LEARNING FROM DISASTER RESPONSE AND PUBLIC HEALTH EMERGENCIES

THE CASES OF BANGLADESH, BHUTAN, NEPAL AND PAKISTAN

DISCUSSION PAPER NOVEMBER 2020

Rianna Mohammed-Roberts
Oluwayemisi Busola Ajumobi
Armando Guzman

/

WORLD BANK GROUP
Health, Nutrition & Population

LEARNING FROM DISASTER RESPONSE
AND
PUBLIC HEALTH EMERGENCIES

The Cases of Bangladesh, Bhutan, Nepal, and Pakistan

Rianna Mohammed-Roberts, Oluwayemisi Busola Ajumobi, and Armando Guzman

November 2020

Health, Nutrition, and Population (HNP) Discussion Paper

For information regarding the HNP Discussion Paper Series, please contact the Editor, Jo Hindriks at jhindriks@worldbank.org or Erika Yanick at eyanick@worldbank.org.

RIGHTS AND PERMISSIONS

Health, Nutrition, and Population (HNP) Discussion Paper

Learning from Responses to Disasters and Public Health Emergencies: The Cases of Bangladesh, Bhutan, Nepal, and Pakistan

Rianna Mohammed-Roberts,[a] Oluwayemisi Busola Ajumobi,[b] and Armando Guzman[c]

[a] Senior Health Specialist, Health, Nutrition, and Population Global Practice, World Bank, Washington, DC, United States
[b] Consultant, Health, Nutrition, and Population Global Practice, World Bank, Washington, DC, United States
[c] Senior Disaster Risk Management Specialist, Social, Urban, Rural, and Resilience Global Practice, World Bank, Washington, DC, United States

Abstract:

This study analyzes responses to past natural disasters in four countries in South Asia—Bangladesh, Bhutan, Nepal, and Pakistan. Of 178 hazardous events reported in the four countries during the 10 years covered by this study (2009–19), 126 were classified as disasters and used for the in-depth analysis.

The analysis revealed that countries have multi-hazard preparedness and response capacities in place, albeit to varying degrees, in areas such as early warning and surveillance systems, emergency operations centers, and whole-of-society approaches to disaster preparedness, response, and recovery. Notwithstanding, the analysis also revealed gaps across each country in their capacity to detect, prepare for, respond to, and recover from hazard-induced disasters, including public health emergencies. To address these gaps, the paper offers recommendations for improving capacities and resilience to disasters.

Recent infectious disease outbreaks, including the ongoing global COVID-19 pandemic, have demonstrated the critical importance of comprehensive disaster risk management systems, which include resilient health systems, in reducing exposure and vulnerabilities to hazards, with an overarching aim of safeguarding national and global health security. To ensure sustainability, this calls for, amongst others, a holistic approach to resilience that incorporates public health, disaster risk and climate change considerations; the integration of community-based disaster risk reduction programs into routine public health service delivery functions; an enhanced and expanded focus on improving multi-hazard preparedness; and the prioritization and institutionalization of after action reviews, as a means of ensuring that corrective actions from past public health events are properly considered.

Keywords: disasters, public health emergencies, hazard events, health and disaster risk management, South Asia region

Correspondence Details: Rianna Mohammed-Roberts (rmohammed@worldbank.org) and Armando Guzman (aguzman@worldbank.org)

Table of Contents

List of Tables

List of Figures

ACKNOWLEDGMENTS

This paper was prepared by a World Bank team comprising Rianna Mohammed-Roberts, Oluwayemisi Busola Ajumobi, and Armando Guzman.

The report was reviewed by a number of technical specialists in the Health, Nutrition, and Population Global Practice and the Social, Urban, Rural, and Resilience Global Practice. Comments, suggestions, and guidance are gratefully acknowledged from: Arati Belle (Senior DRM Specialist), Manav Bhattarai (Senior Health Specialist), Avani Mani Dixit (DRM Specialist), Aliya Kashif (Senior Health Specialist), Swarna Kazi (Senior DRM Specialist), Shaza Khan (Operations Analyst), Sohel Samad (Pandemic Expert Consultant), Jahanzaib Sohail (Economist (Health)), Ahsan Tehsin (Senior DRM Specialist), and Dechen Tshering (DRM Consultant).

The authors deeply appreciate the guidance received from E. Gail Richardson and Christoph Pusch, Practice Managers, World Bank.

The authors are grateful to the World Bank for publishing this report as a Health, Nutrition, and Population Discussion Paper, and to the Global Facility for Disaster Reduction and Recovery for financing this study.

SUMMARY

This study is unique in systematically analyzing hazard-induced disasters and response to these events, in four South Asian countries—Bangladesh, Bhutan, Nepal, and Pakistan—over a 10-year period (2009–19). The objective of the study is to identify evidence-based approaches and lessons learned in disaster preparedness, response, and recovery capabilities, and to propose recommendations for improvement, with a focus on health emergency response capacities. The analysis includes a review of literature on disasters in the four countries over the period 2009–19.[1]

The findings and recommendations are applicable to the ongoing novel coronavirus disease 2019 (COVID–19) pandemic, which was first reported in Wuhan city, Hubei province, China in December 2019. The COVID–19 pandemic is currently occurring in more than 188 countries and, as of November 8, 2020, there were over 49.5 million confirmed cases (with over 1.2 million deaths) worldwide. In the four target countries covered under this analysis, Bangladesh has had 418,764 cases and 6,049 deaths; Bhutan, 359 cases and no deaths; Nepal, 191,636 cases and 1,087 deaths; and Pakistan, 431,753 cases and 6,943 deaths.[2]

KEY FINDINGS

Of 178 hazardous events[3] reported in the four countries during the 10 years covered under the analysis,[4] 126 resulted in disasters due to hazard occurrence and other risk factors[5], and are used for the in-depth analysis. Of these 126 disasters, Bangladesh had the most—49—of which 18 were large-scale, 19 medium-scale, and 12 small-scale (see Table 1).

Of the large-scale disasters that occurred, all four countries were affected by the 2009 H1N1 pandemic. Bangladesh was also affected by the 2015 earthquake with the epicenter in Gorkha, Nepal. Bhutan was severely affected by the 2009 cyclone Aila and the 2016 floods which were caused by torrential monsoon rains. Bangladesh, Nepal, and Pakistan suffered multiple outbreaks of dengue fever, with the highest number of cases reported in Bangladesh.

TABLE 1: DISASTERS USED FOR IN-DEPTH ANALYSIS

Country	**Small-scale**	**Medium-scale**	**Large-scale**	**Total**
Bangladesh	12	19	18	49
Bhutan	4	0	2	6
Nepal	0	14	12	26
Pakistan	6	22	17	45
Total	***22***	***55***	***49***	***126***

[1] These countries were included as “target countries” under a grant from the Global Facility for Disaster Reduction and Recovery.
[2] https://covid19.who.int/. Accessed Nov 9, 2020.
[3] The definitions adopted for the three categories of events are as follows: a small-scale event resulted in ≤ 10 deaths or ≤ 1,000 people affected; a medium-scale event resulted in ≤ 100 deaths or ≤ 10,000 people affected; and a large-scale event led to > 100 deaths or > 10,000 people affected, or was officially classified as a national or global emergency.
[4] Reported events are based on findings from multiple sources used for the literature review, screened to ensure consistency with the more comprehensive list of events in the EM–DAT International Disaster database of the Centre for Research on the Epidemiology of Disasters.
[5] A ‘hazard’ is defined as a “process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. See UNISDR Terminology: https://www.undrr.org/terminology. It is discussed further in the methodology section.

LESSONS LEARNED AND RECOMMENDATIONS

The study found that all target countries have some level of disaster preparedness and response capacities in place, with varying degrees of functionality, in areas such as early warning systems (EWS), multi-hazard preparedness and response capacities, and the adoption of whole-of-society approaches to ensuring sustainable emergency preparedness through effective multisectoral collaboration and community engagement. Notwithstanding, the analysis also revealed gaps across each country in multi-hazard preparedness and response capabilities, including health sector resilience.

Health sector resilience is critical in: (a) reducing the disaster risk posed by multi-hazards, and consequently, the effectiveness of disaster risk reduction approaches; (b) increasing the ability of the health sector to withstand and better manage future shocks to health systems arising from disasters; and (c) preventing disruptions to health service functions during and following a disaster, including a health emergency. Lessons learned, and suggested recommendations for improving health system resilience are outlined below. These recommendations are fully consistent with international guiding documents such as the Sendai Framework for Disaster Risk Reduction (2015–2030) and the 2019 World Health Organization (WHO) Health Emergency and Disaster Risk Management (HEDRM) Framework, which draw on other global standards such as the WHO IHR (2005).[6]

- **Establishment and enhancement of multi-hazard EWS.** EWS have proven effective in preventing, preparing for, and responding to hazards, thereby reducing the impact of disasters, including public health emergencies. Across the four target countries, EWS are in place for multi-hazards and, in Bhutan only, for event-specific risk management. The Cyclone Preparedness Program (CPP) in Bangladesh, for example, which has been exceptionally successful in preparing for and responding to cyclones, has been scaled up to address other geophysical hazard-induced disasters. To improve sustainability, comprehensiveness, and forecasting capabilities, EWS should: (a) be integrated with both surveillance and other emergency management systems, and (b) incorporate risk analysis and prediction science.
- **Adoption of an integrated and inclusive whole-of-society approach to prevent new hazard exposure and reduce existing disaster risk should be prioritized.** All four target countries have adopted a whole-of-society approach.[7] However, there is a need to: (a) develop multisectoral multi-hazard preparedness and response action plans to promote and ensure institutionalization of an integrated multi-hazard management framework; and (b) prioritize a community-based approach that empowers communities, encourages self-reliance, and uses local skills and knowledge.
- **Improve multi-hazard preparedness capabilities through:** (a) development and implementation of action plans for building health sector resilience to hazards, and ensuring contingency planning and financing for hazard and disaster preparedness and response at the national, subnational, and health facility levels; (b) continuous capacity-building of health care workers to improve knowledge and competencies to effectively properly manage the impact of disasters and to avoid disruptions to essential health service delivery functions during health emergencies; and (c) establishment and

[7] A whole-of-society approach embodies the integrated support for emergency preparedness and response across all sectors and levels of government and society, including nongovernmental and private sector organizations, and the full engagement and empowerment of the community in emergency preparedness and response planning and disaster risk management.

enhancement of disaster governance structures to build institutional capacity in all aspects of DRM—preparedness, response, recovery, and reconstruction.

- **Conducting after-action reviews (AARs) following a disaster is a best practice in emergency preparedness and response, and disaster risk management (DRM) and should be institutionalized** in line with WHO recommendation and guidelines. The study found that AARs were not systematically carried out across any of the four target countries. As such, there is a need to put policies in place which institutionalize the practice of conducting an AAR following a disaster, to properly document best practices and corrective actions during disaster response and recovery project implementation, with an aim of ensuring better preparedness for, and response to, future events (WHO 2019c).

LIMITATIONS OF THE ANALYSIS

The report assigns a category of small-, medium-, and large-scale to hazard-induced disasters, based on the number of affected people. A more standard way of classifying the scale of disasters is to use the estimated costs of damages and losses, and their ratio to GDP. A lack of data, however, prevented this approach from being adopted.

A second limitation is that hazardous events identified within the 10-year period were derived from a single data collection method. As such, the numbers of hazardous events, and hazard-induced disasters identified should be considered indicative, rather than conclusive. Finally, the data used in this report were limited to the findings that emerged from the literature review and relevant databases. These findings were not cross-checked against other data collection methods.

Abbreviations and Acronyms

AAR	After-action review
AFN	Asia Flood Network
AJK	Azad, Jammu, and Kashmir
BBB	Build–Back–Better
CCVI	Climate Change Vulnerability Index
CNDRC	Central Natural Disaster Relief Committee
COVID–19	Coronavirus disease 2019
CCHF	Crimean Congo hemorrhagic fever
CPP	Cyclone Preparedness Program
DDM	Department of Disaster Management (Bhutan)
DEWS	Disease early warning system
DM	Disaster management
DRM	Disaster risk management
DRR	Disaster reduction and recovery
EDRM	Emergency and disaster risk management
EOC	Emergency Operations Center
EWARS	Early warning alert and response system
EWS	Early warning system
GDP	Gross domestic product
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic information system
GLOF	Glacial lake outburst floods
GoB	Government of Bangladesh
HEDCP	Health Emergency and Disaster Contingency Plan
HEDRM	Health Emergency and Disaster Risk Management
HEOC	Health emergency operations center
HIV	Human immunodeficiency virus
HPAI	Highly pathogenic avian influenza
IEDCR	Institute for Epidemiology Disease Control and Research
ICT	Islamabad Capital Territory
IHR	International health regulations
JEE	Joint external evaluation
KPK	Khyber Pakhtunkhwa

MNCAH	Maternal, newborn, child, and adolescent health
MoDMR	Ministry of Disaster Management and Relief (Bangladesh)
MoHA	Ministry of Home Affairs (Nepal)
MoHP	Ministry of Health and Planning (Nepal)
NAPHS	National Action Plan for Health Security
NDMA	National Disaster Management Authority (Pakistan/ Nepal)
NDMC	National Disaster Management Council (Bangladesh)
NDRRMA	National Disaster Risk Reduction Management Authority (Nepal)
NGOs	Nongovernmental organizations
NHII	Natural Hazards Impact Index
NHVI	Natural Hazards Vulnerability Index
NRA	National Reconstruction Authority
PDMA	Provincial Disaster Management Authority
PITB	Punjab Information Technology Board
RGoB	Royal Government of Bhutan
SAR	South Asia region
SAARC	South Asian Association for Regional Cooperation
SDMC	SAARC Disaster Management Center
SPCR	Strategic Program for Climate Resilience
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
USAID	United States Agency for International Development
UNISDR	United Nations International Strategy for Disaster Reduction
WHO	World Health Organization

1. INTRODUCTION

This study presents findings from an analysis of hazard-induced disasters, including public health emergencies, across Bangladesh, Bhutan, Nepal, and Pakistan over a 10-year period ending November 2019. The report describes country preparedness, response, and recovery efforts and, based on lessons learnt from the analysis offers recommendations for improving multi-hazard preparedness and response capabilities. Recommendations are aligned with the priorities outlined in the Sendai Framework for Disaster Risk Reduction (2015–2030)[8] to prevent new disaster risks and reduce existing ones, and consistent with the 2019 WHO HEDRM framework guidelines which focus on enhancing the capacities of health systems to reduce health risks and consequences of emergencies and disasters (WHO 2019b).

Both the Sendai Framework and WHO HEDRM Framework includes health-centered actions, and reflect a shift in approach towards reducing disaster risks (including epidemic risks) over the next 15 years through, *inter alia*: (a) adopting an integrated and inclusive whole-of-society approach to prevent new hazard exposure and reduce existing disaster risk; (b) expansion from a *single hazard to an all-hazards approach* that develops efficient and cost-effective preparedness and response capacities and mechanisms applicable to all hazards (supplemented by an individually tailored approach, where appropriate); and (c) movement from planning for communities to planning with communities to establish appropriate DRM interventions based on community vulnerabilities and needs.

This section of the report provides a brief introduction to the target countries, including their disaster preparedness and implementation capacity, and vulnerability to both natural disasters and the effects of climate change. This is preceded by a regional overview of vulnerability to multi-hazards.

REGIONAL OVERVIEW

The South Asia region (SAR) includes eight countries[9] under the South Asian Association for Regional Cooperation (SAARC) with a population of about 1.8 billion (United Nations Department of Economics and Social Affairs 2019). The region has a combined gross domestic product (GDP) of US$3.5 trillion (2018 World Bank estimates). It is reported to be one of the least economically integrated regions globally (World Bank 2019). It is highly prone to hydrometeorological and geological hazards, including floods, droughts, cyclones, earthquakes, and extreme rainfall, in addition to biological hazards that result in infectious disease outbreaks of epidemic and pandemic potential. Reported to be the most vulnerable region to flooding, and the second most vulnerable to cyclones (World Bank 2012), its extreme weather patterns are due to climate change, environmental degradation, and rapid urbanization. In addition, a lack of strong disaster governance structures increases vulnerabilities to hazards, including those of biological origin. Along with individual country vulnerabilities, the cross-border impact of hazard-induced disasters, including large-scale infectious disease outbreaks, is a major source of concern for the entire region.

The World Bank's regional integration strategy for the SAR emphasizes strengthening resilience and addressing disaster risks, including improving disaster preparedness and response capacities. Accordingly, various governments in the region, facing severe and more frequent hazards of varying intensities, are prioritizing DRR and establishing emergency preparedness

8 The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted at the Third United Nations World Conference on Disaster Risk Reduction, held on March14–18, 2015, in Sendai, Miyagi, Japan. The four priorities of the framework are: understanding disaster risk, strengthening disaster risk governance to manage disaster risk, investing in DRR for resilience, and enhancing disaster preparedness for effective Build–Back–Better in recovery, reconstruction, and rehabilitation.

9 Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

and response systems. Health security—through improving health system resilience—is also high on the region's agenda, reflected in an active regional network called the One Health Alliance of South Asia, and the voluntary participation of six of the eight South Asian countries in the Joint External Evaluation (JEE) of IHR (2005) core capacities.[10] As a next step, the WHO health security planning framework and costing tool has been used to develop five-year National Action Plans for Health Security (NAPHS) in these six countries.[11]

OVERVIEW OF THE FOUR TARGET COUNTRIES

Bangladesh

With a population of about 163 million, Bangladesh is bordered by India and Myanmar. Its GDP is about US$274 billion (United Nations Department of Economics and Social Affairs 2019; World Bank 2012). The capital city Dhaka, the sixth largest city in the world and the most densely populated, is home to about 20.2 million. The country has a typical tropical monsoon climate, characterized by wide seasonal variations in rainfall, high temperatures, and high humidity. It is predicted to experience natural hazards more frequently as a result of climate change, and an inundation of 10 percent of its land mass due to rising sea levels. High population density makes the country prone to high rates of morbidity from the increasing frequency of infectious disease outbreaks.

Common outbreaks include cholera, dengue fever, and diphtheria, while typical natural hazards include floods, cyclones, storm surges, riverbank erosion, earthquakes, droughts, landslides, salinity intrusions, and fires. Due to the geographical setting of the country's south and northeast regions, which are characterized by hilly areas and upstream rivers, Bangladesh is more prone to cyclones, flash floods, and landslides. Overall, of the country's 147,570 square kilometers (56,980 square miles), 97.1 percent are highly vulnerable to two or more hazards at any given time. That puts 97.7 percent of the population at risk of health emergencies, including those due to outbreaks of infectious diseases that typically follow natural disasters.

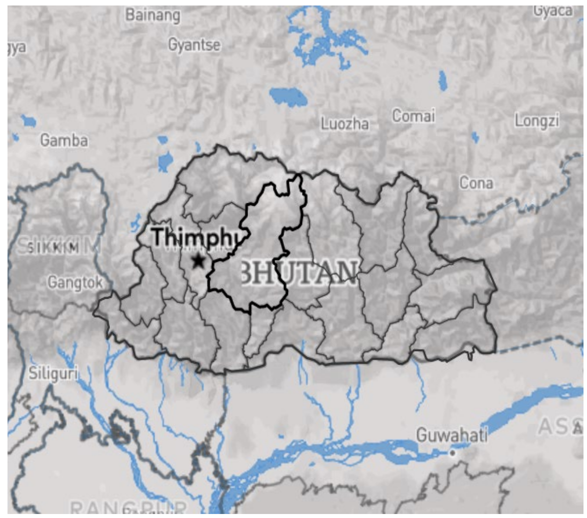
Over the years, the Government of Bangladesh (GoB) has focused attention on resilience-building, including establishing appropriate EWS. As a result, the health consequences of natural hazards such as floods and cyclones are reported to have reduced significantly over the past 40 years due not only effective EWS, but also increased political commitment to disaster preparedness and risk reduction, increasing activities of international development partners and NGOs in DRM, and increased levels of community mobilization for DRM (Cash et al. 2013). The GoB has also prioritized health security on its development agenda, as evidenced by establishment of a functional national One Health Initiative, in line with the country's priority to adopt a multisectoral approach in response to biological hazards; completing the WHO JEE IHR

[10] The six countries are: Afghanistan, Bangladesh, Bhutan, Maldives, Pakistan, and Sri Lanka. Nepal and India have not yet participated in the joint external evaluation process. It is a voluntary, collaborative, and multisectoral process to assess country capacities to prevent, detect, and rapidly respond to public health risks whether occurring naturally or due to a deliberate or accidental event.

[11] Afghanistan, Bangladesh, Bhutan, Maldives, Pakistan, and Sri Lanka.

(2005) process in 2016; the costing of the NAPHS is in-process. However, the displaced Rohingya population—who live in highly congested conditions—are not included in national preparedness planning and early warning mechanisms and continue to be most vulnerable and hardest hit when disasters strike the country (Relief Web 2019).

Bhutan



Extremely rugged and mountainous, with a population of about 763,000 and a GDP of US$2.45 billion (World Bank 2018), Bhutan is in the eastern Himalayas between the Tibetan Plateau of China bordering the north and east, and the Indian plains bordering the west and south. It covers a total area of 38,394 square kilometers (14,824 square miles) and is located on the southern slope of the eastern Himalayas with an elevation ranging from 160 meters in the southern foothills to more than 7,500 meters in the north. Thimphu, the capital city of Bhutan, is home to about 203,000 people, an estimated 25 percent of the population. Given its location and changing climate, which varies according to elevation—ranging from subtropical in the south, to temperate in the highlands, to a cold polar climate in the north—the country is susceptible to various types of disasters, linked to hazards such as earthquakes, glacial lake outburst floods, windstorms, flashfloods, landslides, and forest/structural fires. Despite the country's remoteness and relative isolation, its shared borders with India and China make Bhutan vulnerable to biological hazards originating from other countries.

Due to several shortfalls in disaster preparation and implementation capacity, Bhutan was found to be ill-prepared to deal with hazard-induced disasters by a performance audit of disaster management by the Royal Audit Authority from 2010–15. The Royal Government of Bhutan (RGoB) has prioritized strengthening DRM capacities, building resilience to natural disasters, and ensuring multisectoral coordination by institutionalizing an integrated disaster management framework. Subsequently, the 2016 Health Emergency and Disaster Contingency Plan (HEDCP) was developed, in line with the mandate in the National Disaster Management Act (2013), to enhance preparedness and response capacity of the health sector for emergencies and disasters at different levels of the health system (Ministry of Home Affairs 2018). In addition, by completing the JEE IHR (2005) in December 2017 and the costing of the NAPHS, the government has displayed commitment to enhancing health security and building and maintaining Bhutan's core public health security capacities.

Nepal

A landlocked, mountainous country that borders India to the east, west, and south, and China to the north, Nepal is inhabited by about 29 million people, including about 1.4 million in the capital city of Kathmandu, and has a GDP of about US$29 billion (World Bank 2018). With the Himalayan ranges, the central and northern parts of the country are hilly areas, while the southern part is the plain area called Tarai. The country lies at the center of the 2,500 kilometer-long Himalayan range, in the seismic active zone, and is a hotspot for natural disasters due to difficult and uneven geological terrain, which ranges from 70 meters high in the Tarai, to 8,848 meters high at Mount Everest (Ministry of of Home Affairs and Disaster Preparedness Network 2015). Prone to hazards such as earthquakes, floods, and landslides (resulting in both small and large-scale disasters), and fires, the country is ranked as the fourth most climate-vulnerable country in the world (Verisk Maplecroft 2019). Overall, about 80 percent of the country is vulnerable to natural hazards (Global Facility for Disaster Reduction and Recovery 2020; Ministry of Home Affairs 2018).

A priority for the government of Nepal is to advance DRM and to improve the country's resilience to climate-induced natural disasters. The government also recognizes the importance of establishing effective emergency preparedness and response systems. However, plans for Nepal to conduct a JEE IHR (2005) are currently still in the pipeline.

Pakistan

Inhabited by about 220 million people, the Islamic Republic of Pakistan (Pakistan), faces the Arabian Sea, and shares borders with Afghanistan, China, India, and Iran. The capital city of Islamabad has a population of about 1.1 million, and as of 2018, the country's GDP was reported to be about US$314.6 billion (Cash et al. 2013). The country occupies an area of 778,720 million square kilometers and has the Himalayas, Karakoram, and Hindu Kush ranges in the north and the Baluchistan Highlands in the west. The eastern half of the country is densely populated, and the flood-prone Indus River and its tributaries run through the area. Because of geographical conditions, the country's climate varies greatly by region.

Pakistan is prone to a variety of hazards, including droughts, cyclones, landslides, avalanches, epidemics, and riverine and flash floods. Due to the increasing frequency of hazard-induced disasters in the country, the government of Pakistan is focusing on proactive DRM as a priority. The government is also enhancing the capacity of the National Disaster Management Authority—the government entity that coordinates and monitors the implementation of DRM policies and strategies—in risk assessment, prevention, mitigation, and preparedness. In addition, the JEE IHR (2005) and NAPHS for Pakistan have been completed, and the government is working toward improving preparedness to public health emergencies.

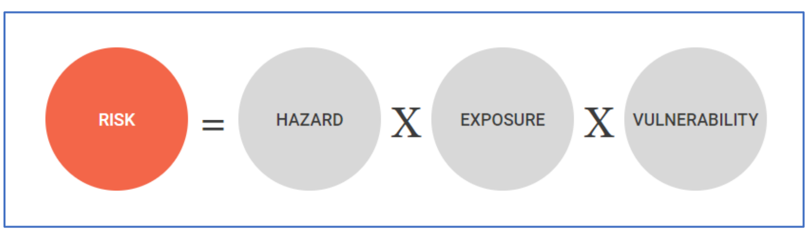
2. METHODOLOGY

This section describes the methodology used for the analysis. This includes the data collection process, event inclusion criteria, and scope of the analysis. The literature review covered 10 years ending in November 2019 and included peer-reviewed and non-peer reviewed articles, reports, publications, and grey literature covering public health emergencies, natural disasters, and multi-hazards. Appropriate search terms and search strategies were used to search databases and online websites, including the World Bank, Global Facility for Disaster Reduction and Recovery (GFDRR), WHO, United Nations Office for Disaster Risk Reduction (UNDRR), United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), and other UN agencies. Bibliographies of relevant literature were also screened for a more comprehensive search. See Annex 5 for search terms.

The definitions in this report are taken from the United Nations Office for Disaster Risk Reduction (UNDRR) standard glossary of definitions.[12] Definitions for three key terms which are mentioned throughout the report- hazards, disasters, disaster risk and health system resilience- are provided below.

- A *hazard* is defined as "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social, and economic disruption or environmental degradation." Hazards may be natural (i.e. associated with natural processes and phenomena), anthropogenic (i.e. human-induced) or socio-natural (i.e. associated with a combination of natural and anthropogenic factors, including environmental degradation and climate change) in origin. There are two broad categories of hazards: (a) geophysical (including geological hazards, meteorological and climate hazards, and hydrological hazards) and (b) biological (including disease outbreaks). Hazards are classified in Annex 3.
- A *disaster* is "a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses, which does exceed the ability of the affected community or society to cope using its own resources." Disasters often follow natural hazards and are sometimes considered as external shocks. A disaster, therefore, is not an inevitable consequence of a hazard, but depends on the level of exposure and vulnerability to the hazard.
- *Disaster risk* is determined by a combination of: (a) the severity and frequency of a hazard; (b) the numbers of people and assets exposed to the hazard; and (c) their vulnerability to damage (see Figure 1).

FIGURE 1: ESTIMATING DISASTER RISK



Source: United Nations International Strategy for Disaster Reduction (2015)

12 https://www.undrr.org/terminology

- *Health System Resilience* is defined as “the ability of the health sector to cope with, or adapt to, stress posed by disasters, including public health emergencies”. As such, it reflects the degree of planned preparation carried out in recognition of a potential hazard, and of spontaneous or premeditated adjustment in response to a hazard, including post-disaster relief, rescue, and recovery. Exposure and vulnerability, therefore, can be reduced through health system resilience. This definition aligns with the commonly referenced definition of resilience by Kruk et al. (2015): “the capacity of health actors, institutions, and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hit; and informed by lessons learned during the crisis, reorganize if the conditions require it.”

EVENT INCLUSION CRITERIA

Following the literature review, a select list of hazard-induced disasters was identified for an in-depth analysis based on the availability of information. This is discussed in the scope of analysis subsection. These disasters were screened for consistency with a comprehensive list of disasters included in the EM–DAT: International Disaster Database (CRED 2018) and the WHO Global Disease Outbreaks News database.[13] Events with missing data on “total number of people affected,” and not classified as an emergency, were excluded from the in-depth analysis (see Annex 4 for the compiled list of hazard-induced disasters).

SCOPE OF ANALYSIS

From the literature review, six key areas were considered for an in-depth analysis:

- *Country and event profile:* A review of country profiles, including factors that make each country prone to hazardous events, were included as part of the analysis. For ease of analysis, and to allow for simplification in reporting on the findings, past events in the four countries are categorized according to intensity using a scale of 1 to 3. The definitions for the three categories of events are as follows:
  - Category 1 (small-scale): an event that resulted in ≤10 deaths and/or affected ≤1000 people.
  - Category 2 (medium-scale): an event that led to ≤100 deaths and/or affected ≤10,000 people.
  - Category 3 (large-scale): an event that led to >100 deaths, affected >10,000 people, and/or was officially classified an emergency at the national or global level. Events that affected >1 million people were automatically classified as category 3 events irrespective of reported number of deaths.
- *Impact of disaster*: The analysis covered any reported data on population health impact due to the disaster, including estimated morbidity and mortality, the burden on the healthcare systems of the affected countries, and the direct and indirect economic impact attributed to the disaster.
- *Adaptive actions in place at the country/regional level*: Analysis of the adaptive actions in place are classified as:
  - Pre-event preparedness and mitigation measures.
  - Response measures adopted during an event.
  - Post-event recovery and resilience measures implemented to withstand the occurrence of future events, in line with the Build–Back–Better principle.

[13] The minimum criteria utilized by EM–DAT for a disaster to be registered in the database must include at least one of the following: 10 or more people reported killed, 100 or more people reported affected, declaration of a state of emergency, or call for international assistance.

    - *Institutional governance and accountability mechanisms* including the types of decision-making structures operationalized in response to an event.
- *Overall scope of response*: Analysis of the overall scope of response to disasters, accounted for the adoption—or lack thereof—of a whole-of-society approach to ensuring multisectoral and multidisciplinary collaboration in emergency response and DRM. This included the effectiveness of the local response at the community level.
- *Lessons learned*: To identify lessons learned following a response to disasters, the analysis considered key findings from country and regional documents that identified and appraised what worked well and what did not. The analysis of lessons learnt uncovered interventions that could inform the development and implementation of appropriate disaster response capacities. Interventions were consistent with two identified international guidelines—the Sendai Framework for DRR and the WHO HEDRM Framework—both of which draw on other global documents, such as the WHO IHR (2005) and the Paris Agreement.
- *Recommendations:* Based on the findings and lessons learnt, the analysis posits recommendations to inform future policy making, to improve and enhance resilience to emergencies and disasters, and to establish evidence-based emergency preparedness and response measures.

LIMITATIONS OF THE ANALYSIS

There are three key limitations of this analysis. The first limitation relates to categorizing disasters as small, medium, and large-scale, based on the number of affected people. A more standard way would have been to classify disasters based on the estimated cost of damages and losses, and their ratio to GDP. This approach, however, could not be adopted because of a lack of data.

The second limitation is that findings are limited to hazardous events and hazard-induced disasters identified in the literature review using the predefined search terms and search strategies (Annex 5), and information gleaned from the list of reported events in the EM–DAT database. As such, it is possible that the list is not complete. As such, the numbers provided in our analysis should not be considered conclusive, but only as indicative.

Finally, the events and disasters identified in the literature review were not triangulated with other data sources, such as interviews and focus group discussions with applicable government officials, development partners, and other key stakeholders.

3. KEY FINDINGS

This section provides an overview of the key findings from the analysis, organized by:

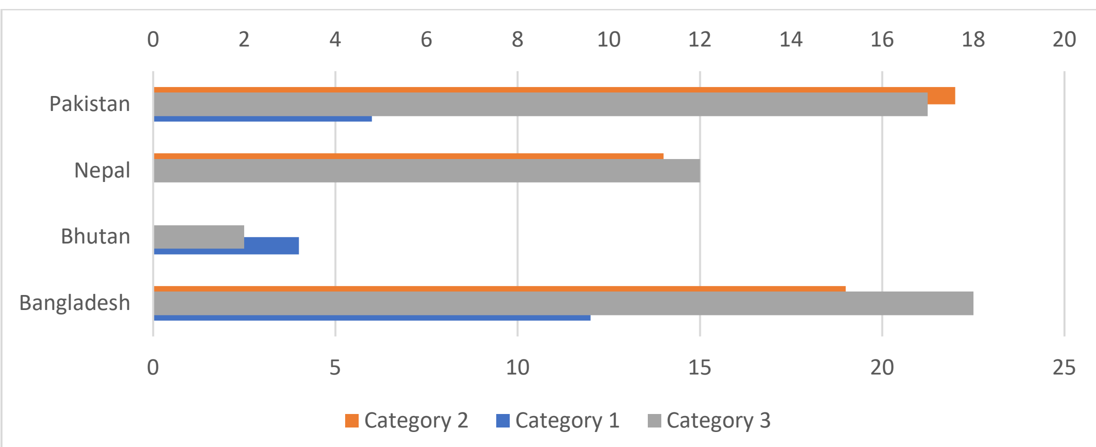
- Event profiles
- Country profiles
- Disaster responses and lessons learned
- Recommendations

EVENT PROFILES

Over the last decade, the four target countries reported a total of 178 hazardous events, of which 126 events of varying intensities met the selection criteria for inclusion in the in-depth analysis as disasters. These disasters comprised small-scale (21), medium-scale (56), and large-scale disasters of catastrophic proportions (49) (Figure 2).[14] Of these 126 disasters, 17 were induced by biological hazard (infectious disease outbreaks including epidemics and pandemics); 14 were induced by geological events (earthquakes); and 95 were induced by hydrometeorological events—avalanches (2), cold waves (6), cyclones (12), drought (2), floods, flashfloods and riverine floods (49), landslides, including landslides caused by earthquakes (8), storms, including connective, severe storms, and windstorms (15), and a tornado (1) (Figure 3).

In the last four years, 42 of the 126 disasters were reported to have occurred in the four target countries combined—13 in 2019 alone, the year with the third highest frequency of disaster occurrence over the 10-year period under review. Figure 4 shows the pattern of hazard occurrence in each country across the 10-year period.

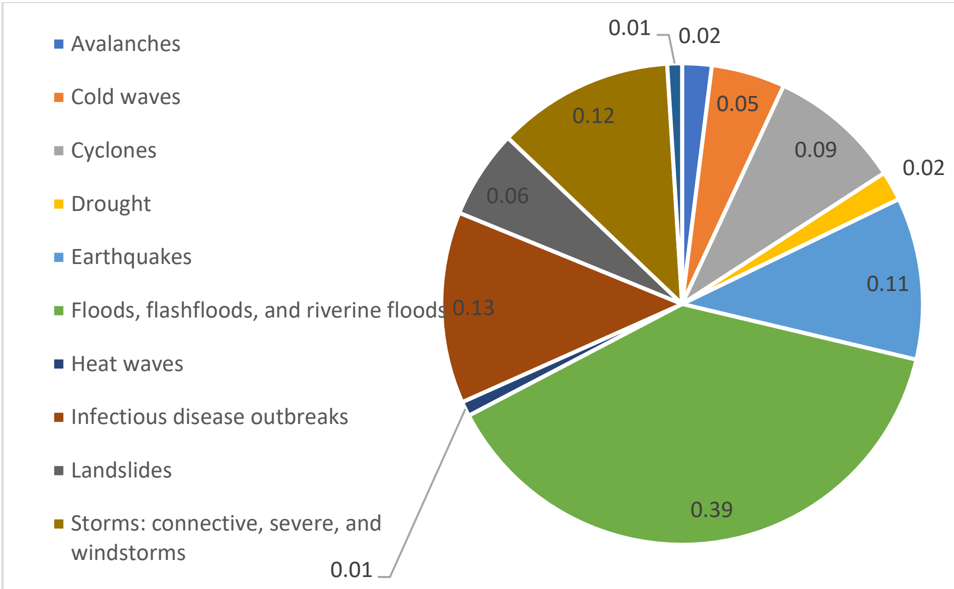
FIGURE 2: FREQUENCY OF EVENT OCCURRENCE IN TARGET COUNTRIES BY ORDER OF MAGNITUDE



Source: Data from Annex 4

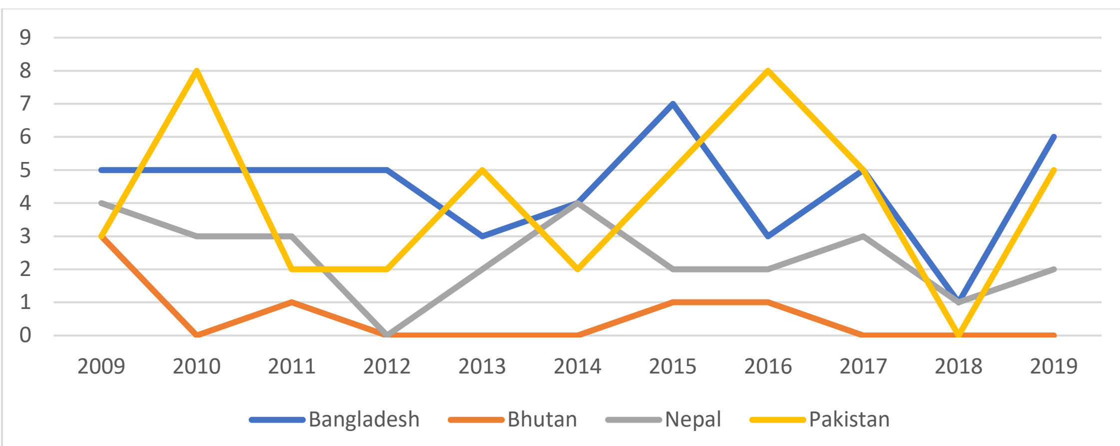
[14] Annex 3 provides a breakdown of disasters occurrence by intensity.

Figure 3: Hazard-induced disaster types



Source: Data from Annex 4

Figure 4: Disaster occurrence over a 10-year period



Source: Data from Annex 4

Country profiles

The profiles of the four South Asian countries reviewed in this analysis provide a summary of the hazard events and hazard-induced disasters in each country and a snapshot of country vulnerabilities to climate change and exposure to hazards, including their impact on the populations and economies. Disaster risks are classified under three indices (climate change vulnerability, natural hazards vulnerability, and natural hazards impact) and scored using a scale from 0 to 10, with 0 being the highest risk and 10 the lowest (Table 2).

In addition to discussing the events that occurred in each of the four target countries during the period covered by the analysis, this subsection of the report also highlights some of the adaptive actions in place in each country, in line with government priorities. This includes institutional arrangements, which are summarized in Annex 2, together with regional response mechanisms.

TABLE 2: COUNTRY INDICES OF CLIMATE CHANGE AND NATURAL HAZARD RISKS, 2019

Country	Climate Change Vulnerability Index (CCVI)[a]	Natural Hazards Vulnerability Index (NHVI)[b]	Natural Hazards Impact Index (NHII) [c]
Bangladesh	4.50	3.77	2.01
Bhutan	5.27	5.46	6.22
Nepal	3.95	3.55	2.81
Pakistan	4.12	3.58	2.35

Extreme risk (0.0—2.5)	High risk (>2.5—5.0)	Medium risk (>5.0—7.5)

Sources: EM–DAT: The Emergency Events Database (CRED 2018) and Verisk Maplecroft (2019).
[a] Climate Change Vulnerability Index evaluates the vulnerability of human populations to extreme climate events and changes in climate over the next three decades.
[b] Natural Hazards Vulnerability Index evaluates the abilities of individuals, communities, the private sector, and the public sector to prepare for, respond to, and recover from the impact of a natural hazard event.
[c] Natural Hazards Impacts Index assesses the risk to populations and economies posed by natural hazards, as measured by the historical record of economic losses and fatalities.

Bangladesh

Bangladesh recorded the highest occurrence of hazard-induced disasters, with a total of 49 disasters (12 small-scale, 19 medium-scale, and 18 large-scale), when compared with the other three target countries (Table 3). During this period, Bangladesh was affected by both geophysical and biological hazards, including 6 cyclones, multiple floods, outbreaks of infectious diseases—including dengue fever, diphtheria, H1N1, and highly pathogenic avian influenza (HPAI) (H5N1)—cold waves, storms, and landslides. Although an earthquake did not occur in Bangladesh during the period covered, the country was affected by the 2015 Gorkha earthquake and two other high-impact earthquakes—a second earthquake in Nepal in 2015, and an earthquake in India in 2016.

TABLE 3: NUMBER OF EVENTS IN TARGET COUNTRIES PER YEAR

Year	Bangladesh	Bhutan	Nepal	Pakistan	Total
2019	6	0	2	5	13
2018	1	0	1	0	2
2017	5	0	3	5	13
2016	3	1	2	8	14
2015	7	1	2	5	15
2014	4	0	4	2	10
2013	3	0	2	5	10
2012	5	0	0	2	7
2011	5	1	3	2	11
2010	5	0	3	8	16
2009	5	3	4	3	15
Total	**49**	**6**	**26**	**45**	**126**

Source: Compiled using data available from EM–DAT: International Disaster Database (CRED 2020).

In 2019, Bangladesh suffered three major disasters of varying intensities:

- Very Severe Cyclonic Storm Bulbul struck the country on November 9 and is reported to have temporarily displaced 2 million people, killed 25 people, and resulted in an estimated US$3.38 billion in losses.
- Monsoon floods struck the country on July 19, affecting about 7.6 million people, including 1,920 refugees in Cox–Bazaar, killing about 119 people, and displacing about 308,000 people (including 208 displaced Rohingya).
- Extremely Severe Cyclonic Storm Fani struck the country on May 19, affecting about 16 million people and killing 17 people. In addition, inundation from heavy rain resulted in breeding grounds for waterborne infectious diseases, posing a health risk to the population.

Given that these disasters occurred recently, the full impact on the health sector is still unknown. Even so, the combined financial cost of these three disasters is estimated to have been significant. Cyclone Fani, for example, was estimated to cost US$63.6 million, with an estimated 13,000 houses damaged.

Although Bangladesh remains highly susceptible to recurring disasters, with an NHVI score of about 3.8, the country has recorded a decline in the mortality rate from disasters linked to hazards such as cyclones. For example, in 2009, Cyclone Aila resulted in about 190 deaths, compared with the 19 deaths in 2019 from Cyclone Bulbul, a cyclone of similar magnitude and impact. This decline is attributable to noticeable progress in the country's disaster management protocols under the CPP, established about 48 years ago. Nevertheless, Bangladesh remains highly vulnerable to climate change, with the country's population and economy being extremely susceptible to fatalities and economic losses due to natural hazards—as reflected by the 4.5 CCVI score and 2.0 NHII score.

In Bangladesh, the Ministry of Disaster Management and Relief (MoDMR) is responsible for coordinating and implementing multi-hazard management activities, while the National Disaster Management Council (NDMC) serves as the national platform for coordinating disaster responses. The CPP is managed by the MoDMR and is widely adopted across the country for disaster preparedness and response. In addition, Health Emergency Operations Centers for the management of public health emergencies exist at the MoHFW and the Institute for Epidemiology Disease Control and Research (IEDCR).

Bhutan

In the past 10 years, Bhutan has been affected by six disasters—two small-scale and four large-scale hazard-induced disasters. These include infectious disease outbreaks (H1N1 pandemic and HPAI H5N1), the 2016 floods that caused damage of about US$8.1 million, 2009 Cyclone Aila, and earthquakes. During the period covered by the analysis, Bhutan was hit by multiple earthquakes, including a severe one that struck the country on September 21, 2009. This 6.1 magnitude earthquake is reported to be the most damaging hazard-induced disaster experienced by the country, affecting a total of 4,614 households and displacing an estimated 7,290 people. Lost infrastructure included 446 houses, 25 health centers and hospitals, 91 educational institutions, and 50 local government offices. Total damages and losses were estimated to be US$52.6 million, while the cost of early recovery, reconstruction, and disaster reduction and recovery were estimated at about US$45.6 million. In addition to the 2009 earthquake, Bhutan has also had to deal with the aftershocks of the 2011 earthquake that hit the Himalayan region bordering north India, Nepal, and Tibet.[15]

Bhutan is reported to have a medium susceptibility to climate change and natural hazards (with a CCVI score of 5.3 and NHVI score of 5.5). The risk to the economy and population due to hazards (NHII score of 6.2) is also ranked as medium.

Following the 2009 earthquake, the government put in place adaptive actions to address these vulnerabilities. This included a holistic DRM framework and the establishment of a multi-hazard EWS. In Bhutan, the Department of Disaster Management (DDM) coordinates DRM-related activities, working closely with the line agencies responsible for specific hazards and response activities.

Nepal

Over 10 years, Nepal has witnessed a number of hazard-induced disasters—26 disasters were identified for the in-depth analysis (14 medium-scale and 12 large-scale). These are linked to geophysical and biological hazards such as infectious disease outbreaks,[16] earthquakes, avalanches, multiple cold waves, heavy rains, storms, flashfloods, and landslides), with the most devastating being the 2015 7.8 magnitude Gorkha earthquake and resulting aftershocks. Box 1 highlights the impact of the 2015 earthquakes on Nepal's health sector. Nepal's vulnerability to natural hazards, and hazard-induced disasters is captured in its ranking as the fourth most climate vulnerable country in the world (based on the CCVI score of 4.0) (Verisk Maplecroft 2019), its high susceptibility to the impacts of hazards (NHVI score of 3.6), and the higher vulnerability of its economy and population to economic losses and fatalities (NHII score of 2.8).

BOX 1: IMPACT OF THE 2015 EARTHQUAKES ON NEPAL'S HEALTH SECTOR

The April 2015 Nepal earthquake (also known as Gorkha earthquake) had a magnitude of 7.8, killed more than 8.800 people, and injured about 22,000 across 30 of the country's 75 provinces, including the capital city, Kathmandu. The earthquake epicenter is shown in Figure 5.[17] On May 12, a magnitude 7.3 aftershock struck 76km east of Kathmandu, killing more than 100 people, and injuring nearly 1,900. The earthquake-induced disaster caused widespread damage to multiple sectors: health, food, and disaster management; education; housing and shelter; agriculture Infrastructure; and water, sanitation, and hygiene.

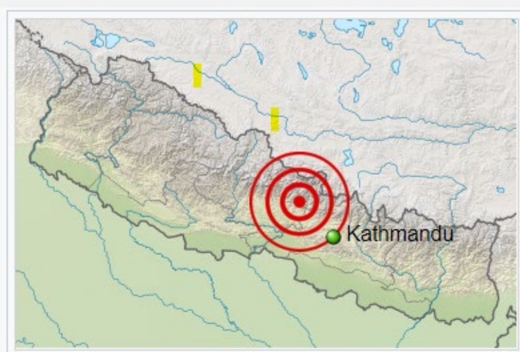


FIGURE 5: EARTHQUAKE EPICENTER

In the health sector, 1,227 health facilities were affected, with at least 450 completely destroyed. This included 32 percent of maternal, neonatal, and child health (MNCH) facilities. In addition, 18 health workers and volunteers were killed and 75 injured. The earthquake-induced disaster exposed the vulnerability of the health sector, as reflected in delayed delivery of basic healthcare services, in particular, routine health services such as antenatal care visits, MNCH treatment,

15 The 4.7 magnitude earthquake that occurred in 2019 did not have any major impact and was excluded from the in-depth analysis due to missing data.

16 Of the four countries, Nepal was the most affected by the 2009 H1N1 pandemic—172 confirmed cases of the 609 patients tested at the public health laboratory.

17 https://en.wikipedia.org/wiki/April_2015_Nepal_earthquake. Accessed: November 12, 2020.

care and support of the HIV infected population, and access to tuberculosis treatment. Overall, the estimated total value of damages and losses to the health sector was reported to be about 5.96 billion Nepalese rupees (US$59.6 million) while the health sector recovery and reconstruction needs following the earthquakes were estimated at 11.27 billion Nepalese rupees (Goyet et al. 2018; Government of Nepal 2015).

Prior to the 2015 earthquake, some effort had been placed on adaptive emergency preparedness actions, such as the 2013 establishment of a health emergency operations center (HEOC) within the Ministry of Health and Population (MoHP), and a structural and nonstructural assessment of health facilities to minimize the risks of potential disasters. Following the 2015 earthquakes, a central information management unit under the HEOC was established as an adaptive emergency response measure to work alongside the central natural disaster relief committee, specifically to allow for the compilation of health service delivery-related information and to implement a hospital-based surveillance system.

In Nepal, disaster preparedness and response activities are typically coordinated by the Ministry of Home Affairs (MoHA), while the MoHP is responsible for implementing health sector responses. Establishing the HEOC within the MoHP was an effective arrangement for managing the health sector response to the Gorkha earthquake. However, for past health emergencies, there were gaps in the provision of health services and disease surveillance reporting, which called for establishing a central information management unit under the HEOC (Goyet et al. 2018). These arrangements have encouraged a positive shift in the focus of coordination and disaster management efforts from emergency response to implementation of health sector recovery and resilience-building activities.

Notwithstanding, the analysis revealed that in the past, the government gave more priority to relief and response operations than a DRM comprehensive approach (Ministry of Home Affairs 2019). As of November 2019, Nepal was the only one of the four target countries that had yet to establish a national disaster management authority (NDMA). In lieu of a national disaster management authority, Nepal formed a national reconstruction authority following the Gorkha earthquake in 2015 (Kafle 2017). With the increasing prioritization of disaster management by the government, the National Disaster Risk Reduction Management Authority (NDRRMA) was established in December 2019. It works under direct oversight of the Executive Committee and is chaired by the Minister of Home Affairs.

Pakistan

Pakistan recorded a total of 45 hazard-induced disasters (6 small-scale, 22 moderate-scale, and 17 large-scale). From 2009 to 2015, several heavy rains and floods occurred, with the 2010 flood-induced disaster the most severe—it affected over 20 million people. There were multiple geophysical hazards (and associated disasters) over the past 10 years; these include floods in 2011 (affecting more than 16 million people), flashfloods in 2013, heavy rains and glacial lake outburst floods in 2015, and a heatwave in 2015 that resulted in about 2,000 deaths in Karachi—the largest city in Pakistan—and that overwhelmed medical and cadaver management facilities. In addition to the 2009 H1N1 pandemic, multiple infectious disease outbreaks were reported in the country. These included Crimean Congo hemorrhagic fever (CCHF), dengue fever, cholera, and typhoid—caused by multiple floods that hit the country—in addition to outbreaks of human immunodeficiency virus (HIV). The 2010 flood-induced disaster in Pakistan resulted in structural damage to health facilities, mortality and injury to health care providers, and disruptions to health service delivery (see Box 2 on the impact of the floods on the country's health sector).

Box 2: Health Sector impact of 2010 floods in Pakistan

The 2010 flood-induced disasters (Figure 6)[18] in Pakistan damaged or destroyed 460 health facilities, displaced 35,000 lady health workers, led to the collapse of health system management capacity at the local (district) level, and resulted in a lack of skilled health workers both in regular and in temporary health facilities. Affecting about 20 million people and causing 2,000 deaths, the large-scale disaster resulted in an increase in the number of cases of waterborne diseases reported by the country's disease EWS. Preliminary damages and needs assessment estimated the costs at US$6.799—8.915 billion (UN 2011).

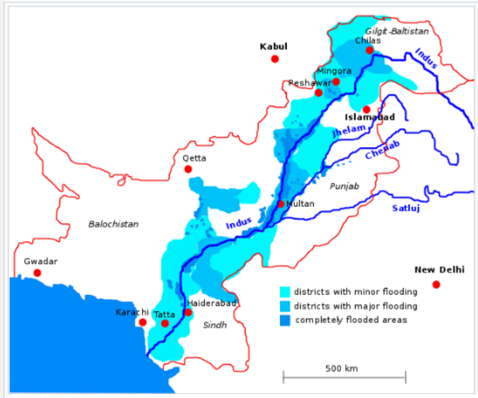


Figure 6: Areas affected by flooding (as of Aug 26, 2010)

More recently, Pakistan has dealt with multiple outbreaks of infectious diseases. From July 8 to November 12, 2019, a total of 47,120 confirmed cases of a dengue fever outbreak (including 75 deaths) were reported from its four provinces, one of two territories, and its capital territory.[19] The outbreak called for the activation of the National Institute of Health's EOC, for close monitoring of the event, and the development of a comprehensive dengue response plan that addresses case management, surveillance, vector control, and community mobilization. During the same year, there was a severe outbreak of HIV in Larkana District of Pakistan—classified by the WHO as a health emergency—with 876 positive cases (from a total of 30,192 screened) of which 82 percent (719 of the 876) were children below the age of 15 (WHO 2019a). The multiple infectious disease outbreaks in Pakistan over the past decade highlight the importance of improving clinical and case management of patients with hemorrhagic fever, clinical management of severe dengue fever, and strengthening control measures to prevent nosocomial infections in health care settings through the utilization of high-impact interventions.

Pakistan's high vulnerability to climate change and natural hazards is captured in both the CCVI (4.12) and NHVI (3.58) scores. To address the increasing frequency of natural disasters and biological hazards that cause devastating impacts to the country's population and economy (reported as extremely susceptible to natural hazards with a NHII score of 2.4), the government has put in place adaptive actions such as implementing community-based DRM preparedness activities.

In Pakistan, the NDMA is the federal authority mandated to deal with hazards. It uses multidisciplinary collaboration in responding to disasters, with involvement from the military, provincial government, and various sector clusters (including collaboration with nongovernmental organizations). With the Central and District Disaster Relief Committees taking the lead on response efforts and emphasizing early recovery as part of its response, this approach allowed for a sustained and coordinated two-pronged approach to disaster response between the government and development partners during the 2010 floods. However, following the floods, and because of the complexities in managing a large cluster, an interagency disaster management team was established to improve preparedness and response to disasters, through an integrated

---

18 https://en.wikipedia.org/wiki/2010_Pakistan_floods. Accessed Nov 12,2020

19 Khyber Pakhtunkhwa (KPK), Punjab, Baluchistan, and Sindh; Azad Jammu and Kashmir (AJK); and Islamabad Capital Territory (ICT), respectively.

approach. Under the National Disaster Management Act, the Provincial Disaster Management Authority (PDMA) serves as the coordinating authority for the management and response to disasters and calamities at the provincial and local level, and provides a platform for all provincial departments to gather and strategize about disaster recovery and long-term rehabilitation needs.

Disaster Responses and lessons learned

Disaster responses across the target countries and lessons learnt are discussed below. These are organized based on four key interventions which emerged during the analysis and literature review, as evidence-based approaches to reducing disaster risk.[20]

i. Establishment of integrated early warning systems
ii. Improving multi-hazard preparedness
iii. Adoption of whole-of-society approaches to disaster preparedness, recovery and response
iv. Conducting and learning from after-action reviews

i. Establishment of integrated early warning systems

Functional EWS have proven effective in preventing, preparing for, and responding to hazards, thereby reducing the impact of disasters, including public health emergencies. As summarized in Table 4, all four countries have EWS in place.

Table 4: Status of EWS Across Target Countries

Bangladesh	Bhutan	Nepal	Pakistan
○ Cyclone Preparedness Program EWS scaled up into a multi-hazard program to address different natural disasters. ○ Integration of EWSs that monitor and provide early warning of extreme weather events into emergency preparedness systems.	○ EWS typically used only for event-specific monitoring.	○ Central information management unit under the Health Emergency Operations Center (HEOC) responsible for compilation of health service delivery-related information and for the initiation of a hospital-based surveillance system. ○ GIS mapping of health facilities to easily identify locations and to stay updated on the status of health facilities post-emergency.	○ Resource mobilization supported by the government for the establishment of a community-based EWS. ○ Use of disease EWS supported by WHO to monitor infectious disease outbreak trends and to identify threats of epidemic-prone diseases early on.

Bangladesh has had an integrated EWS in place for over 40 years. The Bangladesh CPP was established in 1972 to address the country's vulnerabilities to cyclones and is considered a success story (Box 3). It is a vital part of the country's multi-hazard EWS.

[20] Interventions are consistent with the Sendai Framework for Disaster Risk Reduction (2015–30) and the 2019 WHO Health Emergency Disaster and Risk Management framework.

Box 3: A Success Story: The Bangladesh Cyclone Preparedness Program

Six cyclones of varying intensities hit Bangladesh over the 10-year period, 2009-19. The CPP has been widely adopted and provides effective responses to cyclones. The effective and timely evacuation of affected populations (about 2.1 million people) to safe temporary shelters in November 2019, before Cyclone Bulbul made landfall (UN 2019a), has been attributed to the CPP. This disaster response helped to significantly reduce morbidity and mortality from the cyclone hazard—the death toll from the event was estimated at 19. (see Table 5)

Over the years, using the CPP's data collection mechanism to closely monitor epidemiological patterns, has helped policy makers identify population vulnerabilities, track causes of morbidity and mortality, and implement evidence-based practices in emergency preparedness and disaster management. Given the success of the CPP, the government is planning to expand the geographical coverage of the program, and to grow its volunteers over the next five years—from 55,000 to 200,000—so that it can tackle a range of other natural hazards, including earthquakes and floods (United Nations Office for Disaster Risk Reduction 2019).

Table 5: Cyclone Occurrence and Estimated Reduction in Mortality

Event	Year	Magnitude	Estimated total population affected (in millions)	Estimated mortality
Cyclone Aila	2009	Severe	3.9	190
Cyclone Bijll	2009	Weak	0.02	7
Cyclone Roanu	2016	Relatively weak	1.3	24
Cyclone Mora	2017	Severe	3.3	7
Cyclone Bulbul	2019	Severe	3.5	19
Cyclone FANI	2019	Most severe	16	17

Source: UNDRR Prevention web.

In the case of Bhutan, the post-disaster needs assessment (PDNA) carried out following the 2009 earthquake recommended establishing a multi-hazard early warning system (MHEWS), and an interconnected network of EOCs at the national, district, and subdistrict levels. However, a MHEWS is yet to be established, with the EWS that is in place is typically used only for event-specific monitoring.

Nepal has made progress in setting up EWS for hydrometeorological hazards, including early warning about floods in 10 major river basins of the country, covering mostly the Terai region. In addition, and in response to the Gorkha earthquake, the hospital-based surveillance system was strengthened.

In Pakistan, following the 2010 floods, the government prioritized financing the establishment of a community-based EWS in 81 of the worst flood-affected districts (out of 154). Provinces, such as Khyber Pakhtunkhwa province, where people were trained in community-based DRM—including the use of community-level EWS—were better prepared to respond to events such as monsoons and heavy rains. In the same year, the WHO, in collaboration with the Ministry of National Health Services, Regulation and Coordination and the Pakistan NIH implemented the Disease Early Warning System (DEWS), which functions as the main national surveillance system for infectious disease outbreak, detection and response. Findings from a 2011 evaluation provide evidence of the success of the DEWS for outbreak detection and surveillance data reporting at the health facility level, with the system reported to be an "invaluable resource for epidemic control in Pakistan" (WHO 2011).

Although each of the target countries has EWS in place, to some extent, the analysis revealed that the integration of EWS into surveillance systems, such as influenza surveillance systems, could be enhanced. This would allow the burden of disease outbreaks to be better defined, and improve spotting of trends in seasonality, thereby strengthening the forecasting of future outbreaks. In Bangladesh, for instance, a reported gap in the response to multiple cyclones is the need for a robust surveillance system pre- and post-disaster. Such a system is needed to create a baseline and to improve the capacity of the current health system to accurately assess and understand the precise effects of disasters and to maximize relief efforts. Meanwhile, in the case of Bhutan, a gap highlighted during the response to the H1N1 pandemic was the need for a national influenza surveillance center and for sentinel surveillance to improve the early detection and testing capacity of the public health laboratory for rapid case confirmation of infectious diseases.

The enhancement and regular assessment of integrated early warning and surveillance systems, together with investments in MHEWS, could be integrated with risk analysis and prediction science and forecasting) technology; for example, hazard preparedness and geographic information systems (GIS). This would enable countries to better prepare for and respond to natural disasters and outbreaks of infectious diseases. Outbreaks include both those that follow disasters because of heightened risk of disease spread, and those that occur as a result of climate-induced changing weather patterns. While Nepal, for example, was successful in using GIS technology to map and track the status of health facilities during and after the Gorkha earthquake, a lesson that emerged, following that event, was the importance of using modern technology for future events, strategic communication, and risk mapping tools to keep track of and reduce disaster risks and mortality. Along these lines, artificial intelligence (AI) technology could also be adopted to integrate meteorological information from EWS with climate-sensitive health programs, in order to better anticipate infectious disease outbreaks, especially those following a natural disaster. With the advent of the Internet of Things and advanced technology driven sensor devices, for example, AI can enable EWS to mine early warning signals from this data, so that proactive and preventive measures can be planned leading to timely alerts and warnings being disseminated to relevant stakeholders (Lamsal and Kumar 2020).

ii. Improving multi-hazard preparedness

Enhancing health-sector capacity for emergency preparedness is a critical aspect of ensuring resilience to multi-hazards. The analysis revealed that each country has some emergency preparedness capacities in place (see Table 6), which, in the cases of Bangladesh, Bhutan and Pakistan, correspond to assessed capacities under the IHR JEE. Notwithstanding existing capabilities, the analysis revealed gaps relating to multi-hazard governance arrangements, contingency planning and sustainable financing, and health sector emergency preparedness. Each of these are discussed below.

TABLE 6:MULTI-HAZARD PREPAREDNESS MEASURES ACROSS TARGET COUNTRIES

Bangladesh	Bhutan	Nepal	Pakistan
○ EOCs in place. ○ Prioritization of the vaccination of health workers and development of a list of essential medicines and supplies to support response efforts.	○ Set up of interconnected networks of EOCs. ○ Approved NAPHS in place.	○ Implementation of disaster preparedness activities by the MoHP. ○ Set up of HEOCs ○ Structural and nonstructural assessment of health facilities	○ Establishment of fully equipped control rooms to coordinate operations for future disasters. ○ Approved NAPHS in-place.

- ***Multi-hazard governance arrangements***

As noted above under the country profiles, each country has institutional arrangements in place to deal with multi-hazards. This includes having EOCs in place, as shown in Table 6. Following the 2009 earthquake in Bhutan, for example, an interconnected network of district and national EOCs was established by the government between 2010 and 2015, improved the country's preparedness to deal with disasters, including public health emergencies. Similar measures were implemented in Nepal in 2013. Disaster preparedness activities were implemented by the MoHP including establishment of a health EOC within the MoHP, with the support of WHO and other development partners. In addition, to minimize the risk of potential disasters in Nepal, structural and nonstructural assessment of some health facilities were conducted in order to assess disaster risk. Meanwhile, in Pakistan, fully equipped control rooms were established to coordinate operations for future disasters. Notwithstanding existing multi-hazard institutional arrangements, the analysis revealed the need for multi-hazard (multisectoral) disaster governance arrangements to be established and enhanced in an effort to build the capacity for institutional efficiency in all aspects of DRM—preparedness, response, recovery, and reconstruction—in accordance with the 2019 WHO HEDRM Framework.

- ***Contingency planning and sustainable financing***

Of the four countries, Pakistan and Bhutan have approved NAPHS, with Pakistan's NAPHS currently being updated. The development and implementation of a costed and financed action plan for building resilient health systems, with clearly defined measurable outcomes—and closely aligned with findings from the country's JEE—could contribute toward addressing gaps in emergency preparedness and response capacities. Action plans should highlight the need for available contingency financing for disaster preparedness and response and should include periodic simulation of the operational readiness of national health emergency and (multi-hazard) disaster contingency systems, which were found to be generally lacking.

- ***Health sector emergency preparedness***

With regards to health-sector emergency preparedness, the analysis revealed limited numbers and capacity of health care providers in biopreparedness and infectious disease outbreak prevention, management, and control. This points to the need to prioritize health care workers in preparedness and response efforts as key to ensuring that health systems can properly manage the impact of disasters and to avoiding disruptions to essential health service delivery functions (including core laboratory functions) during health emergencies. Capacity building should prioritize the importance of patient trust in health delivery systems during disease outbreaks, including those with epidemic and pandemic potential.

In Pakistan, for example, a lesson learned from the 2019 dengue outbreak was the need for a comprehensive dengue response plan that covers case management, dengue surveillance, vector control, and community mobilization and coordination. Similarly, a case-control study conducted by WHO to identify the cause and source of the 2019 outbreaks of HIV in Pakistan revealed that the new HIV infections were due to poor infection prevention control practices in health facilities—including unsafe intravenous injections during medical procedures—and improper collection, storage, segregation, and disposal of hospital waste (WHO 2019a). Similarly, a lesson learned during the 2009 H1N1 pandemic by Bangladesh, Nepal, and Pakistan was the importance of improving the capacity of healthcare providers to maintain service delivery for EHNS, and whilst ensuring that appropriate disease-responsive care is provided. Although about 15 million H1N1 vaccine doses were donated to Bangladesh, for example, the importance of influenza prevention through vaccines was not leveraged because health care providers had problems accessing vaccine stockpiles and following prevention and treatment guidelines.

These examples highlight the importance of regular sensitization training and capacity building of health care providers in key areas such as epidemic and pandemic preparedness—and infection prevention, case management, and control. In addition, focus should also be placed on assessing emergency preparedness and response capacities—both technical and fiduciary—at the national and sub-national levels and ensuring the availability of clearly defined procedures for procurement and resource mobilization as part of preparedness efforts.

iii. Adoption of whole-of-society approach to disaster preparedness, response and recovery

All four countries prioritized a whole-of-society approach to disaster preparedness, response and recovery that focused on community empowerment and resilience building. A whole-of-society approach- which assumes that no single entity has the capacity to successfully manage the dynamic, complex problems that arise in the event of a disaster (including a pandemic environment)- is critical in ensuring sustainable emergency preparedness through effective multisectoral collaboration and community engagement. This approach allows for application of the build-back-better (BBB) principle, and improved resilience to future hazards, including public health emergencies. The BBB principle calls for the adoption of a post-disaster recovery approach that reduces vulnerabilities to future disasters and builds resilience among communities to address physical, social, economic, and environmental vulnerabilities and shocks.

Whole-of-Society approaches adopted across target countries are summarized in Table 7. Following the 2010 floods, Pakistan adopted a whole-of-society approach to disaster response by integrating a multi-cluster rapid assessment mechanism that combined various sectors to jointly determine the needs of affected populations. Additionally, emphasis on early recovery as part of the response efforts—via the formation of an early recovery working group—allowed for a sustained and coordinated two-pronged approach to relief and early recovery between the government and UN agencies.

In the case of Bangladesh and Bhutan, integration of DRM strategies into existing development strategies was important for ensuring an effective whole-of-society approach. For example, in response to the 2016 floods in Bhutan, the government developed the Health Emergency and Disaster Contingency Plan, and the Strategic Program for Climate Resilience (SPCR), which identifies a framework for integrating climate resilience into national development planning. Although our analysis did not fully capture Bhutan's community-level response to hazards, and hazard-induced disasters—or compare it to the other three target countries—the District-level Disaster Management Plan prepared by the Department of Disaster Management (DDM) adopts a community-based approach. Furthermore, the RGoB has implemented the BBB principle in its comprehensive guidelines on the vulnerability assessment of health facilities.

Similarly, in the case of Nepal, a key lesson learnt following the Gorkha earthquake was that recovery efforts should follow a community-based approach that empowers communities, encourages self-reliance, and uses local skills and knowledge. In addition, an independent national reconstruction authority was formed—in line with the BBB principle—that is responsible for rolling out recovery and reconstruction strategy and policy under three frameworks—immediate, intermediate, and medium term.

TABLE 7: WHOLE-OF-SOCIETY APPROACHES

Bangladesh	Bhutan	Nepal	Pakistan
o Community engagement and localized decision-making in accordance with community priorities. o Mobile phone usage to provide early warning to communities, assess health status and needs, and provide advice on minimizing post-disaster risk to health. o Cash scheme through employment generation program for the poorest and most vulnerable populations. o Creation of cyclone shelters embedded into efforts to train local volunteers and educate communities about EWS. o Integration of disaster recovery and resilience into poverty reduction strategy o Disaster relief/response facility in place	o Establishment of a holistic DRM framework. o Development of SPCR document strategic framework for integrating climate resilience into national development planning. o Development of health emergency and disaster contingency plan. o Development of guidelines on vulnerability assessment of health facilities.	o Public awareness raising campaigns. o integration of community-based disaster reduction programs into routine public health programs. o Building local capacity during Gorkha earthquake via training of local medical doctors to augment disaster recovery efforts of health authorities and continuous health service delivery to ensure sustainability. o Collaborating with customs to set up an arrangement for medicine and equipment release at the international airport to ensure speedy release of drugs and medical equipment and to channel other health-related international support measures. o Development of new Disaster Management Act; this focuses on coordination from emergency response to implementation of health sector recovery activities. o Establishment of an Independent National Reconstruction Authority. o Adoption of the recovery and reconstruction strategy under three implementation frameworks.	o Multidisciplinary approach for an effective response, in collaboration with the military and various sector clusters. o Natural Disaster Board Game project integrated into school activities. o Free diagnostics and clinical management of dengue fever made available in all provinces. o Training of trainer models for building capacity of communities for disaster response (and collaboration with nongovernmental organizations). o Development of the Revised Pakistan Floods Emergency Relief and Recovery Plan. o Transformation of relief efforts into long-term recovery of health facilities.

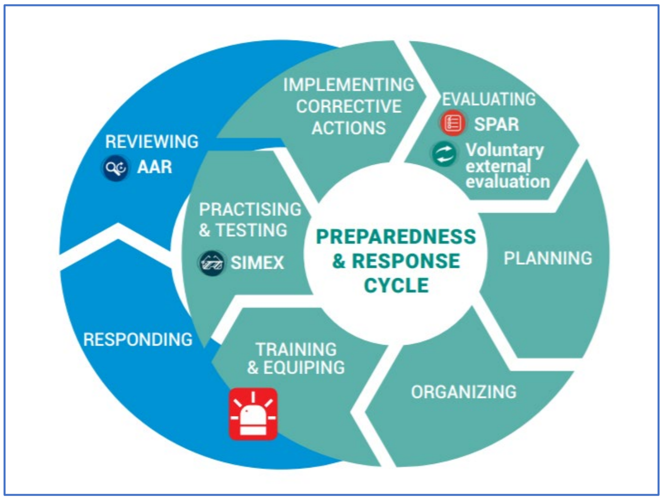
Notwithstanding evidence of multisectoral collaboration across the target countries through whole-of-society approaches, the existence of multisectoral multi-hazard preparedness and response framework, and associated action plans was an identified gap. While Bhutan, for example, has developed and implemented a Health Emergency and Disaster Contingency Plan, and Bangladesh has integrated disaster recovery and resilience into its poverty reduction strategy, there is a need to develop and operationalize a joint and overarching action plan for DRM that can be linked to existing action plans such as the NAPHS.

Action plans and strategies should cover vulnerable populations that are typically the most affected by disasters, including health emergencies, and should include the implementation of DRM activities (including community-based activities) at the health facility level in preparation for hazard-induced health emergencies (linked to climate hazards, for example) to ensure availability and maintenance of essential services such as water, sanitation, and electricity during extreme weather events. The WHO hospital safety index tool, for example, should be systematically implemented to reduce disaster risk, by ensuring that earthquake-resistant infrastructure, for example, is in place to prevent catastrophic consequences of disasters such as the Gorkha earthquake. This would be consistent with BBB principles, and would allow DRR programs to be routinely integrated into public health service delivery functions, thereby providing a thrust for sustainable emergency preparedness.

iv. Conducting and learning from after-action reviews

Of the four countries, only Pakistan has conducted an AAR in the past 10 years. This was carried out in May 2018 to glean lessons learned from the June to December 2017 dengue fever outbreak response efforts. A second AAR was scheduled to review responses to the 2019 HIV outbreak. An effective action taken in response to the HIV outbreak was registering public and private hospitals on the Punjab Information Technology Board (PITB) for case reporting and creating a dashboard for case mapping under the PITB.

FIGURE 7: AAR IN THE PREPAREDNESS AND RESPONSE CYCLE



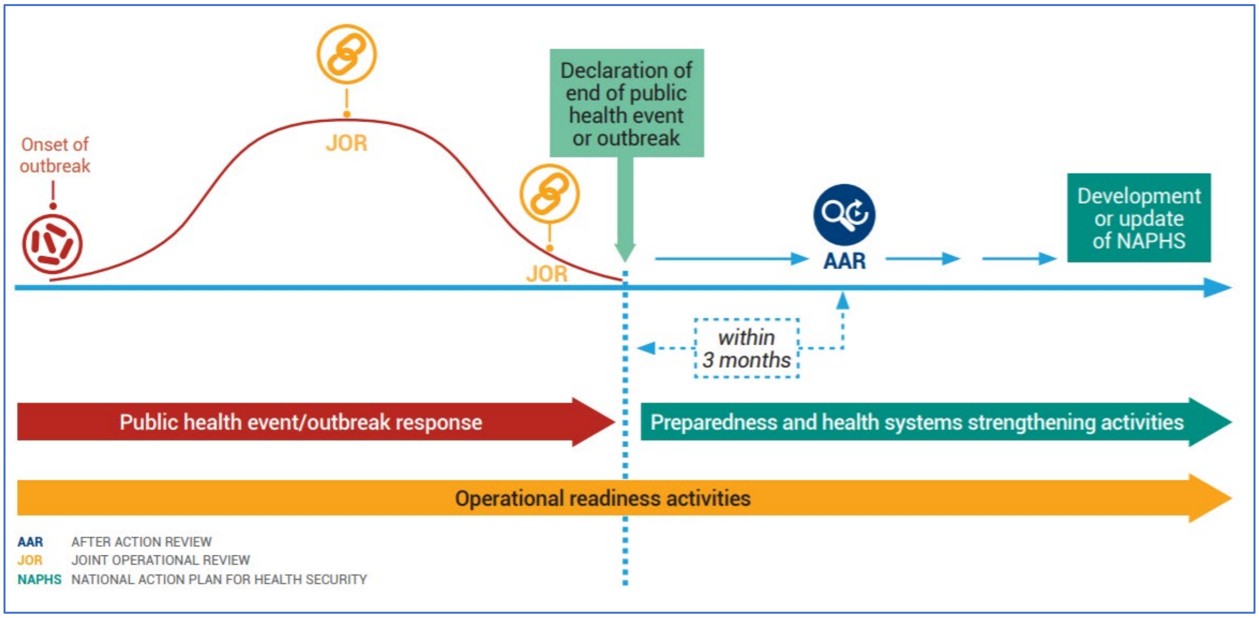
Source: WHO 2019(c)

The AAR is one component of the International Health Regulations (IHR) (2005) Monitoring and Evaluation Framework.[21] An AAR is an effective strategy for improving preparedness and responses to hazard-induced disasters, including public health emergencies. It provides an opportunity to review the functional capacity of public health and emergency response systems and to identify practical areas for continued improvement. It can be implemented as part of the preparedness and response cycle illustrated in Figure 7 (WHO 2019(c)). Specifically, an AAR serves the overarching purpose of: (a) identifying gaps and documenting best practices and challenges during a response to a disaster, including a public health event; (b) identify areas and actions for improvement; and (c) sheds light on lessons learned about the contributions of various actors to response efforts.

In the case of a public health emergency, in particular, the aim of an AAR is to: (a) identify corrective actions that need to be implemented immediately to ensure better preparation for, and response to, the next public health event; and (b) medium-and-long-term actions needed to strengthen and institutionalize the necessary capabilities of the public health system (WHO 2019c). AAR findings can be used to revise DRM management and health preparedness and response. Notably, while an AAR is carried out immediately after the public health event or outbreak is officially declared over, joint operational reviews are conducted during the response to public health events or outbreaks, or at the end of the response (see Figure 8).

[21] The Framework comprises a mixed approach of qualitative and quantitative data collection and analysis, as well as desk reviews and functional assessments of capacities for prevention, preparedness, detection and response. It has four components. Of these, only the State Party self-assessment annual reporting (SPAR) is obligatory. The other three components – the voluntary external evaluation, the AAR, and the simulation exercises – are voluntary (WHO 2019(c)).

Figure 8: Timeline for Conducting Joint Operational Reviews and AAR



Source: WHO 2019(c)

Recommendations

The analysis revealed that countries have multi-hazard preparedness and response capacities in areas such as early warning and surveillance systems, emergency operations centers, and whole-of-society approaches to disaster preparedness, response, and recovery. Notwithstanding, the analysis also revealed gaps across each country in their capacity to detect, prepare for, respond to, and recover from hazard-induced disasters, including public health emergencies. These gaps, together with lessons learnt inform the recommendations that are posited below. With regards to public health emergencies, in particular, these recommendations should help to improve health sector resilience by: (a) reducing the disaster risk posed by multi-hazards, and consequently, the effectiveness of disaster risk reduction approaches; (b) increasing the ability of the health sector to withstand and better manage future shocks to health systems arising from disasters; and (c) mitigating against disruptions to health service functions during and after a disaster.

(a) Establishment and enhancement of integrated multi-hazard EWS through:

a. *Integration of EWS into surveillance systems* (e.g. influenza surveillance, and emergency management systems). This would allow the burden of disease outbreaks to be better defined, and improve spotting of trends in seasonality, thereby strengthening the forecasting of future outbreaks.

b. *Integration of multi-hazard EWS with risk analysis and prediction science*; for example, hazard preparedness and geographic information systems (GIS). Artificial intelligence technology could also be adopted to integrate meteorological information from EWS with climate-sensitive health programs, in order to better anticipate infectious disease outbreaks, especially those following a natural disaster.

(b) Improving multi-hazard preparedness through:

a. *Developing and implementing action plans for building health sector resilience to hazards, and ensuring contingency planning and financing for hazard and disaster* *preparedness and response* at the national, subnational, and health facility levels: A costed and financed action plan, with clearly defined measurable outcomes—and closely aligned with findings from a country's joint external evaluation— could contribute toward addressing gaps in emergency preparedness and response capacities. Contingency planning should include periodic simulation of the operational readiness of national health emergency and (multi-hazard) disaster contingency systems

b. *Continuous capacity-building of health care workers* (on, inter alia, emergency management, infection prevention, case management, and control) to improve knowledge and competencies to effectively manage the impact of disasters and to avoid disruptions to essential health service delivery functions (including core laboratory functions) during health emergencies.

c. *Establishing and enhancing disaster governance structures to build institutional capacity in all aspects of DRM—preparedness, response, recovery, and reconstruction*—in accordance with the 2019 WHO HEDRM Framework. Implementation of DRM activities (including community-based activities) at the health facility level in preparation for hazard-induced health emergencies (linked to climate hazards, for example) could ensure availability and maintenance of essential services such as water, sanitation, and electricity during extreme weather events. Additionally, in line with the BBB principle, this could include enforcement of the WHO hospital safety index tool to reduce disaster risk, by ensuring that seismic-resistant infrastructure, for example, is in place to prevent catastrophic consequences of disasters.

(c) Adoption of an integrated and inclusive whole-of-society approach to prevent new hazard exposure and reduce existing disaster risk should be prioritized. The analysis showed evidence of multisectoral collaboration and community engagement across the target countries, and revealed the importance of:

a. *Developing multisectoral multi-hazard preparedness and response action plans to promote and ensure institutionalization of an integrated multi-hazard management framework*. Development and operationalization of a joint national action plan for DRM, for example, could be linked to existing country strategies and action plans—such as the NAPHS, and poverty reduction strategies. The latter should appropriately cover vulnerable populations that are typically the most affected by disasters, including health emergencies.

b. *Promoting preparedness and recovery efforts through a community-based approach* that empowers communities, encourages self-reliance, and uses local skills and knowledge.

(d) Systematic implementation and institutionalization of after-action reviews (AARs). As recommended by WHO, and using WHO guidelines, it is important that countries prioritize and institutionalize an AAR following a public health emergency (WHO 2019c). An AAR ensures that corrective actions needed to address and incorporate lessons from past public health events are properly considered, and it is particularly important and helpful for countries that are prone to hazards. The findings from AARs can be used to continuously revise and update DRM and health sector policies and plans.

REFERENCES

Cash, R.A., S.R. Halder, M. Husain, M.S. Islam, F.H. Mallick, M.A. May, M. Rahman, and M.A. Rahman. 2013. "Reducing the Health Effect of Natural Hazards in Bangladesh." *Lancet* 382 (9910): 2094-2103. DOI: 10.1016/s0140-6736(13)61948-0.

Center for Biosecurity and Biopreparedness. 2019. *An Introduction to Biopreparedness*. Copenhagen: Center for Biosecurity and Biopreparedness.

CRED (Centre for Research on the Epidemiology of Disasters). 2018. "EM–DAT: The International Disaster Database." (Accessed 07 February 2020), http://www.emdat.be.

Global Facility for Disaster Reduction and Recovery (GFDRR). 2020. "Nepal." (Accessed June 2020), https://www.gfdrr.org/en/nepal.

Government of Nepal National Planning Commission. 2015. *Nepal Earthquake 2015: Post Disaster Needs Assessment, Vol. A, Key Findings*. Kathmandu: Government of Nepal.

Goyet, S., R. Rajan, B. Gyawali, B. Shrestha, G. Lohani, D. Adhikari, E. Salvador, R. Ofrin, J. Vandelaer and R. Samuel. 2018. "Lessons from the Field: Post-Earthquake Health-Service Support, Nepal." *Bulletin of World Health Organization* 96 (4): 286-91.

Kafle, S. 2017. "Disaster Risk Management Systems in South Asia: Natural Hazards, Vulnerability, Disaster Risk and Legislative and Institutional Frameworks," *Journal of Geography and Natural Disasters* 7(3): 2167–0587.

Kruk, M.E., M. Myers, S.T. Varpilah, and B.T. Dahn. 2015. "What Is a Resilient Health System? Lessons from Ebola." *Lancet* 385 (9980):1910–1912.

Lamsal R., Kumar T.V.V. (2020) Artificial Intelligence and Early Warning Systems. In: Kumar T.V.V., Sud K. (eds) AI and Robotics in Disaster Studies. Disaster Research and Management Series on the Global South. Palgrave Macmillan, Singapore. https://doi.org/10.1007/978-981-15-4291-6_2.

Ministry of Health, Royal Government of Bhutan. 2016. *Health Emergency and Disaster Contingency Plan: Plan for Health Sector Disaster Preparedness and Response in Bhutan*. Thimphu: Ministry of Health.

Ministry of Home Affairs, Government of Nepal. 2018. *Nepal Disaster Report 2017: The Road to Sendai.* Kathmandu: Government of Nepal.

_______. 2019. *Nepal Disaster Report 2019*. Kathmandu: Government of Nepal.

Ministry of Home Affairs and Disaster Preparedness Network, Government of Nepal. 2015. Nepal Disaster Report 2015. Kathmandu: Government of Nepal.

National Statistics Bureau, Royal Government of Bhutan. 2019. "City Population," March. Available: https://www.citypopulation.de/Bhutan.html.

Pelling, M. 2003. *The Vulnerability of Cities*. London: Earthscan.

PreventionWeb. 2013. Disaster Management Bureau 2013. (Accessed 2020), http://www.preventionweb.net/english/.

Relief Web. 2019. "NPM–ACAPS Analysis Hub," March 2018. (Accessed 12 December 2019), https://reliefweb.int/sites/reliefweb.int/files/resources/20180326_npm-acaps_analysis_hub_thematic_report_cyclones_background_rohingya_crisis.pdf.

Royal Audit Authority, Government of Bhutan. 2016. *Performance Audit of Disaster Management*. Thimpu: Government of Bhutan.

S.S. Dubb (2020). “Coronavirus pandemic: applying a whole-of-society model for the whole-of-the world.” *British Journal of Oral and Maxillofacial Surgery* 58: 838–842.

UNISDR (United Nations International Strategy for Disaster Reduction). 2015. *Global Assessment Report on Disaster Risk Reduction.* preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf.

United Nations. 2015. *Sendai Framework for Disaster Risk Reduction (2015–2030).* Geneva: United Nations.

________. 2017. “Terminology: Build Back Better.” https://www.preventionweb.net/terminology/view/51750.

________. 2019a. "UNDRR Regional Office for Asia and Pacific." (Accessed 2020), https://www.undrr.org/news/bangladesh-goes-beyond-cyclones.

________. 2019b. "Prevention Web: The Knowledge Platform for Disaster Risk Reduction." (Accessed December 2019), http://preventionweb.net/news/view/69571.

United Nations Department of Economics and Social Affairs. 2019. "World Population Prospect, November 2019.” (Accessed January 2020), https://population.un.org/wpp/.

Verisk Maplecroft 2019, "Verisk Maplecroft Climate Change Vulnerability." (Accessed 06 February 2020), https://portal.maplecroft.com/portal/#/portal/aod/scorecards/index/Climate__Change__Vulnerability/overview.

WHO (World Health Organization). 2005. *International Health Regulations, Third Edition*. https://apps.who.int/iris/bitstream/handle/10665/246107/9789241580496-eng.pdf;jsessionid=5E215B8FDB23492DEC80ED7C82C50876?sequence=1.

________. 2011. *Evaluation of the Disease Early Warning System in Crisis-Affected areas of Pakistan.* Geneva: WHO.

________. 2018. “Ebola Health Worker Infections.” http://www.who.int/features/ebola/health-care-worker/en/.

________. 2019a. "Emergencies Preparedness and Response: Disease Outbreak News," (Accessed February 2020), https://www.who.int/csr/don/en/.

________. 2019b. Health Emergency and Disaster Risk Management Framework. Geneva: WHO.

________. 2019c. *Guidance for After Action Review*. Geneva: WHO. https://extranet.who.int/sph/docs/file/3472.

________. WHO. 2020. *Global Disease Outbreak News*. (Accessed March 2020), https://www.who.int/csr/don/en/

________. 2020. “Surveillance: Early Warning Alert and Response Systems,” 2020. (Accessed June 2020), https://www.who.int/emergencies/surveillance/early-warning-alert-and-response-system-ewars.

World Bank. 2012. Disaster Risk Management in South Asia: A Regional Overview. Washington DC: The World Bank.

________. 2018. "World Bank Open Data." https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=NP.

________. 2019. “South Asia.” https://www.worldbank.org/en/region/sar/overview#2.

ANNEXES

Annex 1. Matrix for analyzing health sector emergencies and multi-hazard disasters

Country profile	Type of event	Categories of emergencies/ disasters *1 = small-scale* *2 = medium-scale* *3 = large-scale of potentially catastrophic proportions*	Year	Affected sectors	Population affected (including mortality/ morbidity)	Burden on healthcare system	Economic impact	Adaptive actions in place (including governance, policy, planning, and coordination)			Overall scope of response	Best practice and lessons learned	Recommendations
								Pre-emergency preparedness/ mitigation measures	During emergency response measures	Post-emergency recovery and resilience measures to withstand future occurrence (in line with Build–Back–Better principles)			

Annex 2. Institutional Arrangements at the National and Regional Levels

(a) At the National Level

Country	National platforms	Applicable act	Institutional structures and key responsibilities
Bangladesh	National Disaster Management Council (NDMC)	Disaster Management Act, 2012	*Ministry of Disaster Management and Relief* - Serves as the main structure responsible for coordinating and implementing multi-hazard management activities
Bhutan	Department of Disaster Management (DDM)	National Disaster Management Act	*Department of Disaster Management* (located within the Ministry of Home and Cultural Affairs and under the National Disaster Management Authority) - Coordinates all disaster management activities in the country and is responsible for public awareness and disaster preparedness with a special focus on vulnerable groups. - Responsible for the formulation and implementation of the National Disaster Management Act, National Disaster Management Framework, Disaster Management Rules and Regulations
Nepal	Central Natural Disaster Relief Committee (CNDRC) National Reconstruction Authority (NRA) for reconstruction of earthquake-affected areas	Disaster Relief Act, 1982 National Disaster Risk Reduction and Management Act (DRRMA) enacted in 2017 and amended in 2019	*Ministry of Home Affairs* - Responsible for coordinating disaster management activities in Nepal. The Natural Calamity Relief Act has provisions to set up the CNDRC, Regional Natural Disaster Relief Committee, District Natural Disaster Relief Committee, and Local Natural Disaster Relief Committee to administer relief and rescue works during an emergency. Natural Disaster Relief Committees at Central and District levels are also functional. - The National Disaster Risk Reduction and Management Authority (NDRRMA) is responsible for all phases of disaster management in coordination with all DRR stakeholders in Nepal, as outlined under the DRRMA. The NDRRMA works under the direct oversight of the Executive Committee chaired by the Minister of Home Affairs
Pakistan	National Disaster Management Authority (NDMA)	National Disaster Management Act, 2010	*National Disaster Management Authority*

	Provincial Disaster Management Authority (PDMA)		- Responsible for the national planning, coordinating, mandating, and implementing of the Disaster Management (DM) plan. Establishes guidelines for preparation of the DM plan by the different ministries and provincial governments. And, through the National Institute of Disaster Management (NIDM), develops stakeholder capacity in disaster management. - Under the National Disaster Management Act, the Provincial Disaster Management Authority is responsible for putting in place measures for combating natural and man-made disasters at the provincial and local level

(b) At the Regional Level

At the regional level, a regional review of governance arrangements and communication and coordination mechanisms among target countries shows that, although limited, some regional structures are in place to support DRM, emergency preparedness, and response and recovery operations for the region (see Table A2.1 below). The SAARC Disaster Management Center (SDMC), an existing regional institutional arrangement, serves as a center of regional cooperation for holistic DRM in the SAR. It has the mandate to support member states in DRR initiatives—in line with global priorities and with the relevant frameworks adopted by member states—through sharing knowledge from multiple disciplines, exchanging best practices and lessons, and developing capacity and collaboration.

International partners, such as the United States Agency for International Development (USAID), have also supported the establishment of regional DRM networking arrangements. An example is the Asia Flood Network (AFN) that served as a regional forecasting center, strengthening the capacity of regional and national hydrometeorological institutions in climate, weather, and hydrological forecasting, while working directly with at-risk communities to reduce vulnerabilities to hydrological hazards. However, the analysis revealed that cross-border vulnerabilities due to hazards impacts still need to be properly considered in regional planning for DRM and emergency preparedness and response (Kafle 2017).

TABLE A2.1: REGIONAL STRUCTURES

Type of hazard	Regional structures	Participating countries
All hazards	SAARC Disaster Management Center	All
Hydrometeorological hazards	Regional Specialized Meteorological Center	All
Hydrometeorological hazards	Asia Flood Network	All

ANNEX 3. CLASSIFICATION OF ALL HAZARDS

<table>
<tr><td>Generic groups</td><td colspan="9">Classification of Hazards</td></tr>
<tr><td>Groups</td><td colspan="7">Natural</td><td colspan="2">Human-induced</td></tr>
<tr><td rowspan="2">Subgroups</td><td rowspan="2">1.1. Geological</td><td colspan="3">1.2 Hydrometeorological</td><td rowspan="2">1.3 Biological</td><td rowspan="2">1.4 Extraterrestrial</td><td rowspan="2">2.1 Technological</td><td rowspan="2">2.1 Societal</td></tr>
<tr><td>1.2.1 Hydrological</td><td>1.2.2 Meteorological</td><td>1.2.3 Climatological</td></tr>
<tr><td>Main types
- Subtypes (sub-subtypes)</td><td>Earthquake
- Ground shaking
- Tsunami

Mass movement liquefaction volcanic activity
- Ashfall
- Lahar
- Pyroclastic flow
- Lava flow</td><td>Flood
- Riverine flood
- Flash flood
- Coastal flood
- Ice jam flood

Landslide
- Avalanche: snow, mudflow, debris, rockfall

Wave action
- Rogue wave
- Seiche</td><td>Storm
- Extra tropical storm
- Tropical storm
- Convective storm: storm/surge, tornado, wind, rain, winter storm/blizzard, derecho, lightning/thunderstorm, hail, sand/dust storm
Extreme temperature
- Heat wave
- Cold wave
- Severe winter condition: snow/ice, frost/freeze,
Fog</td><td>Drought
Wildfire
- Land fire: brush, bush, pasture
- Forest fire

Glacial lake outburst</td><td>Emerging diseases
Epidemics and pandemics
Insect infestation
- Grasshopper
- Locusts

Foodborne outbreaks</td><td>Impact
- Airbust

Space weather
- Energetic particles
- Shockwave
- Geomagnetic Storms</td><td>Industrial hazards
- Chemical spill, gas leak, collapse, explosion, fire, radiation

Structural collapse
- Building collapse, dams/bridge failures

Transportation
- Air, road, rail, water

Explosions/Fire
Air pollution
- Haze

Power outage

Hazardous materials in air, soil, water
- Biological, chemical, radiological

Food contamination</td><td>Armed conflicts
- International
- Non-international

Civil unrest

Terrorism

Chemical, biological, radiological, nuclear, and explosive weapons (CBRNE)

Financial crisis
- Hyperinflation
- Currency crisis</td></tr>
</table>

Source: WHO 2015, Western Pacific Region Framework for Action for Disaster Risk Management for Health: Annex 1 Nomenclature of Disasters.

Annex 4. Comprehensive list of events

Year	Hazard group	Hazard type	Event name	Total mortality	Total injured	Total affected
Bangladesh						
2009	Meteorological	Tropical cyclone	Cyclone Aila	190	7103	3,935,341
2009	Meteorological	Tropical cyclone	Cyclone Bijli	7	84	19, 209
2009	Hydrological	Riverine flood		6		50,000
2009	Hydrological	Riverine flood				5,000
2009	Meteorological	Cold wave		135		50,000
2009	Biological	Pandemic (viral)	Influenza A (H1N1)	6		899
2010	Meteorological	Storm		15		50
2010	Hydrological	Flash flood				75,000
2010	Hydrological	Riverine flood		15		500,000
2010	Hydrological	Landslide		66	100	55,230
2010	Meteorological	Tropical cyclone		8	200	247,110
2010	Meteorological	Tropical cyclone		3		10,000
2011	Hydrological	Flash flood		10		1,570,559
2011	Meteorological	Cold wave		50		100,000
2011	Meteorological	Storm		13		121
2011	Hydrological	Landslide		17		
2011	Meteorological	Cold wave		12		2,000
2011	Biological	Disease outbreak	Influenza (H5N1)	3		
2012	Hydrological	Riverine flood		139		5,148,475
2012	Meteorological	Severe storm		25	121	55,000
2012	Hydrological	Riverine flood				250,000
2012	Meteorological	Connective storm		108	183	129,558
2012	Meteorological	Cold wave		72		75,000
2013	Meteorological	Tornado		2		25,020
2013	Meteorological	Severe storm		31	388	8,543
2013	Meteorological	Tropical cyclone		17	65	1,498,644
2014	Meteorological	Storm		16	12	4,012
2014	Hydrological	Riverine flood		59	447	2,800,447
2014	Meteorological	Storm		4		1,250
2014	Hydrological	Flood				400,000
2015	Meteorological	Storm		53	200	20,200
2015	Hydrological	Riverine flood		20	20,651	1,401,901
2015	Hydrological	Riverine flood		11		10,000
2015	Meteorological	Tropical cyclone	Cyclone Komen	45		2,600,000
2015	Meteorological	Connective storm		13		
2015	Meteorological	Connective storm		6	50	40,050
2015	Geophysical	Earthquake		4		200
2015	Hydrological	Landslide		7		1,003
2016	Meteorological	Tropical cyclone	Cyclone Roanu	28		1,203,555
2016	Meteorological	Connective storm		59		

2016	Geophysical	Earthquake		5		70
2016	Hydrological	Riverine flood		106		1,900,000
2017	Hydrological	Landslide		160	187	80,187
2017	Meteorological	Connective storm		12		
2017	Hydrological	Riverine flood				86,025
2017	Meteorological	Tropical cyclone	Cyclone Mora	7	12	3,300,012
2017	Biological	Epidemic (bacterial)	Diphtheria	15		789
2017	Hydrological	Flood		144		8,000,000
2018	Hydrological	Flood		14		
2018	Meteorological	Connective storm		33		
2018	Meteorological	Cold wave		34		
2018	Hydrological	Flood		21		14,000
2019	Hydrological	Flood		114		7,600,000
2019	Meteorological	Connective storm		15		
2019	Hydrological	Landslide		2	16	18,016
2019	Meteorological	Tropical cyclone	Cyclone Fani	39	45	10,045
2019	Meteorological	Tropical cyclone	Cyclone Bulbul	40	71	251,506
2019	Meteorological	Cold wave		50		4,500
2019	Biological	Disease outbreak	Dengue fever			
Bhutan						
2009[a]	Meteorological	Tropical cyclone	Cyclone Aila	12		
2009	Biological	Pandemic (viral)	Influenza A (H1N1)			
2009	Geophysical	Earthquake		11		4,614
2011	Geophysical	Earthquake (aftershock from North India, Nepal and Tibet		1	16	20,016
2015	Meteorological	Windstorm			3	792
2016[a]	Hydrological	Floods		4		125
2019	Geophysical	Earthquake		2		
Nepal						
2009	Biological	Epidemic (bacterial)	Diarrhea	314		58,874
2009	Biological	Pandemic (viral)	Influenza (H1N1)			172 cases
2009	Hydrological	Riverine flood		87	62	257,786
2009	Hydrological	Riverine flood		30		
2009	Climatological	Drought				303,000
2009	Hydrological	Landslide		28	10	
2009	Meteorological	Cold wave			18	
2010	Hydrological	Riverine flood		138		8,000
2010	Hydrological	Riverine flood		12		
2010	Biological	Epidemic (bacterial)	Diarrhea	65		3,972

2010	Biological	Epidemic (bacterial)	Cholera	8		1,400
2011	Hydrological	Riverine flood		89	32	1,826
2011	Geophysical	Earthquake		7	89	167,860
2011	Hydrological	Riverine flood		15		
2011	Hydrological	Landslide		16		
2011	Hydrological	Landslide		13		
2011	Meteorological	Cold wave				25,000
2011	Meteorological	Cold wave		42		
2012	Hydrological	Riverine flood		72		
2012	Hydrological	Avalanche		11		
2012	Meteorological	Cold wave		49		
2013	Hydrological	Riverine flood		76	29	12,503
2013	Hydrological	Flash flood		119	6	4,320
2014	Hydrological	Avalanche		16		
2014	Hydrological	Flood		294	149	184,894
2014	Meteorological	Storm		83		175
2014	Hydrological	Riverine flood		8		
2014	Hydrological	Riverine flood		16		2,400
2014	Hydrological	Landslide		156		476
2015	Geophysical	Earthquake	Gorkha earthquake	8831	17,932	5,639,722
2015[b]	Geophysical	Earthquake		138		2,428
2015	Hydrological	Landslide		29		
2016	Hydrological	Flash flood		138	51	10,551
2016	Climatological	Forest fire		11		
2016	Hydrological	Flood		25	23	10,023
2017	Hydrological	Flood		11		6000
2017	Hydrological	Flood		176	134	1,700,134
2017	Hydrological	Landslide		11		7,500
2018	Hydrological	Flash flood		15	6	1,406
2018	Meteorological	Cold wave		50		
2019	Hydrological	Flood		119	41	82,541
2019	Meteorological	Storm		28	612	14,854
Pakistan						
2009	Hydrological	Flash flood		14	10	
2009	Hydrological	Flash flood		36		75,000
2009	Hydrological	Riverine flood		52		70
2009	Biological	Pandemic (viral)	Influenza A (H1N1)			366
2010	Hydrological	Riverine flood		22		
2010	Meteorological	Tropical cyclone	Cyclone Phet	23		4,000
2010	Hydrological	Flash flood		60		4,000
2010	Hydrological	Flash flood		1,985	2,946	20,359,496
2010	Hydrological	Riverine flood		46		

2010	Hydrological	Avalanche		31	72	3,705
2010	Hydrological	Landslide		19		26,700
2010	Biological	Disease outbreak	Cholera			99
2010	Biological	Disease outbreak	Crimean Congo Hemorrhagic fever (CCHF)	3		26
2010	Biological	Epidemic	Dengue fever	15		1,500
2011	Geophysical	Earthquake		2		1,000
2011	Hydrological	Riverine flood		509	755	5,400,755
2012	Hydrological	Flash flood		12		
2012	Hydrological	Riverine flood		480	2,902	5,046,462
2012	Hydrological	Riverine flood		26		1,200
2012	Hydrological	Avalanche		135		
2012	Hydrological	Landslide		18		
2013	Geophysical	Earthquake		41	175	15,175
2013	Geophysical	Earthquake		399	599	185,749
2013	Geophysical	Earthquake		22		50
2013	Hydrological	Riverine flood		34		57
2013	Hydrological	Riverine flood		234	855	1,497,725
2014	Meteorological	Heat wave		139		
2014	Meteorological	Storm		16		82
2014	Hydrological	Riverine flood		255	673	2,530,673
2015	Hydrological	Flashflood		49	267	5,067
2015	Geophysical	Earthquake		280	1,745	502,590
2015	Geophysical	Earthquake		3		85
2015	Geophysical	Mass movement		13		
2015	Hydrological	Flash flood		20		
2015	Hydrological	Riverine flood		32		
2015	Hydrological	Riverine flood		18		
2015	Meteorological	Heat wave		1,229		80,000
2015	Hydrological	Flood		10		
2015	Hydrological	Flood		238	232	1,572,423
2016	Hydrological	Flash flood		92	77	
2016	Hydrological	Flash flood		32		2,900
2016	Hydrological	Flood		26	3	
2016	Meteorological	Storm		34		191
2016	Geophysical	Earthquake		6	42	142
2016	Hydrological	Flash flood		46		410
2016	Hydrological	Flood		10		
2016	Hydrological	Riverine flood		141	127	4,412
2016	Hydrological	Flood		22	60	2,960
2016	Biological	Epidemic	Typhoid fever (XDR)			5,274
2017	Meteorological	Storm		11		

2017	Hydrological	Avalanche		9		113
2017	Hydrological	Flash Flood		167	167	2,367
2017	Meteorological	Storm		15		113
2017	Biological	Epidemic (viral)	Dengue fever	25		2,492
2017	Hydrological	Flood		13	650	60,650
2018	Meteorological	Heat wave		180		
2018	Hydrological	Flood		60		
2019	Hydrological	Flash flood		64	71	871
2019	Hydrological	Flash flood		28		
2019	Hydrological	Flood		25	22	
2019	Hydrological	Flood		26	4	
2019	Hydrological	Flood		16		
2019	Climatological	Drought		77		4,680,912
2019	Geophysical	Earthquake		39	746	130,398
2019	Hydrological	Flash flood		20		
2019	Meteorological	Storm		39	135	
2019	Hydrological	Flood		16		
2019	Hydrological	Flood		11		
2019	Biological	Epidemic (viral)	Dengue fever	95		53,834
2019	Biological	Epidemic (viral)	HIV			872

Source: Compiled EM-DAT: The Emergency Events Database (CRED 2020); and WHO Global Disease Outbreak News.

Note:

Events included for in-depth analysis	Category 1 event	Category 2 event	Category 3 Event

[a] Data shown are not representative of actual event impact, which is reported to have significantly impacted the country.
[b] Figures vary from what is provided in the Post-Disaster Needs Assessment of Gorkha Earthquake.

Annex 5. Search terms

"health system" AND "disaster risk reduction" AND (outbreak OR "natural disaster") AND "South Asia"

"health system" AND "disaster risk reduction" AND (outbreak OR "natural disaster" OR multihazards) AND (Bangladesh OR Bhutan OR Maldives OR Nepal OR Pakistan

"health system" AND "disaster risk reduction" AND (outbreak OR "natural disaster" OR multihazards) AND Bangladesh

"health system" AND "disaster risk reduction" AND (outbreak OR "natural disaster" OR multihazards) AND Bhutan

"health system" AND "disaster risk reduction" AND (outbreak OR "natural disaster" OR multihazards) AND Maldives

"health system" AND "disaster risk reduction" AND (outbreak OR "natural disaster" OR multihazards) AND Nepal

"health system" AND "disaster risk reduction" AND (outbreak OR "natural disaster" OR multihazards) AND Pakistan

"Health sector" AND "disaster risk management" AND ("disease outbreak" OR "natural disaster) and Bangladesh OR Bhutan OR Maldives OR Nepal OR Pakistan

"health system" AND recovery AND ("infectious disease outbreak" OR "natural disaster") AND "South Asia"

"health system" AND ("avian influenza" OR chikungunya OR dengue OR nipah OR landslides OR cyclone OR hurricane OR tsunami OR earthquake OR flooding OR tornado OR landslides)

"health system strengthening" AND ("infectious disease" OR outbreak OR "natural disaster" OR "global health security")

"health system" AND "disaster risk reduction" AND "public health emergencies" AND (outbreak OR "natural disaster") AND "South Asia"

This study analyzes responses to past natural disasters in four countries in South Asia—Bangladesh, Bhutan, Nepal, and Pakistan. Of 178 hazardous events reported in the four countries during the 10 years covered by this study (2009–19), 126 were classified as disasters and used for the in-depth analysis.

The analysis revealed that countries have multi-hazard preparedness and response capacities in place, albeit to varying degrees, in areas such as early warning and surveillance systems, emergency operations centers, and whole-of-society approaches to disaster preparedness, response, and recovery. Notwithstanding, the analysis also revealed gaps across each country in their capacity to detect, prepare for, respond to, and recover from hazard-induced disasters, including public health emergencies. To address these gaps, the paper offers recommendations for improving capacities and resilience to disasters.

Recent infectious disease outbreaks, including the ongoing global COVID-19 pandemic, have demonstrated the critical importance of comprehensive disaster risk management systems, which include resilient health systems, in reducing exposure and vulnerabilities to hazards, with an overarching aim of safeguarding national and global health security. To ensure sustainability, this calls for, amongst others, a holistic approach to resilience that incorporates public health, disaster risk and climate change considerations; the integration of community-based disaster risk reduction programs into routine public health service delivery functions; an enhanced and expanded focus on improving multi-hazard preparedness; and the prioritization and institutionalization of after action reviews, as a means of ensuring that corrective actions from past public health events are properly considered.

ABOUT THIS SERIES:

WORLD BANK GROUP
Health, Nutrition & Population

1818 H Street, NW
Washington, DC USA 20433

Telephone: 202 473 1000
Facsimile: 202 477 6391
Internet: www.worldbank.org
E-mail: feedback@worldbank.org