (Central Nepal)

	Rainfall (mm)				Rainfall (mm)	
Stations	Aug 11	Aug 12	Aug 13	Stations	Aug 12	Aug 13
Govindabasti	172	123	231	Janakpur	137.6	192.4
Charchhare	339	84	278	Simara	217.2	173.2
Bankatta	93	68	239			

Data Source: Department of Hydrology and Meteorology (DHM)

Table 1.3 Precipitation recorded during 24-hour period (East Nepal)

Stations	Rainfall (mm)		
	Aug 11	Aug 12	Aug 13
Zeetpur	53.6	134.2	24.2
Soktim Tea Estate	31.2	162.8	16.8
Kanyam Tea Estate	102	158	54

Data Source: Department of Hydrology and Meteorology (DHM)

Jaleshwor, Matihani, Balawa, Ramgopalpur, and Loharpatt were the most affected municipalities. A 300-metre embankment along Ratu Khola at Kusang, Bardibas was washed away and the connecting road between Dhanusha and Mohattari was severely disrupted. Flash floods at the Khado River in Saptari breached embankments at several locations. Rajbiraj municipality was completely submerged by floods from the nearby Khado, Jeeta, and Mahuli rivers, while several areas of Morang were engulfed by floods from the Nunsari and Bakraha rivers. The entire Itahari Sub-Metropolitan City of Sunsari was inundated after flood waters from the Budhi Khola and Tegraha Khola rivers entered the city. In Jhapa, flooding in the Aduwa River submerged Mechinagar and Birtamod municipalities while the Ratuwa River flooded the village of Kohabra. The floods also caused secondary damage in the form of widespread landslides, leading to fatalities in Sindhuli and Jhapa districts. The automatic water level radar sensor in the Kankai River was washed away at about 9.00 p.m. on 11 August as the water level rose over 5.47 metres, exceeding the danger level of 4.2 metres. Most of the eastern districts were without electricity for several days after the floodwaters damaged transmission lines, substations, and other infrastructure. The rainfall recorded from 11 to 13 August across the Kankai River basin of East Nepal is shown in Table 1.3.

1.3 River basin(s) studied

The 2017 flood was not just limited to a particular river basin; every stream and river that originated from the Chure hills brought widespread flooding across the Terai plains, spanning from Jhapa in the east to Kailali in the west. However, this more detailed study on the flood event has been carried across four river basins, namely Kankai, West Rapti, Babai, and Karnali. There are already flood early warning systems in operation across the flood plains of these rivers. To date, Practical Action has ongoing flood resilience initiatives and community based disaster risk reduction projects in the regions. Brief introductions to each river basin have been provided below with more in-depth analysis in Section 3.

1.3.1 Kankai River basin

The Kankai River originates from Mahabharat in the middle hills in Eastern Nepal (Figure 1.4) and covers an area of 1,284 km^2. Major upstream tributaries are Jogmai, Puwamai, and Deumai, which join together at Mainachuli in Ilam district, entering Jhapa as Kankai (or Mai). In Jhapa, the Kamal and Banani rivers are two major tributaries which are important from a flood perspective. The Kankai basin frequently suffers from flash floods as the catchment response to high intensity and short duration precipitation is swift, leading to flooding and water-logging downstream. In addition, there have been numerous instances where heavy rainfall in the downstream areas has led to water-logging and impacted communities in Jhapa.

This river is also a holy river for Hindus and many religious rituals and festivals are celebrated along its banks throughout the year. The Kankai flows from north to south, traversing two urban municipalities and two rural municipalities in the middle of Jhapa district. The river is frequently flooded by the monsoon rains and its population of around 5,700 are directly affected by the flood. A flood forecasting station for the Kankai River is based at Mainachuli with predefined thresholds for warning and danger level at 3.7 and 4.2 metres respectively.

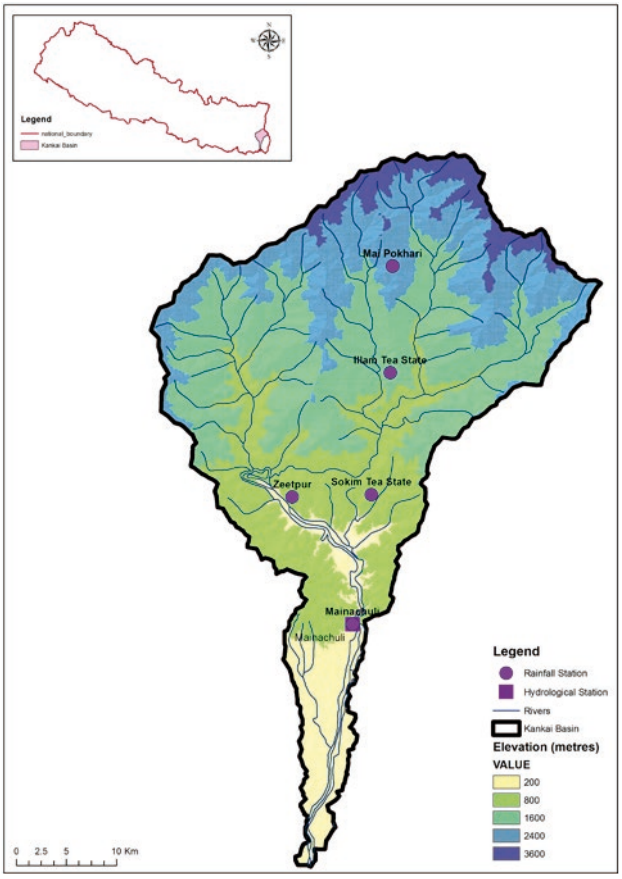

Figure 1.4 Kankai River basin showing automatic hydro-met stations

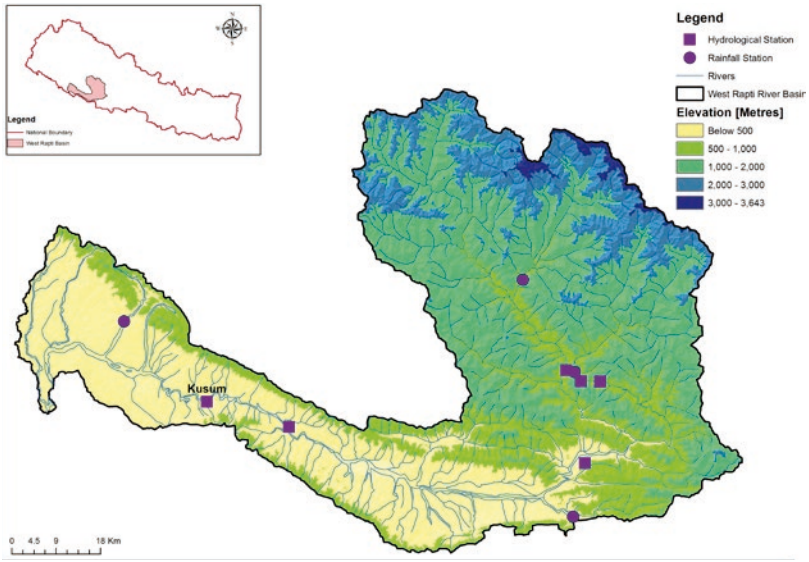

Figure 1.5 West Rapti River basin with hydro-met stations

1.3.2 The West Rapti River basin

The West Rapti River originates from the middle mountains of mid-western Nepal, enters the Terai plains via the Shiwaliks and drains into the Ghagra River – a tributary of the Ganges in India (Figure 1.5). The major tributaries of the West Rapti River are the Jhimruk, Mari, Arun, Lungri, Sit, Dunduwa, Sotiya, and Gandheli rivulets (Talchabhadel et al., 2014). The watershed has a catchment area of 5,200 km^2 at the Kusum flood forecasting station. The West Rapti basin usually suffers from flash floods as the catchment responds to high intensity and short duration precipitation. However, this pattern is not always

predictable as there is not always a direct correlation. The flood frequently affects approximately 30,000 people (based on CBS, 2011) and during medium to large flood events this number rises to over 100,000 people (96,002 during the August 2017 flood). The West Rapti flood forecasting station is at Kusum station, with predefined thresholds for warning and danger level at 5 and 5.4 metres respectively.

1.3.3 Karnali River basin

The Karnali is a perennial trans-boundary river which originates from the Himalayas in the Tibetan Plateau and flows through the steep mountainous terrain of West Nepal (Figure 1.6). The river carries snow-fed flows and has significant discharge even during the dry seasons. Based upon historical discharge records, 80% of the total flow occurs during the monsoon season with maximum discharge events occurring mostly during the months of June through September. The headwaters of Karnali drain into the Terai plains from a narrow gorge at Chisapani, where the river splits and bifurcates into the Geruwa and Kaudiyala Karnali, creating an inland delta before converging as the Ghagra downstream in the Indian floodplains. The Karnali has three major sub-basins in the West Seti, Bheri, and Karnali which are the mainstream of five different rivers. The total catchment area of the Karnali basin up to the Nepal-India border is approximately 49,000 km^2. The Karnali flood forecasting station is at Chisapani station with predefined thresholds for warning and danger levels at 10 and 10.8 metres respectively.

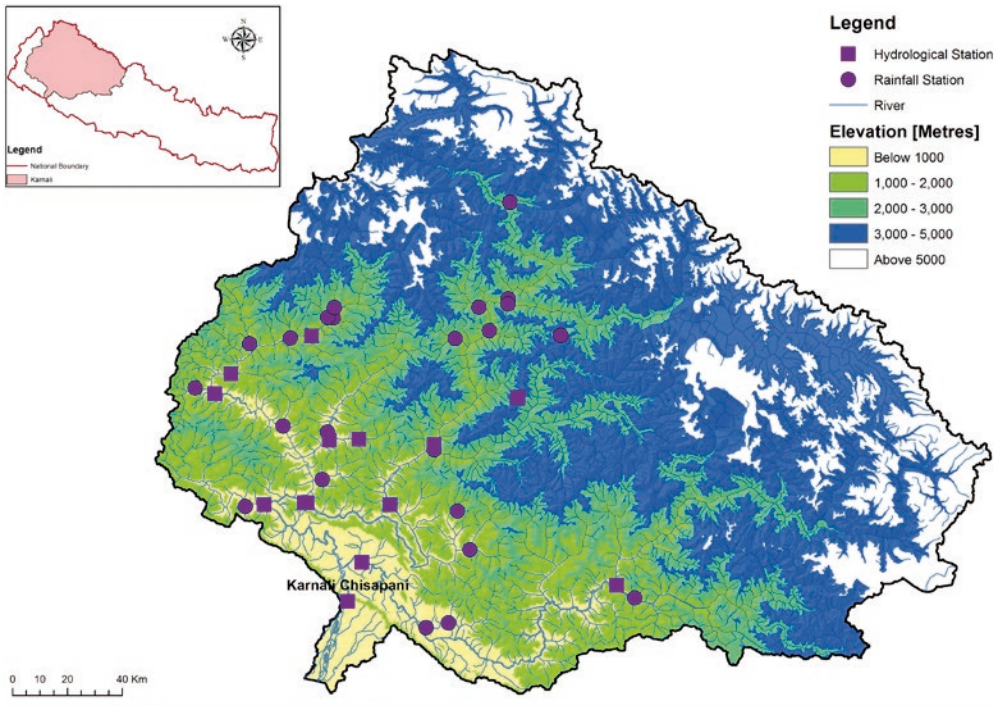

Figure 1.6 Karnali River basin in Nepal

1.3.4 Babai River basin

The Babai originates from the low mountains in the Mahabharat hills and flows in a north-west direction, enclosed by these hills on either side. It then flows southwards as it passes through the Royal Bardiya National Park in the Terai plains. As the river enters the Terai plains, its dynamics change from a straight path to numerous ox bow formations leading downstream, dictated by local slope conditions and the sediment fluxes. The total catchment area in Nepal is 3,380 km^2. It flows down to India where flooding from this river is also a major concern. The flood forecasting station for the Babai River is at Chepang station, (see Figure 1.7) with predefined thresholds for warning and danger level at 5.5 and 6.1 metres respectively.

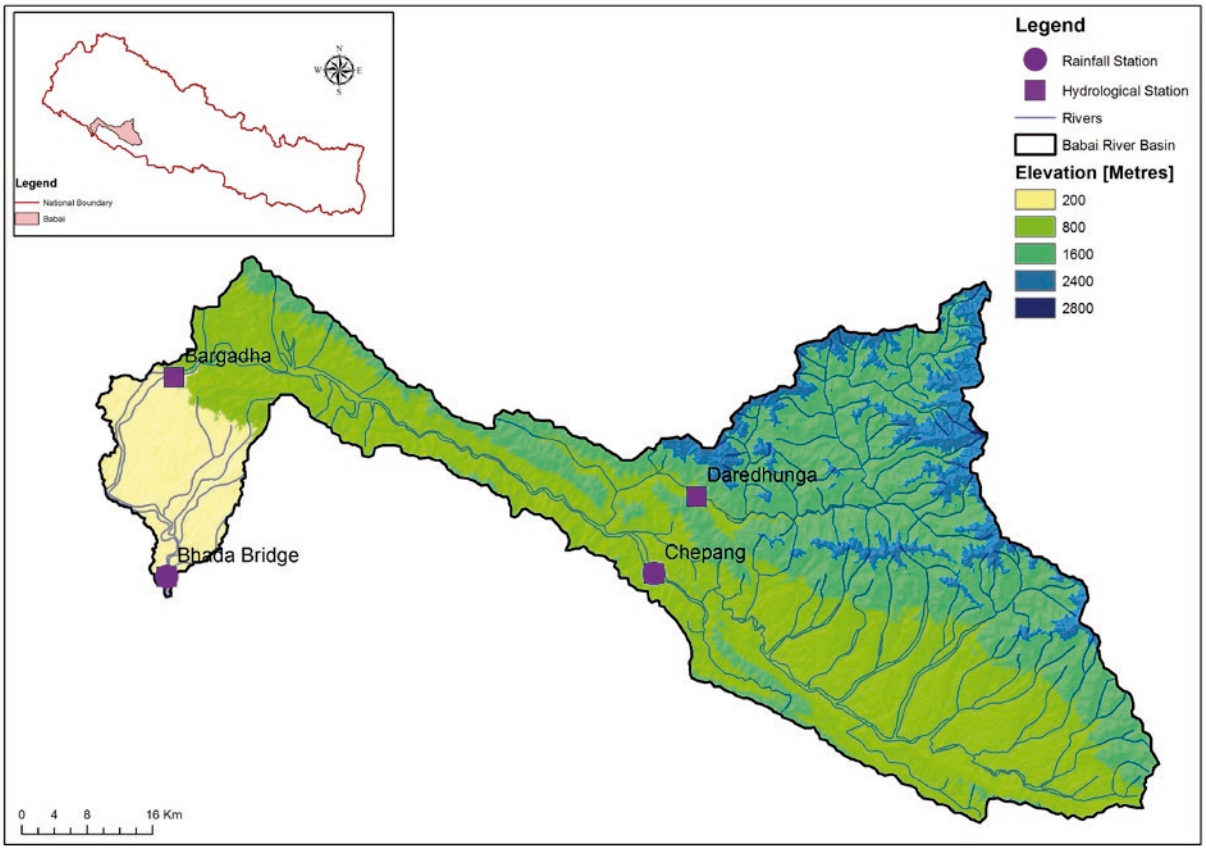

Figure 1.7 Babai River basins in West Nepal with flood forecasting station at Chepang and Bhada bridge

Section 2: Socio-economic landscape of disaster risk management in Nepal

In Nepal there are high levels of poverty and social inequality. Nepal is classified as a low income country and a low human development nation, ranked 144 out of 187 countries in the composite Human Development Index (UNDP, 2017). Globally, Nepal is ranked very high in terms of vulnerability to geophysical and climate hazards (MoHA, 2009a). A recent global assessment of climate risk for the last 20 years (1995–2014) ranks Nepal 17th in terms of impacts of weather-related loss events (Kreft et al., 2016).

Hazards in Nepal often get translated into disasters due to poverty, unplanned development activities, deforestation, environmental degradation, and increasing population (MoHA and DPNet, 2015; UNDP, 2009). Due to government apathy, inherent fatalism, and a lack of implementation of policy instruments and integrative institutional mechanisms at the national and regional levels, preparedness and early action towards natural hazards is limited.

The Natural Calamity Relief Act of 1982 (GoN, 1982) provides an organizational structure for rescue, relief, rehabilitation, and resettlement led by the Ministry of Home Affairs (MoHA). There is a Central Natural Disaster Relief Committee (CNDRC), which is responsible for formulating policies and plans regarding disaster management in coordination with key DRR actors. To facilitate disaster management at different levels, there is also a Regional Disaster Relief Committee (RDRC), a District Disaster Relief Committee (DDRC), and if required there can also be a Local Disaster Relief Committee (LDRC). However, these are likely to be soon replaced by similar but better structures at province and local government levels.

In 2009 the Government of Nepal adopted a National Strategy for Disaster Risk Management (NSDRM) (MoHA, 2009a). These strategies are active during and after disaster in the majority of cases. The MoHA established a National Emergency Operation Centre (NEOC) in 2010 as a coordination and communication point for disaster information across the country, connecting district emergency operation centres. By 2015, 46 DEOCs had been established (MoHA and DPNet, 2015). Following the issue of district disaster preparedness and response planning guidelines, every district now prepares and updates their disaster preparedness and response plan through a consultative process, ideally before the onset of monsoon every year. The MoHA has a number of guiding documents, such as National Disaster Response Framework (NDRF) (MoHA, 2013), that specifically refer to DRR.

The Ministry of Federal Affairs and Local Development (MOFALD) is the second ministry that looks after local government body (then VDC, municipality, and DDC) affairs, and which issued the Local Disaster Risk Management Planning Guideline, 2011 (MOFALD, 2011). These guidelines focus on ensuring local governments prepare DRR and management plans in consultation with local communities. For the last few decades Nepal's DRR has not been taking steps to shift the focus from a traditional approach to relief towards the prevention of losses, as anticipated. Political instability is one of many reasons for this, as is bureaucratic reluctance. The UN, along with both international and national civil society, have been supporting and influencing government in its disaster preparedness. A new DRR Act was drafted in 2008 but went through numerous revisions up to 2017. The floods in 2017 served to finally promulgate the Act.

Despite several milestones being reached in DRR, there remains very little focus on implementation. The majority of the DRR plans and policies are limited only to blueprint papers and often miss the provision of proactive mitigation measures and mainstreaming hazard reduction in the development process (Gaire et al., 2015).

For example, there has been an effective practice in place over the last 8 to 9 years whereby every flood-prone district carries out pre-monsoon workshops and revisits their preparedness and response plans. However, implementation is very poor for a number of reasons. In particular, devastating levels of flooding are not an annual phenomenon, therefore authorities and agencies do not take the planning process seriously and consider it more as a ritual event. As a result, there were fewer preparations on the ground than were credited in the meetings and documents, although authorities tried their best to cope.

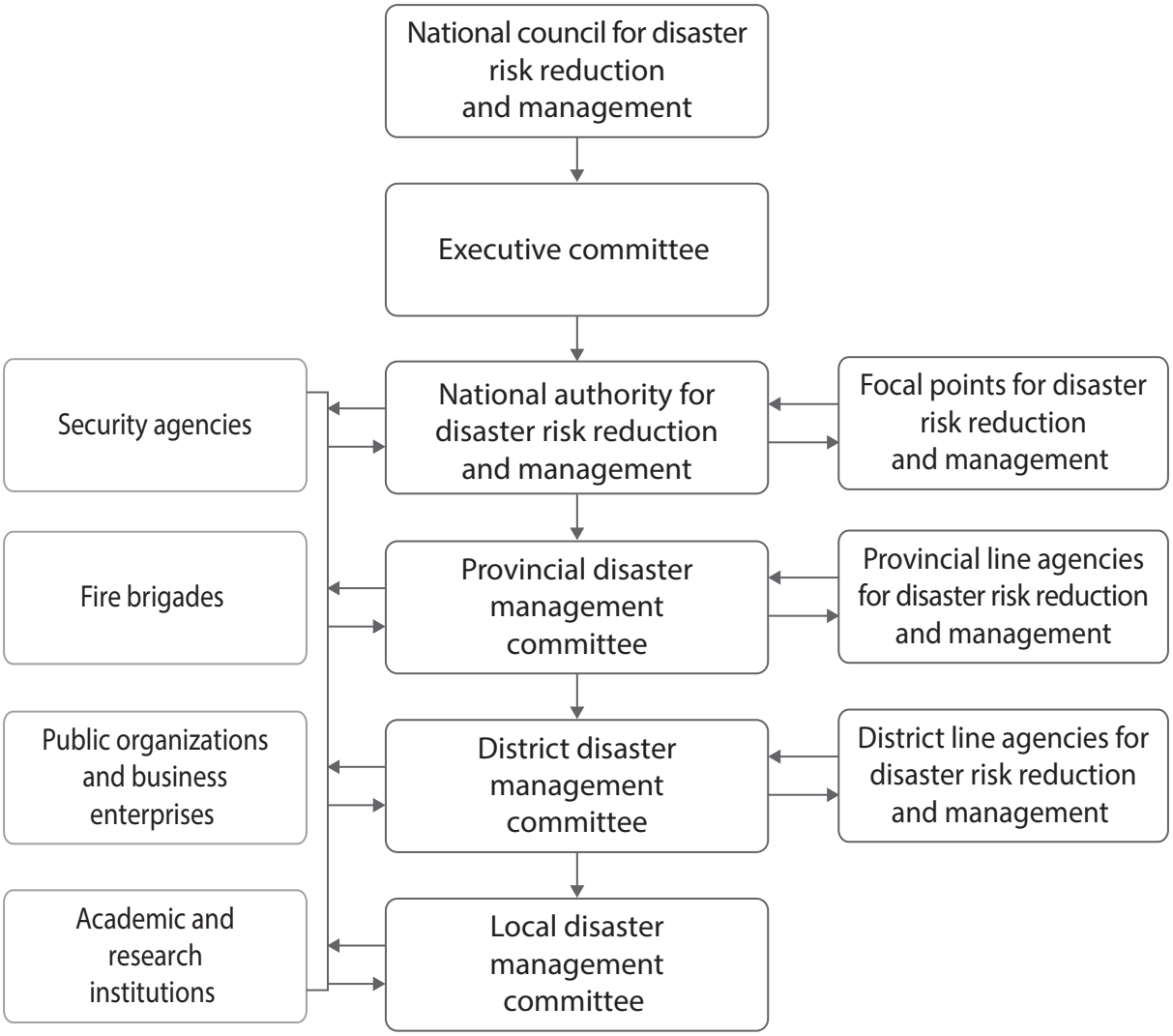

Figure 2.1 Institutional structure for disaster risk governance as per the Disaster Risk Reduction and Management Act 2017

Box 2.1 The last steps of the last mile

At the community level, as the post-event consultations revealed, authorities were unable to take necessary evacuation and rescue measures in time following the early warning information from the DHM. Communities did not act on available warning information as the people perceived the risk of flooding to be less severe than was the case. While this is to some extent due to the underestimation of the role local rainfall played in aggravating the severity of the flood in each locality, a central missing component was the lack of institutional action to call for evacuation. The Community Disaster Management Committees (CDMCs) and other community groups lacked experience to take the right decision at the right time. Secondly, people were not willing to leave their livestock and other assets at home until they were adversely hit by the flood, and by then it was too late to take action. While it is important for institutions to have the capacity to respond adequately, it took the experience of the previous flood of 2014 for people in the Babai River flood plains to take flood alerts and warnings seriously and prepare for the worst.

Section 3: Flood preparedness in 2017

3.1 Overview of flood preparedness (national level)

Current disaster preparedness activities are based on the average level of risks, assuming disasters like floods and landslides are likely to occur during the monsoon season. As usual, the National Emergency Operation Centre (NEOC) conducted a pre-monsoon meeting with the relevant stakeholders in 2017. Information from all humanitarian organizations regarding the available stockpiled materials in different parts of the country was updated centrally. All the security forces (i.e. Nepal Army, Armed Police Forces, and Nepal Police) were kept on high alert from mid-June to September. Three army helicopters were kept on standby in Surkhet (western region), Itahari (eastern region), and Bharatpur (central region). The Nepal Food Corporation updated its food stockpiles in all parts of the country and details of this were available to NEOC before the summer.

According to NEOC officials, a series of meetings were held before and during the monsoon involving relevant government ministries and departments, NGOs, and UN agencies. These meetings were a sharing exercise in order to understand the actions being taken by various stakeholders and the capacity available in the event of an emergency. Instructions were given by the MoHA to all district administration offices to prepare for the monsoon floods and report progress back to the ministry.

The Department of Hydrology and Meteorology (DHM), responsible for generating weather and flood alerts in the country, was prepared for providing rainfall and flood forecasts. DHM began generating a bulletin three times a day from June to September. It also set up Facebook and Twitter accounts targeting the large number of social media users in the country. Furthermore, DHM effectively coordinated with telecommunication companies and media centres to disseminate the information on a mass scale as and when required.

3.2 Flood preparedness in the districts

District level preparedness was coordinated by District Disaster Relief Committees (DDRCs) under the leadership of Chief District Officers. This study uses as its reference the district documents of Jhapa, Banke, and Bardiya. In these districts, DDRC meetings were conducted before and after the onset of the

Photo 3.1 DDRC workshops are conducted before and after the monsoon (Credit: Practical Action)

monsoon. All the clusters, each with its respective thematic focus, were instructed to revisit their plans and prepare for any likely flood in the upcoming monsoon. In Nepal there are up to 12 clusters following the UN OCHA humanitarian clusters for disaster response, which are led jointly by the respective line ministries, international organizations, and UN Agencies. The meetings also ensured that District Emergency Operation Centres (DEOCs) were kept on high alert. DDRCs updated the available resources (i.e. food and non-food items stockpiled in different locations) and communication channels and took the decision to mobilize the Nepal Red Cross for emergency response if required.

The Disaster Preparedness and Response Plans (DPRPs) for all districts have identified earthquakes, floods (mostly in perennial rivers), heat waves, cold waves, lightning, health hazards, and household fires as key disasters. However, these documents failed to anticipate the scale of the 2017 flooding that resulted from massive rainfall and flash floods in small streams. The DPRP updates did not take into account the devastating scale of flooding in the third order rivers.

In western Nepal, DEOCs had prepared a separate Standard Operating Procedure (SOP) in line with the timeline of available forecast information and its probability level, with a clear set of protocols for carrying out a range of preparedness activities when forecasts indicate an increased level of flood risk. The SOPs were based on forecast information such as the seasonal outlook from SASCOF, GLOFAS' 15-day flood forecast, and RIMES and DHM's 3-day rainfall forecast. They had also carried out a table-top simulation exercise to implement the prepared SOPs prior to monsoon.

3.3 Cluster level preparations: preparedness of agencies

The DDRCs of each district (Jhapa, Banke, and Bardiya) have 8–10 clusters, which are understood as sectoral coordinating agencies, representing all related government, non-government, and civil society organizations able to contribute during any form of disaster. Each of the clusters holds regular meetings. In the case of flooding, each cluster meets before the monsoon to increase their preparedness level and to ensure that all clusters are involved in post-flood relief and rescue work. Before the 2017 monsoon, each cluster of the districts in our study held a meeting and discussed the possible contribution each member organization could make in the event of a disaster.

Some of the meeting notes reveal that the preparedness was not very focused on early response action. The humanitarian clusters focused on post-event relief items. The DPRPs and concerned agencies were less focused on prevention of losses and damage. Some of the authorities mentioned that the event was beyond the national and district capacity to anticipate and prepare for. However, the clusters lacked actionable preparation.

3.4 Flood preparedness in vulnerable communities

Community level preparedness in areas where consultations were conducted was found to be significantly improved compared to that in the previous flood of 2014. Task forces within Community Disaster Management Committees (CDMCs) played a crucial role in disseminating the risk information at household level. Most of the communities had collected money for emergency funding. The fund is available to member families as a soft loan during the non-rainy season. These loans were paid back before the monsoon and deposited in the community fund. Most CDMCs in the Karnali, Babai, West Rapti, and Kankai basins had updated their Vulnerability and Capacity Assessment (VCA) Reports and household details. Local communication channels were updated and the list of task force members provided to the respective local government agencies to enhance collaboration and coordination. However, as with the DPRPs, they could not anticipate flooding in the small rivers and rivulets. These preparedness plans, which were developed and updated with the help of NGOs, lacked scenario-based planning. Flood mock exercises took place in Kankai and Karnali, however this did not happen in West Rapti. To date, all households have been involved in the mock flood exercise drills. These community plans highlighted more gaps than capacities in community level preparedness.

Section 4: Nepal flood 2017: the event

4.1 Early warnings and the flood event

The 2017 monsoon in Nepal as a whole was moderate with average monsoon rainfall (Figure 4.1). Only a few rivers and rainfall stations crossed warning levels or thresholds up until the end of July. In the first week of August, monsoon troughs of low pressure started developing parallel to the foothills of the Churia range, and from midnight of 11 August consistent heavy downpour for three consecutive days unleashed devastating flash floods and landslides across 36 districts in Nepal (Figure 4.2).

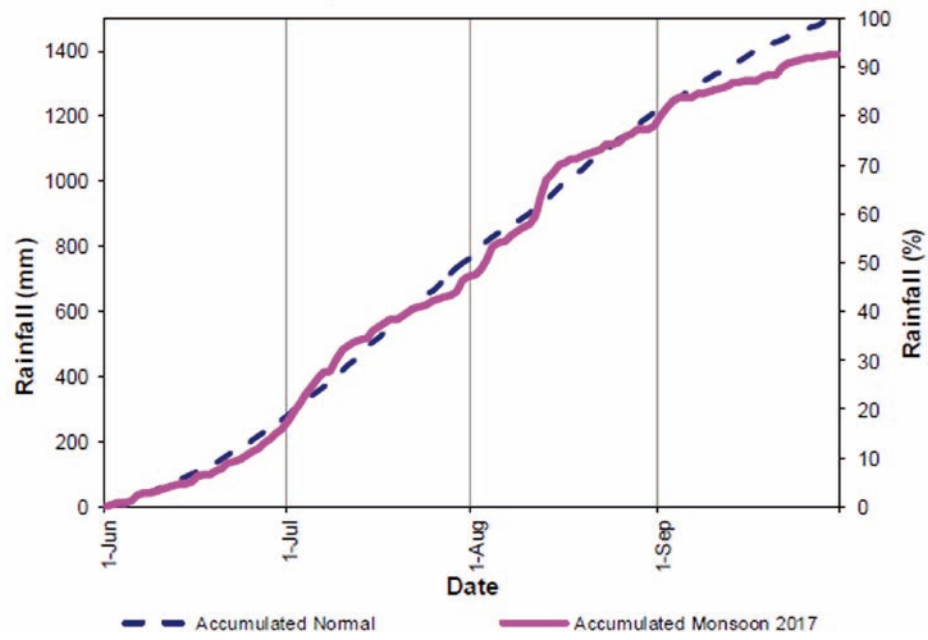

Figure 4.1 The 2017 monsoon rainfall in Nepal
Source: DHM, 2017

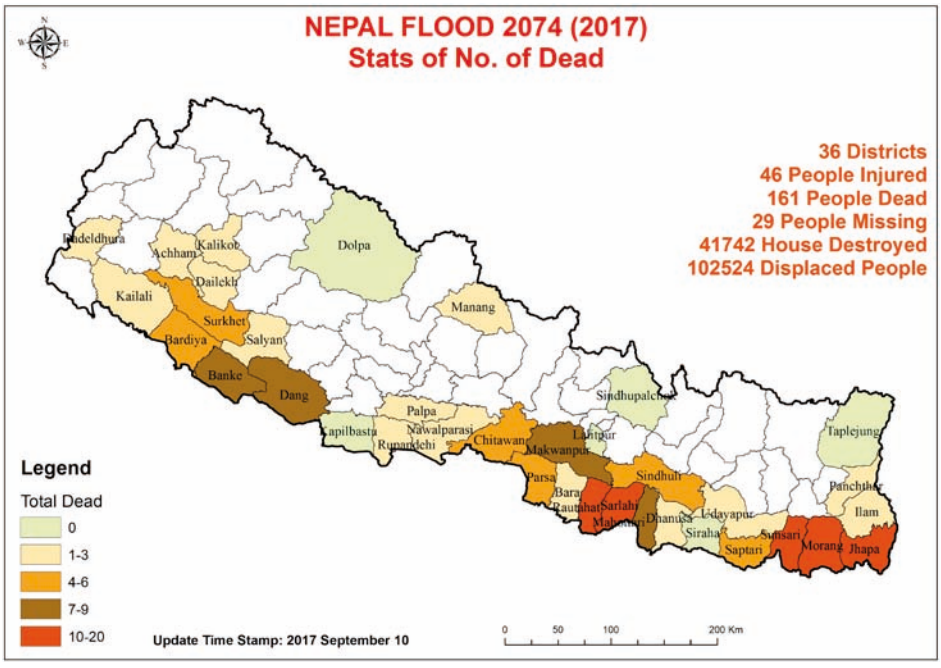

Figure 4.2 Effect of floods in 2017 in Nepal
Source: MoHA, NEOC 2017

Box 4.1 Spotlight on West Rapti: know your role and responsibility

Heavy rainfall began on 11 August 2017. The highest level of flooding at the Kusum gauge station was 8.9 metres on 12 August 2017. It created 3–5 ft waters in the communities downstream. The community and stakeholders were taking actions based on the information from the Kusum flood gauge station based on past events. However, the operators of the Sikta Irrigation Dam, located a few kilometres downstream of Kusum, were not aware of the early warning system in the river, nor were other stakeholders aware of the consequences that mishandling of the dam would bring for downstream communities. Once the barrage operators received flood warning text messages, they ran away from the barrage and observed the flooding. During that time an insufficient number of barrage gates were opened to let the water pass through in more manageable amounts and flood water built up to dangerous levels behind the dam. As soon as the operators realized the flood water would overtop the barrage and embankment, they quickly rushed to the barrage and opened all the gates at once, resulting in a sudden increase in flood levels downstream. While people were evacuating, the flood rose rapidly. Although the community managed to escape, some lost their livestock and grain stocks in addition to houses and land.

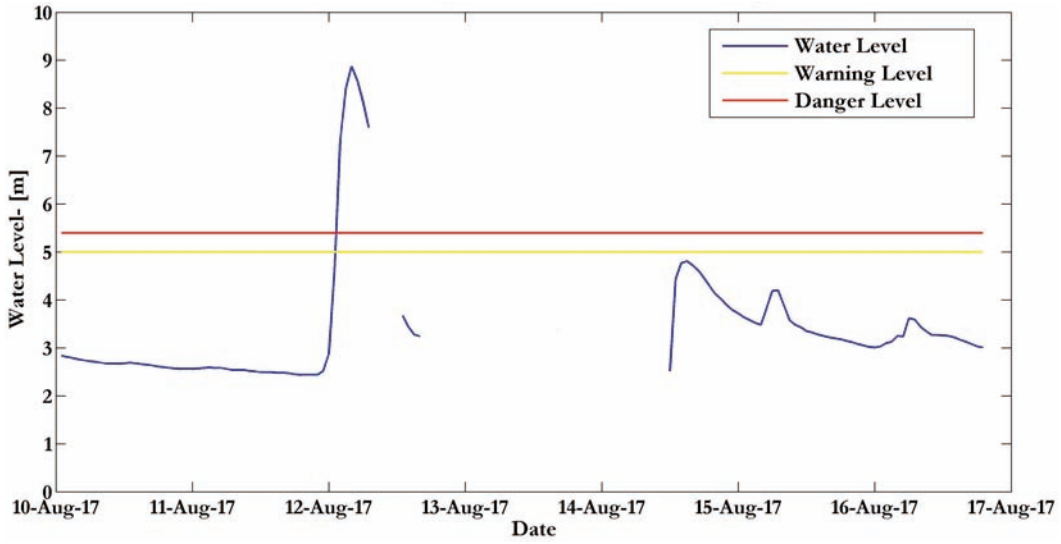

Figure 4.3(a) Water level of West Rapti River at Kusum station during 2017 flood
Source: DHM 2017

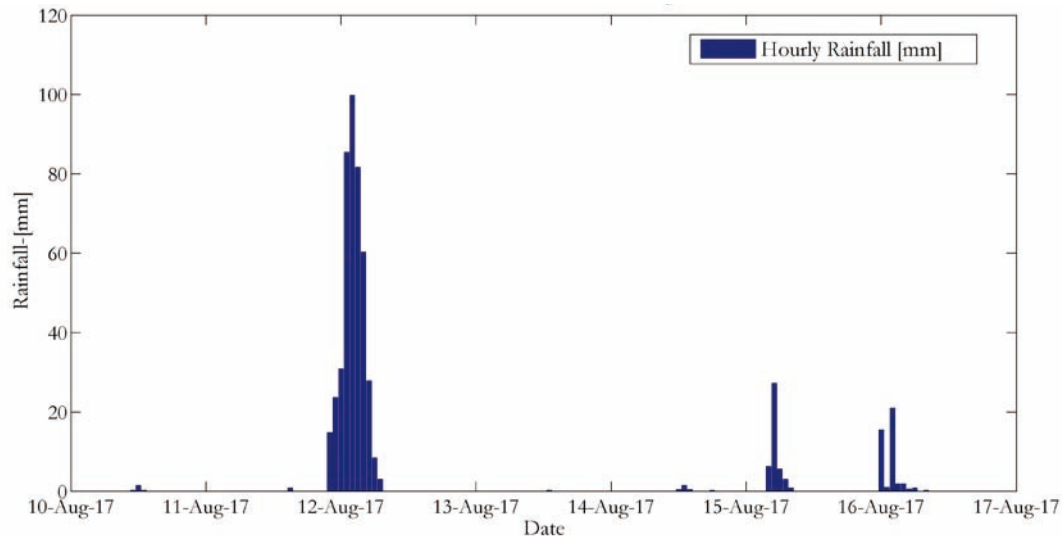

Figure 4.3(b) Rainfall recorded in Kusum station during 2017 flood
Source: DHM 2017

Box 4.2 Spotlight on Babai floods 2017

Rapidly increasing from 11 August onwards, the highest flood level at Babai River reached 10.07 metres at the Chepang gauge station on 13 August 2017, exceeding the danger level of 6.1 metres. DDRC records showed that 2,280 households were completely destroyed and a further 17,140 partially damaged, affecting 103,204 people (12,438 severely and 90,766 partially). The flooding lasted for four days, preventing people moving or returning home. The flood killed only five people (3 male, 2 female), far fewer than anticipated given its severity, as people took action upon early warning. The flood waters were up to 8 feet high in the settlements. Total loss and damage as estimated by the different sectors was about $14.5 million, including agriculture, livestock, infrastructure, and office utilities. However, these estimates were higher than in reality. Communities and authorities commented that the losses and damages were far less when compared to the 2014 floods, as lessons from the previous event were applied and flood-prone communities placed more trust in the early alerts and warnings. Drinking water facilities were particularly affected as the hand-pumps were submerged for 5–6 days. The electricity services were resumed in 10–15 days in the villages. Some telephone services were disturbed for a few days. The district hospital and other agencies' infrastructures were submerged at district headquarters. The flood affected more than 69 schools.

Similarly, the heavy rainfall in the Dang, Surkhet, and Bardiya districts resulted in huge flooding in Babai and other streams across several areas of the Bardiya district, including the villages of Jamaniya, Ghor Pittal, Kamadaha, Jhapkipur, Beshattpur, Dhungrahi, Lathahuwa, Bhaisakhani, Ranipur, Barbata, Goranwa, Jamjhi, and Khuntipur. The Jabdighat bridge over the Babai River also caved in and the district headquarters in Guleriya were submerged under flood waters.

In the Kankai River, the automatic water level radar sensor at Mainachuli was carried away by a landslide at about 9.00 p.m. on 11 August as the water level crossed 5.47 metres (exceeding the danger level of 4.2 metres). Over the next four hours, the river inundated more than eight communities downstream, reaching its peak at 1.00 a.m. The flash flood continued for over seven hours until it gradually receded. Communities were informed of the flood risk through alerts in the afternoon and warnings in the evening of 11 August. However, they did not anticipate the devastating levels the flooding would reach and paid less attention to the warnings than they should have. Most communities had no safe evacuation routes due to the lack of robust river crossings, and the heavy rainfall filled in gullies and blocked local roads, making them almost impassable.

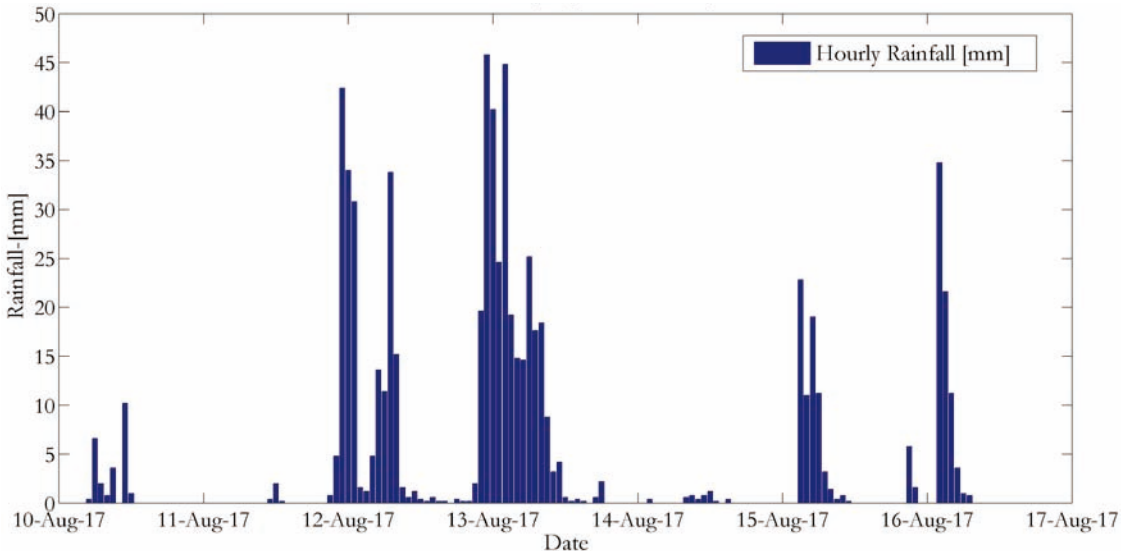

Figure 4.4(a) Rainfall recorded at Chepang station during 2017 flood
Source: DHM 2017

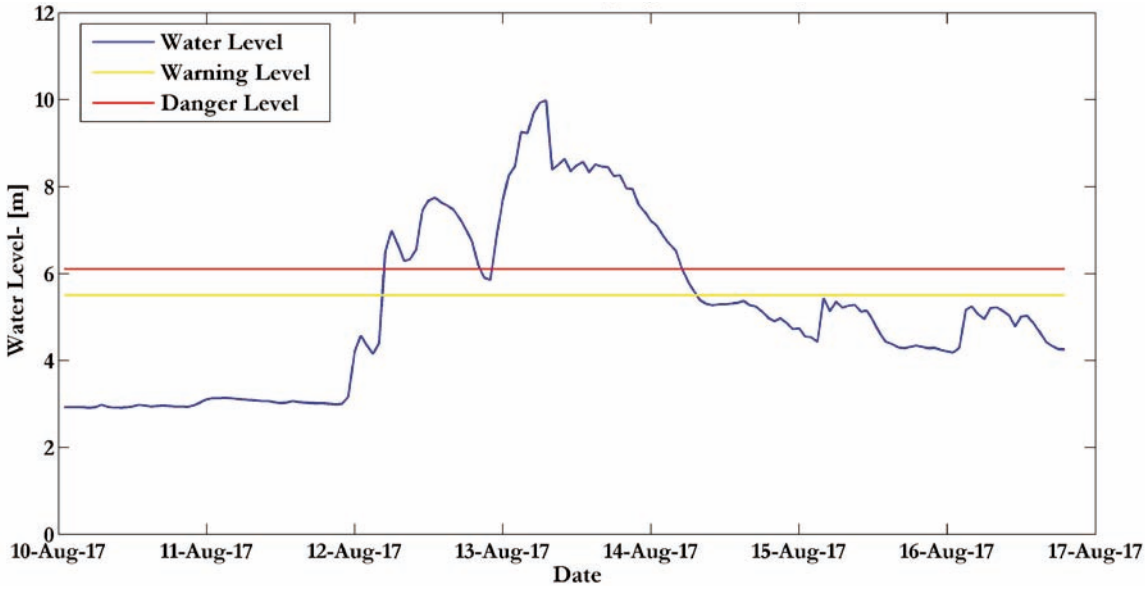

Figure 4.4(b) Water level of Babai River at Chepang station during 2017 flood

Photo 4.1 Mainachuli station of Kankai River (the station washed away by the 2017 flood)
Source: NRCS/Practical Action/USAID

4.2 Losses and damages caused by the flood events

According to the analysis carried out by the National Planning Commission (NPC) of Nepal, more than about 41,000 houses were destroyed completely and another 151,000 were partially damaged across the country, displacing tens of thousands of people. Household assets and food grains were damaged and the affected communities faced shortage of food, water, and non-food items. Almost all development and livelihood sectors within the flooded area were severely affected by the 2017 flood. The total estimated financial loss is $584.7 million (US$1 ≅ 104NPR), with the highest damage

Photo 4.2 Damaged house in Jhapa
Source: NRCS/Practical Action/USAID

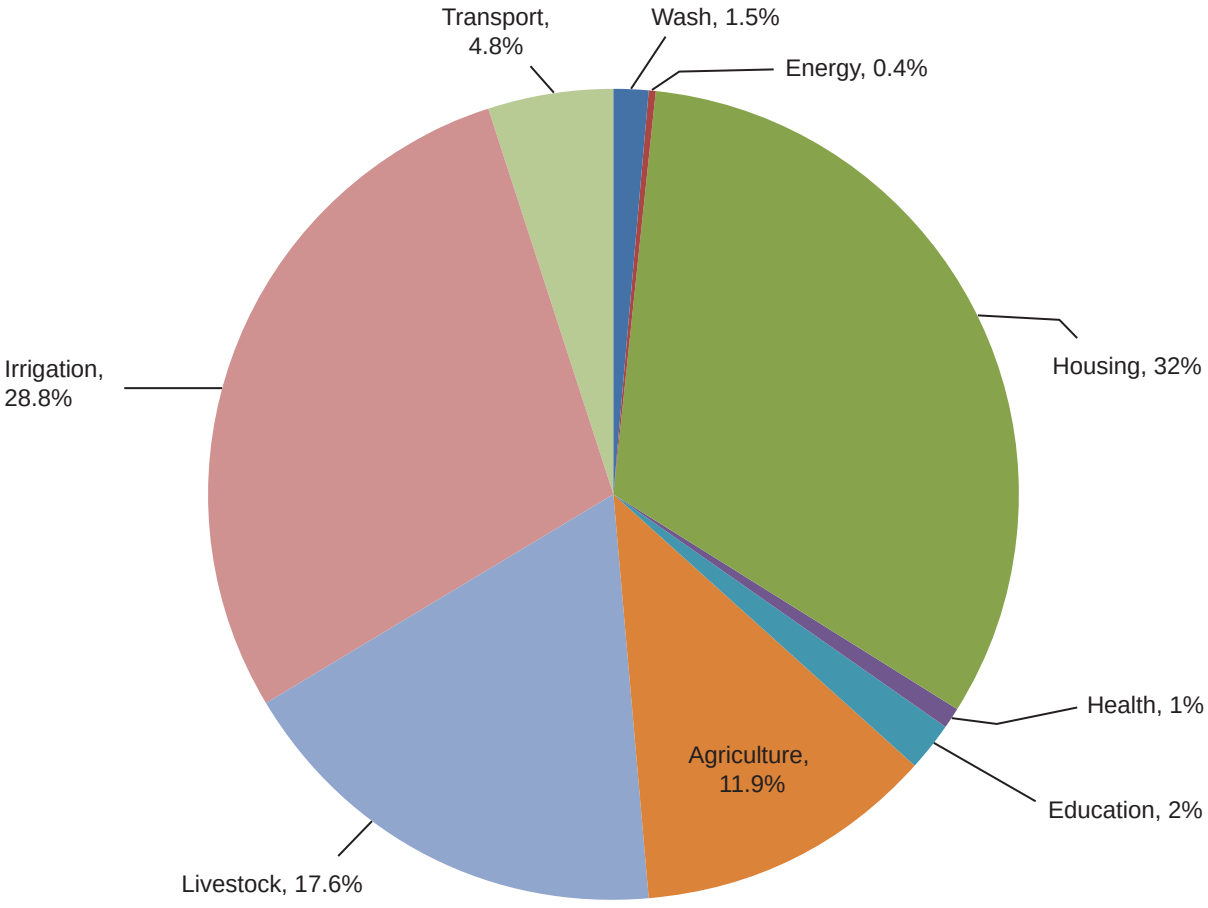

Figure 4.5 Flood effects across sectors
Source: NPC, 2017

incurred to housing, followed by irrigation, livestock, and agriculture (crop) sectors (Figure 4.5). The figure required to cover these damages and losses was estimated at $705.1 million, according to the post-recovery need assessment report (NPC, 2017). The figures estimated for recovery needs involve the cost of reconstruction and restoration of damaged assets and are thus higher than the total losses.

Table 4.1 Summary of flood effects in study basins

Basin	Total Human Casualties	Completely Damaged HHs	Partially Damaged HHs	Loss of Agri. Land (Ha)	Total Estimated Damage (Million, NPR)
Karnali	0	7	234	17.8	1341.6
Babai	4	2273	16906	5543.3	2163.6
West Rapti	8	1071	15737	5622	NA
Kankai	11	41	602	18.45	NA

Source: DDRC Bardiya, Banke, and Jhapa, 2017

Box 4.3 Spotlight on Banke floods 2017

In Banke, the flood continued for 5 days – longer than any others in past decades. According to DDRC Banke records, a total of 96,002 people (49,601 male and 46,401 female), from 16,808 families, were affected (1,071 families severely and 15,737 families partially). Four people died, of which three were females from the same family. Rescue from outside was not possible until flooding had receded. The helicopters could not reach the area due to bad weather and ground movement was ceased due to heavy rain and flood-damaged roads. A total of 86 schools were affected; some of them remained closed for a month. In addition, 690 hectares of paddy field were eroded; 2,168 hectares of land filled by silt; 2,764 hectares of land inundated and standing crops destroyed; 3,749 metric tons of stored food stuffs were destroyed; and 961 metric tons of stored crop seeds and vegetables were lost. Mobility was halted for 4–5 days.

Photo 4.3 Flood photo from Banke
Source: DDMC Banke

Photo 4.4 Rescue activities at Hokalbari, Jhapa
Source: NRCS/Practical Action/USAID

Respective DDRCs of the study district had analysed the flood situation through initial rapid assessment. The Babai and West Rapti basins had experienced severe devastation compared to the other river basins studied, with four and eight human casualties respectively, and damage to thousands of households (Table 4.1). More than 5,000 hectares of agricultural lands were affected, potentially damaging the standing crop in these river basins. However, the loss of land was not as severe as initially feared as the deposited sediments consisted of sandy loam, which did not cause a deterioration in land quality – hence much of the crop was spared. Based on consultations that took place in Banke and Bardiya, the officially estimated figures are thought to be higher than real losses due to over-estimations by respective owners.

The estimated losses varied from time to time based on the assessments carried out by different sector agencies and also the needs outlined by different clusters in different districts. The initial relief efforts were better coordinated by each district and were distributed according to availability. The government lacked stock-piles and therefore depended on relief items donated by individuals and various other organizations (clubs, NGOs, businesses, social groups, etc).

The pace of growth of Nepal's economy had been projected to slow down to 4.7 per cent compared to highest growth of 6.9 per cent in the last fiscal year. Although the major flood led to families losing some portion of their rice crop, the rain enhanced overall rice production despite the estimates (https://thehimalayantimes.com/business/paddy-production-rice-import/). Similar results were found in Bangladesh after the 1998 floods (World Bank and United Nations, 2010).

4.3 Response, relief, and recovery measures

Although different ministries and department representatives were instructed prior to the monsoon to prepare for the floods, preparedness was mostly limited to meeting minutes, updating of plans, resource mapping, and so on, based on the average disaster risk scenario. They did not consider or develop contingencies for a disaster of this scale and extent. After the disaster events, actions were reoriented to cope with flood hazards, in particular to maintain surveillance over the situation and to take response measures following assessment of losses, damages, and impacts according to the established procedure of relief and recovery efforts.

The MoHA led the response efforts and initially released $11.3 million to the affected areas in 36 districts. About 27,000 security personnel and civil servants were mobilized to support rescue and relief operations. The Humanitarian Clusters were activated. Nepal Red Cross Society (NRCS) provided basic shelter and non-food Items (NFI). Similarly, the UN Humanitarian Country Team (HCT) and several I/NGOs provided support to NRCS and the Government of Nepal. In order to provide immediate humanitarian assistance to almost 1.7 million people for the coming six months, HCT had put forward a joint response plan seeking $41.4 million across health, water sanitation and hygiene (WASH), food security, nutrition, shelter, livelihood, protection, education, and early recovery support. The government adopted a flexible approach to the relief and response budget and efforts following the immediate and detailed assessment of needs. They decided on both a materials and cash distribution approach. For the first time, the national government provided cash for food for the victims of the flood nationwide.

In the Kankai basin, relief works were carried out in accordance with the 'one-door policy' at district level where all the rescue and relief operations (government and agency specific) were coordinated by the District Chapter of NRCS. This was made based on the lessons learned from past events. The policy worked initially, however it was later halted as local communities perceived that this system delayed the process of relief distribution. This was mainly owing to the lack of adequate warehouse facilities and trained human resources in the NRCS chapters, while other agencies offered insufficient support to NRCS to carry out relief works. Initial support focused on distributing tarpaulin sheets, mattresses and accessories for temporary shelter, water purification tabs, food, and clothes to the victims. However, as relief materials started coming in, there was an abundance of some items while other important items were not available. Therefore some agencies, including Practical Action, provided cash and DDRC was then able to buy essential items such as mosquito nets, sanitary products, food grains, and other essential items.

The aid for food activity loss (NPR70 per person, per day) provided by the government also ran into some difficulties within the local communities. There were a number of issues with identifying victims and providing appropriate relief as more people claimed to be victims than was the case, while others claimed more losses and damages than they had actually incurred. All clusters were not equally active and the response reflected the low capacity of many clusters and agencies.

Photo 4.5 Relief distribution to flood affected families at Jhapa
Source: NRCS/Practical Action/USAID

In West Rapti, all clusters of the DDRCs in Banke district were mobilized for relief and rescue work through the one-door policy coordinated by a Chief District Officer (CDO). A similar approach was taken in all districts with some necessary adaptation in response to the local situation. However, in Banke district clusters had mixed feelings about the effectiveness of the one-door policy. Some realized its effectiveness, but others struggled with the gaps in coordination between different clusters. As the newly elected local government was put in place following a two-decade gap in Nepal, each cluster recognized there was a lack of effective coordination at local level in these basins. This provided local government with an opportunity to improve effective response and recovery at local level. At district level, cluster meetings and DDRC meetings involving broader stakeholders were frequently held. Discussions and decisions were transparent and participatory, although questions were raised as to the most appropriate use of the resources available. The first post-disaster meeting was organized on the morning of 12 August, about eight hours following the onset of the disaster. The DDRC meeting notes and records show that about $21.9 million in cash was distributed to the affected families in addition to the food stocks, non-food items, and logistical materials.

In the Karnali flood plains many communities had carried out mock flood exercises, building on the early warning systems to help reduce anticipated loss and damages. Rescue and relief actions were almost non-functional for the initial 3–4 days as the flood affected every walk of life and governmental mechanism. Affected people took refuge in schools, along roads, community buildings, and market gathering places, as well as approaching their relatives and neighbours for temporary shelter. Meanwhile, in several communities people were forced to take refuge on the roofs of houses. One community, Mahajidiya, at the Nepal-India border, was completely cut off physically, as rescue efforts were not able to reach it for five days. The local population remained on roof tops and on the first floor of a temporary shelter just one foot above the flood waters. The communities maintained communication links through mobile telephones (Ncell) for 2–3 days until the batteries died. Many people managed to save their more movable assets by hanging them under roofs in the upper storeys.

The District Health Office provided emergency health services in several places by setting up temporary camps in villages. Security forces provided rescue services for affected people from the Barbardia and Guleriya municipalities. Helicopters were used to distribute relief items to refuge areas and local government provided ready-to-eat foods. Several households managed to bring their livestock to a safe place before the flood waters reached them.

Photo 4.6 Flood level at Taduwa, Gulariya municipality, Bardiya
Source: CSDR/Practical Action/Zurich

4.4 2017 flood: how it differed from previous floods in the region

Flooding is a frequent event in Nepal, however the extent and severity of flash flooding in the Terai belt during August 2017 was unprecedented. Most of the floods were from the third category streams originating from the Churiya regions which affected 50 per cent of its 77 districts, with a death toll of 161. More than 41,000 houses were destroyed and nearly 300,000 people were displaced (Figure 4.2) – about one third of these for more than a week.

While the 2014 floods in mid- and far-western Nepal were triggered by a cloud burst in specific areas that brought heavy rains within 24 hours (Zurich, 2015), the 2017 floods were due to heavy rainfall across the Shiwalik and Terai region. Generally, the regions receive about 80 per cent of their annual 1,900 mm rainfall between June and August through several rainstorms. In the case of this flood event, it rained over 500 mm in less than a week, surpassing the carrying capacity of catchments, drainage, rivers, and embankments. The 2014 flood claimed lives and assets in specific locations, in particular in the Bheri (one tributary of Karnali) and Babai River banks. The central cause of this was the overtopping and breaching of dams by the flooded river, claiming lives and settlements en route. In contrast, the flooding in 2017 affected populations in both ways; local inundations due to heavy downpours combined with flash floods in seasonal streams in Terai and the second order rivers Babai, Rapti, and Kankai. The Terai region was most affected by both events. Those who experienced the 2014 floods took greater heed of the early warning information and took action based on the warnings. This resulted in a greater ability to save lives and property despite the 2017 floods being more severe and longer-lasting.

The difference in the affect and impact of the 2017 flooding compared with the 2014 flooding is evident from a geographic coverage perspective as well. While previous floods affected communities along the river bank only, the 2017 flood has also affected communities in small rivulets located far from the main river flood plain. This flood water did not originate upstream of the flood forecasting station, but rather from localized rainfall.

Section 5: Key insights and lessons

5.1 Disaster governance: learning from the past to anticipate the future

The 2017 Nepal flood highlights a need to move to forecast-based flood preparedness and away from traditional approaches. Disaster governance is very weak with little focus on prioritization. Regardless of the frequency of disaster events which cripple the country, the government is yet to adapt its disaster management approach from customary rescue and relief operations to sound preparedness and response.

There have been significant advances in flood forecasting and weather prediction across the globe and the DHM is undertaking some key initiatives on 3-day weather and flood forecasting. Unfortunately, very few resources have been put in place to operationalize these forecasts for pro-active disaster management through early actions and preparedness. Although the scale and extent of the Nepal flood in 2017 was not anticipated and rare in the experience of authorities and communities, the event was definitely not unprecedented and much could have been done before the floods. Had there been a mechanism in place to translate the forecasts into preparedness and emergency response, a significant reduction in loss and damage could have been achieved as well as the confidence to defend against future hazards.

The MoHA, being the focal ministry for disaster preparedness and management nationwide, is currently being sensitized to these recent advances in weather and flood forecasting alongside other agencies such as the MoFALD and humanitarian responders. However, there is currently limited capacity to understand, interpret, and translate this technical forecast information into meaningful actions. Even the flood alerts issued by DHM 24 hours in advance were hardly used by the disaster managers and local governments to support their emergency planning, and there were limited efforts to mobilize resources internally for disaster preparedness. The MoHA mechanism was slow to act due to the inherent uncertainty in the nature of the forecasts, and therefore limited precautions were taken to prepare for the impending floods.

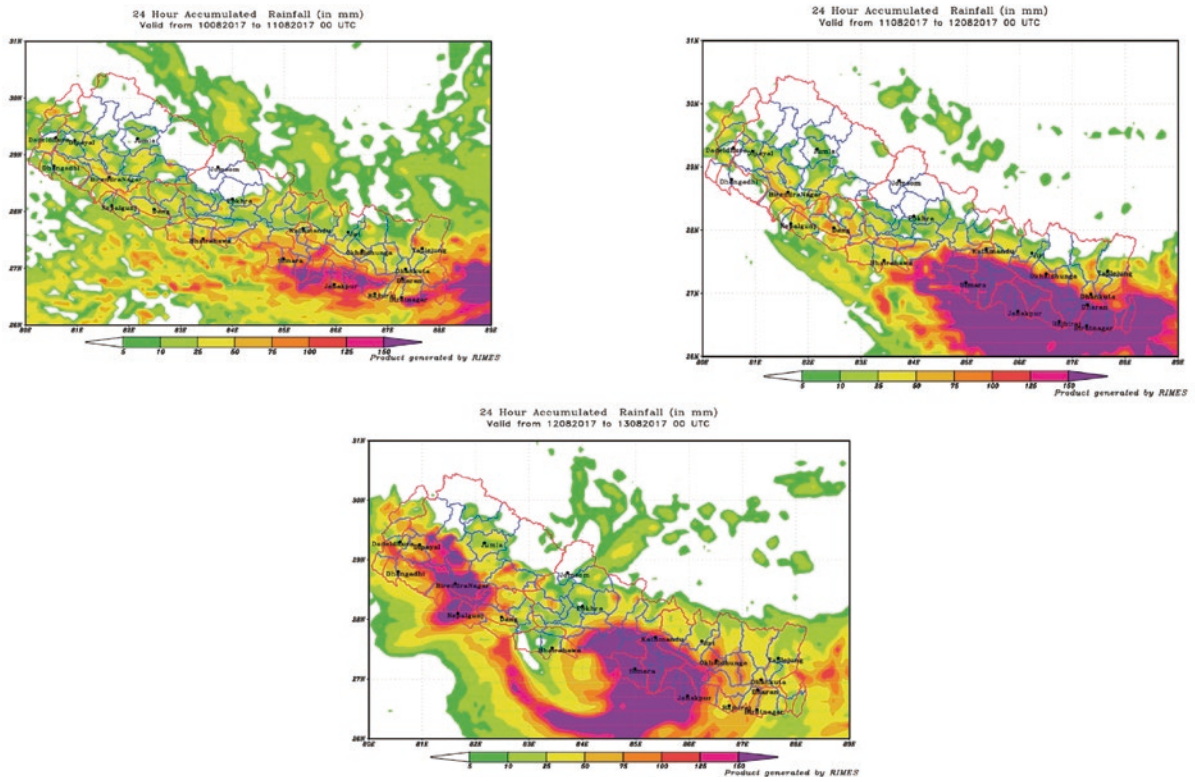

Figure 5.1 Three-day rainfall forecast by RIMES issued on 10 August 2017

The August 2017 floods clearly showed that the existence of weather and flood forecasts alone is not enough. There needs to be a mechanism in place to link forecasts with the existing humanitarian landscape, which is still response-oriented. Despite having SOPs for early actions and preparedness in West Nepal, the contingency protocols and district preparedness and response plans were slow to react to the forecasts that showed increased level of risk. This meant that by the time humanitarian instruments were activated, it was already too late.

There are a number of weather and flood prediction models and services available to the government, although uncertainties remain. The Global Flood Awareness System (GLOFAS), which provides 30-day streamflow predictions for the major river basins of Nepal, indicated increased flood risk with medium probability in mid-August when forecasts were viewed on a daily basis. Similarly, 3-day rainfall forecasts from the Numerical Weather Prediction (NWP) by the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES) also indicated heavy rainfall in the Terai plains 2–3 days in advance (Figure 5.1). Yet due to the challenges associated with communicating probabilistic streamflow and deterministic rainfall forecasts, early actions were not taken and the impact of flooding in the Terai plains was unprecedented.

5.2 Chure exploitation and isolated flood mitigation

The Chure region is the major source of gravel, sand, and timber raw materials for the Terai region and parts of neighbouring India. Each year the forests of the Chure region are being destroyed at a rate of 1.7 per cent (Republica, 2017). This figure is rapidly increasing in order to support the expanding informal construction sectors of Nepal and India, threatening the stability of the Chure hills and Terai. The incessant rainfall in August 2017 therefore worsened the extent of the flooding as it carried more loose sediment. The economic development practices of the region are not taking disaster risk into consideration. Floods in many cities in central Terai (Biratnagar, Birgunj, Itahari, Janakpur) were linked to poor drainage. Similarly, flood mitigation actions, for example embankment construction work carried out along one bank only, deflected the flooding of the river to the other side where the embankment was weak, allowing it to scour the land and cause damage.

5.3 Dams and embankments: cross-border issues in flood management

There are community perceptions that the embankments or roads built along the border in India cause inundation in Nepal due to their obstruction of natural drainage. Many Indian communities share similar perceptions that 'Nepal sends flood'. Where cross-border cooperation exists (e.g. West Rapti, Babai, and Karnali River flood plains), these perceptions are being challenged through the exploration of win-win options. During the 2014 Rapti flood, Indian authorities cooperated well with Nepali authorities, the barrage was managed in good time, and flood waters smoothly drained away. Early information and cooperation were critical to saving lives and property on both sides of the border. In the 2017 floods cooperation had improved even further, mostly benefiting the Indian side of the border. The study team discussed with district, sub-district, and Tahasil level authorities and communities in Baraich, reviewed published documents, and held discussions with members of the cross-border EWS Network in October and November. According to these assessments, Indian authorities were able to inform about two million people in their six districts in a timely manner and take necessary response measures, evacuating about 200,000 people. They opened the sluice gates in time and were able to reduce the level of flood risk both in Nepal and in India. Although these are bilateral issues and many of them beyond the scope of this study, we are confident that cross-border cooperation has a crucial role in reducing losses.

The rainfall during that period extended across three countries, with south-western Nepal to northern Bangladesh receiving heavy rainfall. IMERG rainfall estimates by NASA indicated that the most extreme rainfall totals of greater than 1000 mm (39.4 inches) fell over northern Nepal, India, and Bangladesh

(Figure 1.3). The situation could have been better handled had there been region-wide coordinated efforts around effective forecasts, information sharing, and early warning, as well as supported response actions.

5.4 Inadequate awareness led to incorrect action

Several casualties were also due to sheer negligence and lack of awareness of flood risk among the authorities and the population. In many instances, the public ignored the flood warnings, including mobile SMS, and behaved illogically (such as by fishing and gathering wood in swollen rivers), eventually paying the price with their lives. Despite receiving warning messages of flood risk in time, people died when vehicles trying to cross the flooded river were washed away. These examples highlight the state of awareness of flood risks and preparedness across the community. In addition, it is clear that there are further issues to be explored in relation to how different people understand alerts and warnings through various media (web, social media, radio, TV, telephone calls, sirens, hand mikes, SMS text messages), and the extent to which they take or do not take actions upon them. The most critical example is that of the irrigation department – how prepared it is to take action and how its staff interprets and takes action following alerts and warnings (see Box 4.1 Spotlight on West Rapti). The situation could have been different had operators of the Sikta irrigation barrage properly understood their role when they received the flood warnings. Communication with communities, stakeholders, and local government, including the DHM, is key to ensuring effective delivery of early warnings. A feedback mechanism for further clarity was also lacking if someone did not understand what to do after messages were received.

5.5 Timely evacuation and rescue of at-risk people

Taking the decision to leave home was a very difficult one for the local community members, particularly the task forces. Even though they received information in a timely manner, many people throughout the Nepal river floods studied here were reluctant to leave their homes. In India, the Baharaich District Magistrate mobilized the National Disaster Response Force (NDRF), building on the alert and warning information he accessed from Nepal. As a result, over 200,000 people were brought to safety either through autonomous action by communities or the deployment of forces to evacuate at-risk zones. Conversely, Nepali authorities forwarded the alert and warning information to communities but were not able to take any further response action. Although standard operational procedures were discussed in some districts, they were not followed by agencies. A lesson to learn from downstream in India is that there should be provision for forceful rescue if the situation is identified as critical and people are reluctant to leave their houses.

5.6 Importance of local capacity in an emergency

Local capacities are more crucial when compared to national capacities. Locally available boats (e.g. in Kankai and Babai) were instrumental in rescuing people, while the helicopters deployed from national government could not reach communities in need for various reasons. Community level emergency funds established by the CDMCs were found to be helpful in providing immediate supplies to the neediest households. The local governments now have the authority to undertake DRR-related activities, which may pave the way to increase local capacities to cope with these kinds of disasters in future. Currently it is controlled by a central government treasury, with relief coming in forms such as food allowances in cash that can take weeks, if not months, to arrive. The assessments are time-consuming and reports are not uniform. As observed by one community in West Rapti, flood events are opportunities for some bureaucrats and politicians to hover in helicopters. With the recent change in government structures, it is hoped this situation will improve in future, particularly with regard to accessing resources in time and decision-making, as this will be based at local level with the responsibility falling to local governments. This will also hopefully mean that outside relief will be more fairly and easily distributed. In Baharaich,

local village Panchayat teams were assigned this responsibility in the 2017 flood. Community members expressed their satisfaction at the rescue and relief efforts, as state and district government were able to support local leadership. Similarly, having the relevant skills at community level was critical to taking action. A CDMC coordinator in Kankai rescued all the people in the village and brought them to safety in India at midnight. Local leadership and trust in this leadership is very important, particularly when leaving a risky area in order to reach safe shelter in time. Receiving support from the government and external stakeholders takes time. The relief and rescue-related training and first aid-related training provided to the communities was found to be very useful when it came to managing a disastrous situation.

5.7 Practice helps but negligence costs

During discussion with CDMCs in Holiya in West Rapti, an elder stated that disaster preparation is like preparing for war with an army, and everybody should consider themselves to be a soldier. Logistical preparations and serious mock flood exercises are important for both communities and government authorities. Stock-piling of essential goods and provision of warehouses helps reduce the disaster impact. People often fail to consider the risk to livestock and crops, and it is not considered in either DPRP's or community plans. The hazard maps prepared by the communities were helpful in situations where practices were carried out and taken seriously. However, many government agencies ignored the communities' plans on disaster preparedness and response. Investment to implement these plans is important.

Section 6: Recommendations for the future

Learning from past events is critical. Critical review, reflection, and institutional memory are lacking, particularly at government level. Disaster preparedness needs to shift from traditional ritual meetings and workshops to actionable mandatory decisions and their implementation, setting up clear accountability to respective authorities.

It is essential to strengthen and update information on flood risk. The current warning and danger levels lead and lag time require updating in line with local rainfall information and changes in physical infrastructure such as barrages, roads, bridges, and embankments, as well as the river beds and geographical situations of communities. Every individual and agency needs to be aware of the actions they should take following alerts, warnings, and danger information as well as the normal situational updates from the flood forecasting agencies.

Effective, actionable preparedness is essential at all levels, and each agency should improve to act on their responsibilities in a coordinated manner. Each government organization needs to ensure that transfers and changes in roles and responsibilities do not affect the flood preparedness and response tasks to be carried out by the organization. This should be part of the formal hand-over and take-over process and induction package.

Early warning systems need to be expanded to third order (seasonally flowing) rivers, with technological improvements to generate better forecasts from rainfall monitoring. DHM needs to improve its institutional capacity and expand its rainfall monitoring and flood forecasting actions across the country in order to provide alerts to authorities for flood preparedness and response actions. Furthermore, it needs to expand its outreach to private sectors, local governments, and NGOs to provide warning services to authorities and communities. Local rainfall, which can dramatically influence the local flood situation, should be more carefully considered when it comes to flood preparedness and response.

Public awareness of the need to take timely, appropriate actions based on the early warning system is essential. Public, private, and social media have a crucial role, and all played a very active role in the 2017 floods in their different ways. Most were active during and throughout the aftermath of the disaster event. The Ministry of Information and Communication should take necessary actions to work with and mobilize media to raise public awareness before, during, and after disasters to prevent and reduce losses and damages.

Government and private sector cooperation can help mitigate risk and impacts. Government and private sector cooperation has increased at various levels and should be further encouraged. It helps ensure business and service continuity during disasters – for example by maintaining communication with telecoms companies before, during, and after a disaster event – to mitigate the impact.

Improved local government and community capacities are essential to ensure an effective response. This also includes maintaining their access to information and resources from sub-national, national, and international communities. Devastating floods are not yet an annual occurrence, however uncertainty is rising and investment is not prioritized. Governments need to be serious about integrating DRR into future development plans.

Cross-border cooperation between India and Nepal is crucial to saving lives in both countries. The timely sharing of information and support during a disaster response would significantly prevent losses.

The DDRCs should reflect critically on their actions and review the gaps in their planning and implementation based on this event. There remain some gaps in actions taken when a real event occurs. The post-event review meetings in each district need to be systematic beyond ritual workshops. There should be in-depth analysis of capacities and actions, and the outcomes should be fed into upcoming plans in a transparent manner by allocating roles and accountability to every actor.

Section 7: Conclusions

Flooding in Nepal can be the result of erratic rains in the fragile and degraded hill slopes and the situation is aggravated by continued erosive land use. The 2017 flood event warrants a shift away from the current flood preparedness, which is confined to table talks, revisiting contingency plans, resource mapping, and limited pre-positioning. Preparedness actions need to focus more on mobilizing resources and reaching the vulnerable well before the event. It is a wake-up call to governments to depart from ritual practices of role play to actual preparedness by anticipating unprecedented floods. It is important that such preparedness is instilled at both local and national level, and authorities and actors at all levels should exchange information with each other in advance. In Baharaich in India, district and state governments had not only prepared but communicated that at all levels, while in Nepal the authorities had just taken this process as a role play. There was little exchange in-between and real preparedness was lacking.

A culture of precaution and safety at all levels is important, and agencies should also focus on increasing awareness in order for people to take immediate actions once they receive any risk information. Since communities are often reluctant to leave their location, evacuative actions on the part of the government are also necessary in order for people living in vulnerable areas to be moved to safety. Integration into formal and informal education at various levels can help improve attitudes and practices. We also see the need for study into developing strategies and enabling environments to encourage people to move to safe places in time when they receive flood risk information.

Legal and institutional frameworks and capacities are essential to ensure authorities are accountable. While it is considered everybody's responsibility, there need to be clear roles and responsibilities in place so that standard operating procedures can be followed. Nepal's legal provisions do not hold authorities responsible for taking essential measures and there are no specially designated government units and officials to facilitate and lead the process.

There is huge potential for governments to cooperate with each other to protect their citizens from flood disasters. Sharing rainfall forecasts, actual rainfall, and flood updates helps affected nations to prepare for and respond to flooding. Nepal and India have that potential. This can be at local to regional river basin level.

There have been notable improvements, such as in Babai and West Rapti, building on lessons learned from the 2014 floods; however, the overall mechanism of government has not been improved to tackle the problem. Learning and understanding are essential at both national and local level in order to mitigate risks and prevent greater losses.

International processes and discourses should highlight the benefits of honest preparedness and the cost of neglecting it. The current focus of disaster reviews and evaluations is very much on how response and relief were carried out, but future studies and discourse should expand their scope to cover the links between preparedness and the situation following the event.

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Interviewees

Affected communities in Mehipurwa, Maikpurwa, Nanpara, UP, India
Chief District Officers, Assistant Chief District Officers of Banke, Bardiya, and Jhapa districts
Communities of Binauna, Fattepur (Joraiya and Sidhaniya) and Tepari, Banke
Communities of Taduwa, Mahjidiya, Parsiya, Pattharbojhi, and Rampurtappu, Bardiya
Department of Hydrology and Meteorology, Kathmandu
District Emergency Operation Centre of Banke, Bardiya, and Jhapa districts
District Emergency Operation Centre of Banke
District Magistrate, Additional District Magistrate, and Upjiladhikari in Baharaich, UP, India
Gram Panchayat and Tahasil representatives in Baharaich, UP, India
Group consultations: CDMCs and task forces in Kankai, West Rapti, Babai, and Karnali – three CDMCs and task forces from each river flood plain affected by the flood
Individuals and family members from people with disabilities in the affected communities
Karnali Basin Office of DHM, Nepalganj
Member of cross-border early warning system in Karnali, Babai, and West Rapti, UP, India
National Emergency Operation Centre, Ministry of Home Affairs, Kathmandu
Nepal Red Cross Society, District Chapter, Bardiya, Kailali, and Jhapa. Sub Chapters in Kailali, Bardiya, and Jhapa
Purvanchal Gramin Vikas Sanstha, Lakhnow
Radha Krishna Jana Sewa (RKJS), Bardiya

List of acronyms and definitions

CDMC	Community Disaster Management Committee
CDO	Chief District Officer
CNDRC	Central Disaster Relief Committee
DDRC	District Disaster Relief Committee
DHM	Department of Hydrology and Meteorology (of Nepal)
DPRP	District Preparedness and Response Plan
DRR	Disaster Risk Reduction
EWS	Early Warning System
GLOFAS	Global Flood Awareness System
HCT	Humanitarian Country Team
I/NGO	International/Non-Governmental Organization
LDRC	Local Disaster Relief Committee
mm	millimetre (measure of rainfall)
MOFALD	Ministry of Federal Affairs and Local Development
MoHA	Ministry of Home Affairs
NDRF	National Disaster Response Framework
NEOC	National Emergency Operation Centre
NFI	Non Food Items
NPC	National Planning Commission
NRCS	Nepal Red Cross Society
NSDRM	National Strategy for Disaster Risk Management
NWP	Numerical Weather Prediction
OCHA	Office for Coordination of Humanitarian Affairs
PERC	Post-Event Review Capability
RDRC	Regional Disaster Relief Committee
RIMES	Regional Integrated Multi-Hazard Early Warning System for Africa
SASCOF	South Asian Climate Outlook Forum
SMS	Short Message Service
SOP	Standard Operation Procedures
UN	United Nations
VCA	Vulnerability and Capacity Assessment

About PERC

As part of Zurich's flood resilience alliance, 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. Since 2013, PERC has analyzed various flood events. It has engaged in dialogue with relevant authorities, and is consolidating the knowledge it has gained to make this available to all those interested in progress on flood risk management.

The PERC repository - Learning from past disasters
Available at: https://www.zurich.com/en/corporate-responsibility/flood-resilience/learning-from-post-flood-events

The PERC manual - Learning from disasters to build resilience: a simple guide to conducting a post event review
Available at: https://www.zurich.com/_/media/dbe/corporate/docs/corporate-responsibility/the-perc-manual.pdf

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.

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