

2007-2017

10

© 2018 Global Facility for Disaster Reduction and Recovery

1818 H Street, N.W., Washington, D.C., 20433, U.S.A.

The text in this publication may be reproduced in whole or in part and in any form for educational or nonprofit uses, without special permission, provided acknowledgement of the source is made. GFDRR's Secretariat would appreciate receiving a copy of any publication that uses this report as a source. Copies may be sent to the Secretariat at the above address.

No use of this publication may be made for resale or other commercial purpose without prior written consent of the Secretariat. All images remain the sole property of the source and may not be used for any purpose without written permission from the source.

Notes: Fiscal year (FY) runs from July 1 to June 30; the financial contributions and expenditures reported are reflected up to June 30, 2016; all dollar amounts are in US dollars (\$) unless otherwise indicated.

Design: Miki Fernández/ULTRAdesigns, Inc.

# A Decade of Progress in Disaster Risk Management

- **UN Cluster System** introduced
- **Hyogo Framework** adopted
- **BRR** established in Indonesia as world's first disaster recovery agency
- **Multi Donor Fund** for Aceh & Nias raises \$650 million for reconstruction
- **ISMEP** launched in Turkey
- **GFDRR** established
- Mexico's **FONDEN** issues world's first sovereign CAT bond
- **CCRIF** established—first regional risk-pooling mechanism for vulnerable countries
- **Joint Declaration on Post-Crisis Assessments and Recovery Planning** signed between UN, World Bank, and EU

2004



**Indian Ocean Tsunami**

**280,000**

deaths

**\$15B**

in damages

2005



**United States:  
Hurricane Katrina**

**1,833**

deaths

**\$81B**

in damages

**Pakistan Earthquake**

**75,000**

deaths

**\$5B**

in damages

2006



**Indonesia:  
Yogyakarta Earthquake**

**6,000**

deaths

**200,000**

homeless

**\$3.1B**

in damages

2007



**China:  
Sichuan Earthquake**

**68,000**

deaths

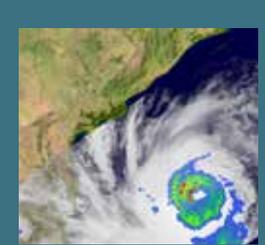
**5M**

homeless

**\$20B**

in damages

2008



**Myanmar:  
Cyclone Nargis**

**138,000**

deaths

**\$10B**

in damages

DRM timeline: developments and disasters

- **Understanding Risk** community established
- First use of **OpenStreetMap** to map disaster risk—Haiti

- **OpenDRI** launched
- **Haiti Reconstruction Fund** raises \$400 million for recovery
- **World Reconstruction Conference, Geneva**
- **Global Platform for Disaster Risk Reduction**

- **Joint Declaration on Post-Crisis Assessments and Recovery Planning** signed between UN, World Bank and EU

- **Post-Disaster Needs Assessment guidelines** issued
- **PCRAFI** launched

2009



**Melbourne, Australia Bushfires**

**181**

deaths

Worst-ever recorded bushfires

2010



**Haiti: Earthquake**

**160,000**

deaths

**\$81B**

in damages

**Iceland: Eruption of Eyjafjallajökull**

**30,000**

flights grounded

**Indonesia: Eruption of Mount Merapi**

**350,000**

evacuated

2011



**East Japan Earthquake**

**15,882**

deaths

Fukushima reactors melt down

**New Zealand: Christchurch Earthquake**

**185**

deaths

**\$15B**

in damages

**Thailand: Bangkok Floods**

**85**

deaths

**\$46.5B**

in damages

**East Africa Drought**

**260,000**

deaths in Somalia famine

2012



**US and Caribbean: Hurricane Sandy**

**\$75B**

in damages

**Western Pacific: Cyclone Evan**

**\$180B**

in damages

2013



**Philippines: Typhoon Haiyan**

**6,000**

deaths

**3.6M**

displaced

**Cyclone Phailin**

**\$75B**

in damages

- First **GeoNode** created to map communities affected by Ebola
- **2nd World Reconstruction Conference, Washington, DC**
- **Disaster Recovery Framework guidelines**
- **CCRIF** expands to Central America
- Adoption of **Sendai Framework**
- Adoption of **SDGs**
- **COP21 Paris Conference**
- Launch of **CREWS**
- **InsuResilience** adopted at G7
- **World Humanitarian Summit**
- Entry into force of the **Paris Agreement**
- **Global Platform for Disaster Risk Reduction**
- **3rd World Reconstruction Conference, Brussels**
- World Bank issues largest ever CAT Bond to Mexico under FONDEN

2014



**East Africa  
Drought Begins**

**10M**  
affected

2015



**Nepal:  
Ghorka Earthquake**

**9,000**  
deaths  
**\$10B**  
in damages

2016



**Caribbean:  
Hurricane Matthew**

**500**  
deaths  
**\$15B**  
in damages

**Italy: Amatrice  
Earthquake**

**297**  
deaths  
**\$11B**  
in damages

2017



**Floods in South Asia**

**1,300**  
deaths  
**\$14M**  
in damages

**United States:  
Hurricane Harvey**

**83**  
deaths  
**\$70B**  
in damages

**Caribbean:  
Hurricane Irma**

**82**  
deaths  
**\$62.7B**  
in damages

**Puerto Rico:  
Hurricane Maria**

**49**  
deaths  
**\$72B**  
in damages

**US and Canada: Wildfires**

**8M hectares**  
of forest destroyed

**Mexico Earthquakes**

**470**  
deaths

SICHUAN, CHINA, 2008. Wenchuan earthquake. Photo credit: Yekaixp | Dreamstime.com



Foreword  
Acknowledgments  
Abbreviations and Acronyms

# Contents

CHAPTER

1 p1

## From Disaster Response to Disaster Risk Management

A Shifting Development Landscape 3

A House of Many Rooms 5

UNISDR:  
A Powerful Voice 6

2 p9

## From Producing to Communicating and Using Risk Information

Indonesia: Response to the Tsunami Leads to a More Integrated Approach to DRM 10

Voices of Transformation:  
Decisive Action 12

Aceh and Beyond 13

A Comprehensive Strategy 14

Identifying and  
Communicating Risk 16

Risk Assessments 18

The Understanding Risk  
Community 21

OpenStreetMap: Where the  
Streets Have a Name 22

Regional Risks, Global  
Statistics 25

3 p27

## From Crisis Management to Risk Reduction

Turkey: Building Resilience  
through ISMEP 28

An Architecture of Achievement:  
Lasting Results of ISMEP 29

Voices of Transformation:  
A Homecoming 29

Learning Experience: The Global  
Program for Safer Schools 30

Safety in Numbers 31

Serbia: Regulating Risk 32

4 p35

## From an Improvised to a Planned Response

Odisha: A Tale of Two  
Cyclones 36

Women Prepared 40

Community Preparedness  
in Bangladesh 41

Voices of Transformation:  
Communities Taking Control 42

Climate Challenge: CREWS  
and Africa Hydromet 42

## 5 p47

**From Financial Products to Comprehensive Financial Protection Strategies**Mexico: A Holistic Approach **48**Weathering the Storm:  
How a CAT-DDO Works **49**Voices of Transformation:  
Decisive Action **49**Sharing the Load: Pooling Risk  
in the Pacific and Caribbean **50**Panama: Institutionalizing  
Risk Financing **52**

## 6 p55

**From Reconstruction to Building Back Better**Nepal: From the Ground Up **56**Voices of transformation:  
A Sturdier Future **58**Djibouti: Season of Hope **60**Iraq: Rebuilding after  
Conflict **60**Lessons from Recovery  
Processes **62**A Decade of Damage and Needs  
Assessments **64**Acting Local: Capacity Building in  
Malawi **67**

## 7 p69

**From Disaster Reduction and Recovery to Protecting Livelihoods**Ethiopia: Spreading the Net **70**Sector-Specific Resilience **73**Upward Mobility: Innovations in  
Financial Inclusion **75**

## 8 p79

**From Disaster Risk Management to Resilient Development**DRM and Development **80**The Next Ten Years **83**Through Risk, to Resilience **87**

CENTRAL REGION, CHILE, FEBRUARY 2010. Building destroyed in an 8.8 magnitude earthquake.  
Photo credit: hdur, CC BY-NC 2.0





7 Febre 2011



**Francis Ghesquiere**

Head, GFDRR Secretariat

# | Foreword: | A Decade of Progress

2017 marks 10 years of Global Facility for Disaster Reduction and Recovery (GFDRR) operations, an occasion we wanted to observe by looking back at a decade of enormous change and progress in disaster risk management (DRM). While we are proud of the role we have played in this, we felt it more important to highlight in this book the achievements of particular countries, and of the DRM community as a whole.

Indeed, the story of the last 10 years in DRM is one of people and communities building their own resilience in the face of increasing risk, and of vulnerable nations enacting policies and strengthening capacity to reduce risk and protect hard-won development gains. It's the story

of businesses and the international community supporting these efforts with the necessary expertise and resources, from financial protection to better early warning systems. As technology advances, such interventions are becoming increasingly widespread, efficient, and affordable.

This is also a story of partnerships, the growth of which is perhaps the most significant achievement of the last decade. The 2004 Indian Ocean tsunami, with which this report begins, saw the rise of a new approach to disaster management. Many of the partnerships documented here had their roots in that humanitarian tragedy, when it became immediately obvious that the approach of reactive

assistance was inadequate. One such partnership is that of the European Union, World Bank, and United Nations (UN) in helping countries quickly assess damages following a disaster and establish a framework to build back better. All over the world, school children are being protected against disaster through the Global Program for Safer Schools (GPSS), supported by partners like Japan and Save the Children. The years after the tsunami have also seen the growth of networks consisting of international institutions, donor countries, civil society, and the private sector to coordinate planning and prepare better for future hazards.

The advances of the last decade are just the start. Many of the

stories of progress in this book are examples of what is possible under the right circumstances and with the necessary will. In Indonesia, the Indian Ocean tsunami ushered in a new era of partnership and collaboration between international institutions and affected countries. In Turkey and Serbia, the disasters strengthened governance and thus enhanced preparedness. In India and Bangladesh, communities are now mobilized by early warning systems and evacuation plans which have dramatically reduced the loss of life during cyclones and floods. In Mexico, civil and financial protection are integrated to protect communities, infrastructure, and the economy against natural disaster. In

Nepal, a devastating earthquake mobilized the government and the people to improve both infrastructure and homes. In Ethiopia, DRM is an important part of a wider social safety net. In each of these instances, what the country did after a disaster has left them more resilient and better prepared for future disasters.

Finally, this report documents the extent to which DRM is becoming integrated into development planning. GFDRR has played a significant role in mainstreaming risk, weaving it into the fabric of the Sustainable Development Goals, the Paris Agreement, and

the investments of the World Bank. There is a growing recognition that resilience is not a by-product of good development but is integral to it—something that is at the core of GFDRR's strategic objective.

Many of the examples in this report are drawn from the developing world, which is disproportionately exposed to disasters arising from climate change and rapid urbanization, and where the development gains of the last decades are most under threat. These are also the countries and communities that are the focus of much of the work of institutions like the World Bank

and the UN, and thus where the efforts of GFDRR, United Nations Office for Disaster Risk Reduction (UNISDR), and the Red Cross are concentrated, and where donors like the European Union (EU), Japan, and Switzerland make their largest investments in DRM. However, disaster also affects countries with the resources to deal with it better, and learning from places like the United States after Katrina and Japan after Fukushima inform our efforts elsewhere in the world.

2017 has been punctuated by a series of natural disasters—hurricanes Irma, Maria, and

Harvey in the Caribbean and on the Gulf Coast, deadly earthquakes in Mexico, wildfires in the American west, and floods in the densely populated regions of South Asia. As factors like climate change and rapid urbanization exacerbate the intensity and scale of future disasters, all of us in the DRM community need to work together in replicating successful interventions and bringing such efforts to scale, ensuring a more resilient future for everyone.





LEYTE, PHILIPPINES, NOVEMBER 2013. An aerial view of a coastal town devastated by Typhoon Haiyan. Photo credit: Dan Kitwood/Getty Images



# Acknowledgments

*This report was compiled by Shaela Rahman, Nick Paul, and David Tucker. Josef Leitmann and Stephane Hallegatte provided guidance on its structure and in drafting specific areas of content.*

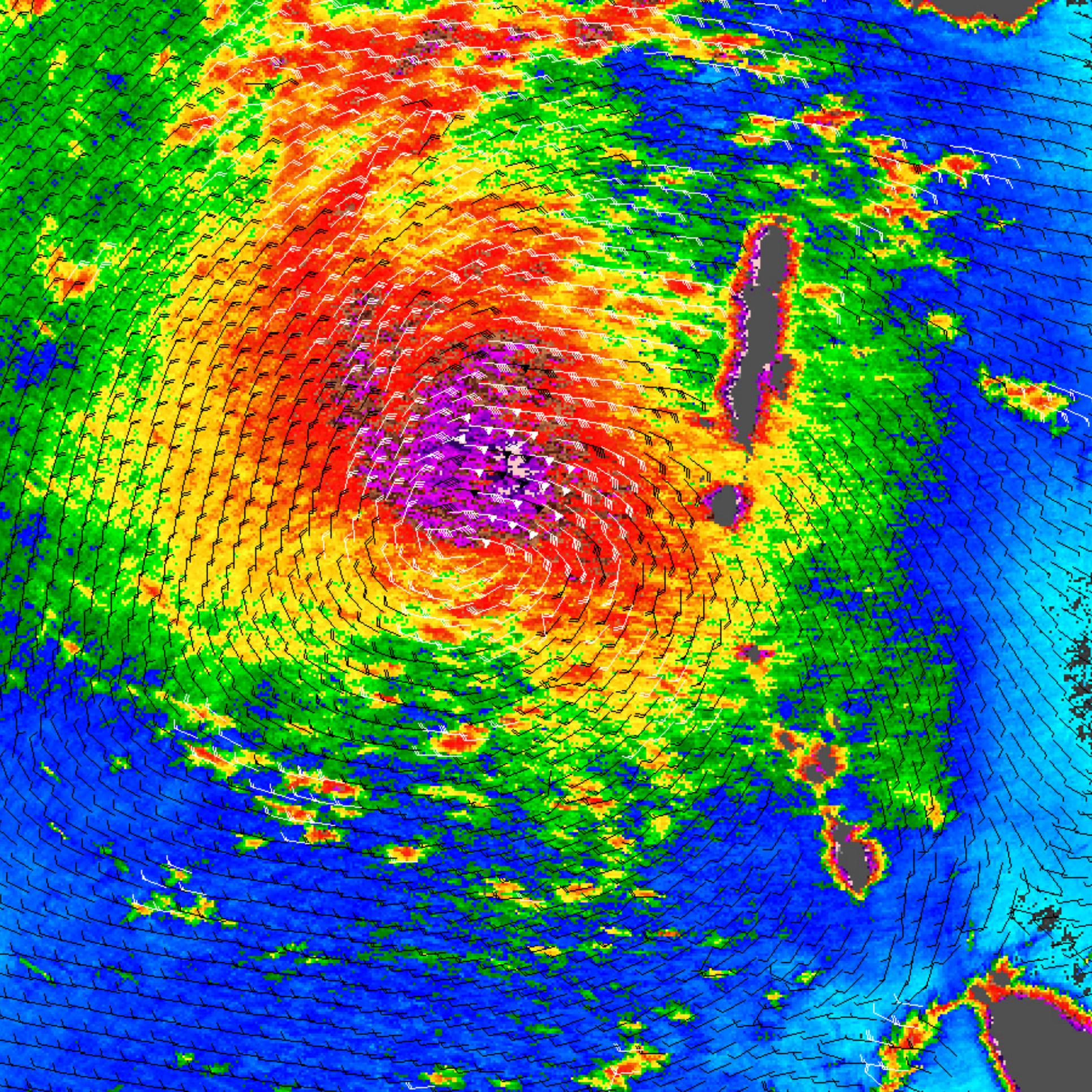
Our thanks go to the many colleagues who contributed their time and effort to the development of the report, specifically: Tahir Akbar; Joy Aoun; Margaret Arnold; Raja Arshad; Simone Balog; Anna-Maria Bogdanova; Manuela Chiapparino; Vivien Deparday; Tafadzwa Dube; Marc Forni; Habiba Gitay; Stephane Hallegatte; Niels Holm-Nielsen; Saroj Kumar Jha; David Jimenez; Hemang Karella; Yann Kerblatt; Josef Leitmann; Sonia Luthra; Olivier Mahul; Henriette Mampuya; Cristina Otano; Christoph Pusch; Sumati Rajput; Alex Rossi; Alanna Simpson; Benedikt Signer; Emma Phillips; Luis Tineo; Joaquin Toro; and Vladimir Tsirkunov.

Drafts of the report were shared with World Bank country teams in Indonesia, Mexico, Turkey, and Ethiopia, with government counterparts in various countries, and with the United Nations Office for Disaster Risk Reduction (UNISDR). We especially thank them all for their valuable time and insights.

Proofreading services were provided by Shepherd, Inc., and Miki Fernandez of Ultra Designs designed the document. Devan Kreisberg and Scott Andrews provided editorial assistance.

Particular thanks go to all of GFDRR's donors and partners, and to Francis Ghesquiere who provided the original inspiration for the report.

**2011 GREAT EAST JAPAN EARTHQUAKE.**  
Aerial view of the Japanese Ground Self-Defense Force and disaster relief crews.  
Photo credit: Stocktrek Images



# Abbreviations and Acronyms

## **AMCOMET**

African Ministerial Conference on Meteorology

## **BNBP**

Indonesia's National Disaster Management Authority

## **BRR**

Agency for the Rehabilitation and Reconstruction of Aceh and Nias

## **CAPRA**

Central America Probabilistic Risk Assessment

## **CAT-DDO**

Development Policy Loan with a Catastrophe Deferred Drawdown Option

## **CBDRM**

Community-based disaster risk management

## **CCRIF**

Caribbean Catastrophe Risk Insurance Facility

## **CDD**

Community-driven development

## **CDRRP**

Coastal Disaster Risk Reduction Project

## **CENAPRED**

National Centre for Disaster Prevention

## **COP21**

21st Conference of Parties

## **CPP**

Government of Bangladesh's Cyclone Preparedness Program

## **CREWS**

Climate Risk and Early Warning Systems

## **DaLA**

Damage and Loss Assessment

## **DRM**

Disaster Risk Management

## **DRM-SPIF**

Ethiopia's DRM Strategic Program and Investment Framework

## **ECLAC**

Economic Commission for Latin America and the Caribbean

## **EU**

European Union

## **FIDIC**

International Federation of Consulting Engineers

## **FONDEN**

Mexico's Fund for Natural Disasters

## **FOPREDEN**

Fund for the Prevention of Natural Disasters

## **GAR**

Global Assessment Report

## **GFDRR**

Global Facility for Disaster Reduction and Recovery

## **GIR**

Holistic Risk Management

## **GPSS**

Global Program for Safer Schools

## **HOTS**

Humanitarian Open Street Maps

## **IDNDR**

International Decade for Natural Disaster Reduction

## **InaRISK**

Indonesia Disaster Risk Index

## **InaSAFE**

Indonesia Scenario Assessment for Emergencies

## **InaWARE**

Indonesia All-Hazards Warning, Analysis and Risk Evaluation

## **ISMEP**

Istanbul Seismic Risk Mitigation and Emergency Preparedness Project

## **MDF**

Multi-donor Fund for Aceh and Nias

## **MDGs**

Millennium Development Goals

## **NCRMP**

National Cyclone Risk Mitigation Project

## **NDMP**

Indonesia's National Disaster Management Plan

## **NDRMP**

Serbia's National Disaster Risk Management Program

## **NGO**

Nongovernmental organization

## **NMHS**

Mali's National Meteorological and Hydrological Services

## **NRA**

Nepal's National Reconstruction Authority

## **ODRAF**

Odisha Disaster Rapid Action Force

## **OpenDRI**

Open Data for Resilience Initiative

## **OSDMA**

Odisha State Disaster Mitigation Authority

## **OSM**

OpenStreetMap

## **PCRAFI**

Pacific Catastrophe Risk Assessment and Financing Initiative

## **PDNA**

Post-disaster needs assessment

## **PSNP**

Ethiopia's Productive Safety Net Program

## **SDGs**

Sustainable Development Goals

## **SEDATU**

Mexico's Ministry of Territorial and Urban Development

## **SINAPROC**

Mexico's National System for Civil Protection

## **UN**

United Nations

## **UNICEF**

United Nations International Children's Emergency Fund

## **UNISDR**

United Nations Office for Disaster Risk Reduction

## **UR**

Understanding Risk

## **WMO**

World Meteorological Organization

## **WRC**

World Reconstruction Conference

**BANGLADESH, NOVEMBER 2007:** Tropical Cyclone Sidr as observed by NASA's QuikSCAT satellite. The colors indicate wind speed, with the strongest winds in the center of the storm reaching 160mph. Image credit: David Long/Brigham Young University/NASA JPL





# From Disaster Response to Disaster Risk Management

In the last decade, natural disasters have affected the lives of over 2 billion people. Economic losses from natural disasters are rising—from \$50 billion each year in the 1980s, to over \$400 billion<sup>1</sup> each year in the last decade. Taking into account the effects of poverty and a lack of capacity to cope with disasters, these losses are equivalent to an annual drop in consumption of \$520 billion<sup>2</sup>, threatening to reverse gains in economic development and poverty alleviation. However, in the same period, we have also seen rapid advances in our ability to identify and reduce risk, prepare for disaster, mitigate its financial costs, and build more resilient communities in its wake. These advances have been due in no small measure to the rise of an international network of partnerships in DRM, encompassing local communities, international institutions, country governments, civil society, and the private sector.

**As the world's population grows and urbanizes, and as the effects of climate change intensify, the nature and scale of disasters are changing. Ninety-four percent of natural catastrophes in 2015 were weather-related events<sup>3</sup>, and many occurred in heavily populated or urban areas. However, parallel to these shocks, the way the world approaches disaster risk management (DRM) has evolved and matured, becoming more sophisticated and better integrated with other policies.**

There is a greater coordination of efforts between affected countries and the international community. Advances in technology—from cloud computing and social media to drones—have improved the ability of countries and organizations to predict and reduce risk. Massive data collection efforts have helped to better understand the impact of natural disasters on livelihoods and well-being, and therefore on development and poverty reduction. Using social media and crowdsourcing, communities are increasingly able to prepare

themselves for disasters, while a range of financial instruments have been developed to reduce the impact and help them build back better post-disaster.

This publication tells the story of the last 10 years of DRM. It looks at the progress made by countries, communities, and international organizations, and at how specific disasters have defined the way risk is identified and managed. It also examines the forces shaping disasters yet to come, and the innovations already in place to respond to them.

The case studies in each of the chapters that follow have been chosen to illustrate the gains in DRM over the last 10 years, as well as the challenges remaining. These examples show that progress is possible. We in the international community now need to emulate these experiences and integrate resilience into everything we do. The Sendai Framework calls for a “reduction in disaster loss.” This will only be possible with a radical change in the way we consider development itself.

**SRINAGAR, INDIA, 2014.** Floods in India and Pakistan affected 2550 villages and caused over 500 people to lose their lives. Photo credit: Stocktrek Images





**DID YOU KNOW?**

Without action, climate change could push more than 100 million additional people into poverty by 2030<sup>4</sup>

## A Shifting Development Landscape

The integration of DRM with the broader development agenda is one of the most significant advances of the last 10 years. From mobilizing only in response to disasters, international actors are now proactively managing and incorporating disaster risk into all existing and new development plans and projects.

The **Hyogo Framework for Action**, adopted by the international community in 2005 in response to the Indian Ocean tsunami, emphasized risk identification, risk reduction, and preparedness. In 2015, Hyogo was succeeded by the more ambitious **Sendai Framework for Disaster Risk Reduction** at the World Conference on Disaster Risk Reduction. This framework adopts a more proactive and systemic risk management approach, promoting the mainstreaming of DRM in countries' sustainable development and poverty reduction approaches, and the building of resilience in and by communities. Sendai shares the focus of many of the key players in DRM; many European Union (EU) priorities for DRM were included in the Framework, like risk management capability assessment, a strong knowledge base, and the contribution to DRM of data and science.

Also in 2015, the **Millennium Development Goals** (MDGs) were replaced by the **Sustainable Development Goals** (SDGs), which will guide action on global development until 2030. These goals are more holistic, covering poverty reduction and inequality, sustainability and economic growth with job creation. The SDGs put resilience at the core of the development agenda, embracing targets related to DRM, which the MDGs did not cover. Building on the momentum of Sendai and the SDGs, 2015 also witnessed the adoption of the Paris Agreement at the **21st Conference of Parties (COP21)** of the United Nations Framework Convention on Climate Change. The Agreement commits the global community to reduce emissions of greenhouse gases and adapt to the unavoidable impacts of climate change, including natural disasters.

In spite of these efforts, risks from natural hazards keep increasing in most countries, and disasters remain a threat to development and to global efforts in poverty reduction. Managing disaster risk and the effects of climate change are essential in advancing this agenda and protecting the advances already made.



# A House of Many Rooms

Since 2004, the international DRM community has grown from a scattering of individual entities working independently post-disaster to networks of institutions, governments, and communities working together to improve coordination in all aspects of DRM. While this had its roots in the **UN International Decade for Natural Disaster Reduction (IDNDR)** in the 1990s, the challenges of the Indian Ocean tsunami created the need for a more coordinated approach, which brought different

agencies together after an emergency to work in thematic clusters. Where previously agencies were independently funded, the **Multi-Donor Fund (MDF)** for Aceh and Nias was created after the Tsunami to finance the work of UN agencies, the World Bank, the Asian Development Bank (ADB) and other organizations in Indonesia, and this facilitated coordination in future disasters. A further evolution saw the World Bank, the UN, and the EU starting to work together in crisis response, an arrangement which

culminated in the 2008 **Tripartite Agreement**. GFDRR works closely with some of the largest donors supporting DRM efforts, including the EU and Japan, on a range of initiatives around the world—some of which are documented in these pages. In addition to these bedrock partnerships, GFDRR works with over 400 organizations, institutions, and businesses in every area of DRM, from identifying risk to building resilience in communities around the world.

## From MDGs to SDGs: integrating DRM into development

	MDGs (2000–2015)			SDGs (2015–2030)		
	8 Goals	21 targets	60 indicators	17 Goals	169 targets	230 indicators
<b>Application</b>	<ul style="list-style-type: none"> <li>Disproportionately focused on developing countries</li> </ul>			<ul style="list-style-type: none"> <li>All countries, governments, civil society, development, and private sector actors</li> </ul>		
<b>DRM Focus</b>	<ul style="list-style-type: none"> <li>6 of 8 Goals identified by UNISDR as linked with disaster risk reduction</li> </ul>			<ul style="list-style-type: none"> <li>10 of 17 SDGs and 25 targets identified by UNISDR as related to disaster risk reduction</li> </ul>		
<b>Relevant DRM Agreements</b>	<ul style="list-style-type: none"> <li>Hyogo Framework for Action (2005)</li> </ul>			<ul style="list-style-type: none"> <li>Sendai Framework for Disaster Risk Reduction/SFDRR (2015)</li> <li>Paris Climate Agreement (2015)</li> <li>New Urban Agenda (2016)</li> </ul>		
<b>Coherence with DRM Agreement</b>	<ul style="list-style-type: none"> <li>Different time frame</li> <li>No ex-ante synchronization process</li> </ul>			<ul style="list-style-type: none"> <li>Same time frame</li> <li>Process to synchronize SFDRR with SDG targets and indicators</li> </ul>		

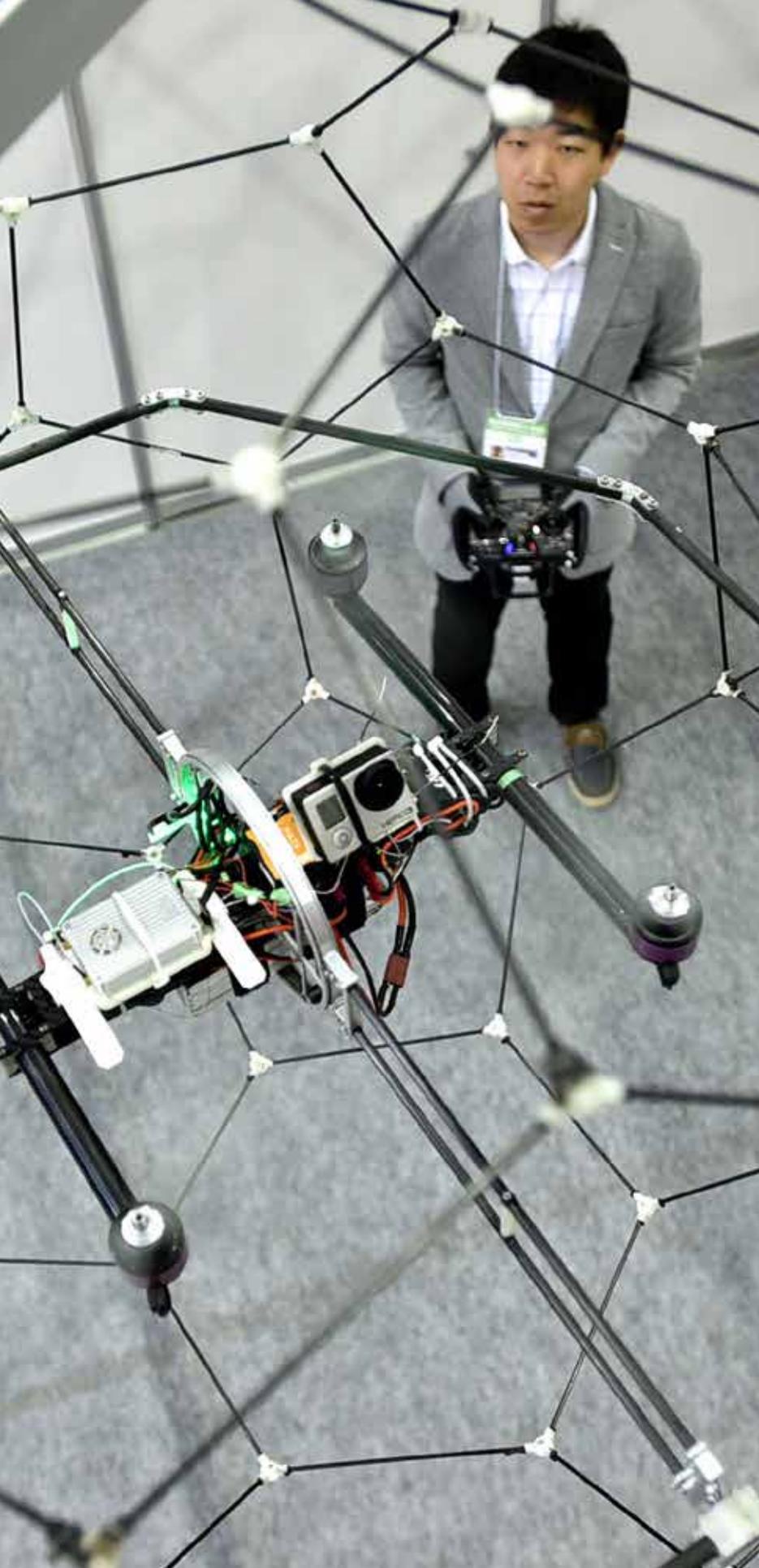
# UNISDR: A Powerful Voice

The UN's **Office for Disaster Risk Reduction** (UNISDR) has been a key partner in the implementation of the Hyogo and Sendai Frameworks. UNISDR, with the UN system and partners, supports member states in their implementation, monitoring, follow-up, and review of the Sendai Framework for Disaster Risk Reduction. A key mechanism for this is the **Global Platform on Disaster Risk Reduction**, a biennial multi-stakeholder global forum for deliberations and strategic guidance on disaster risk reduction, for which UNISDR convenes and leads the preparations. Held most recently in Cancun in May 2017, the event is a gathering of governments and stakeholders who come together to share best practices and lessons learned, and to foster partnerships and collaboration.

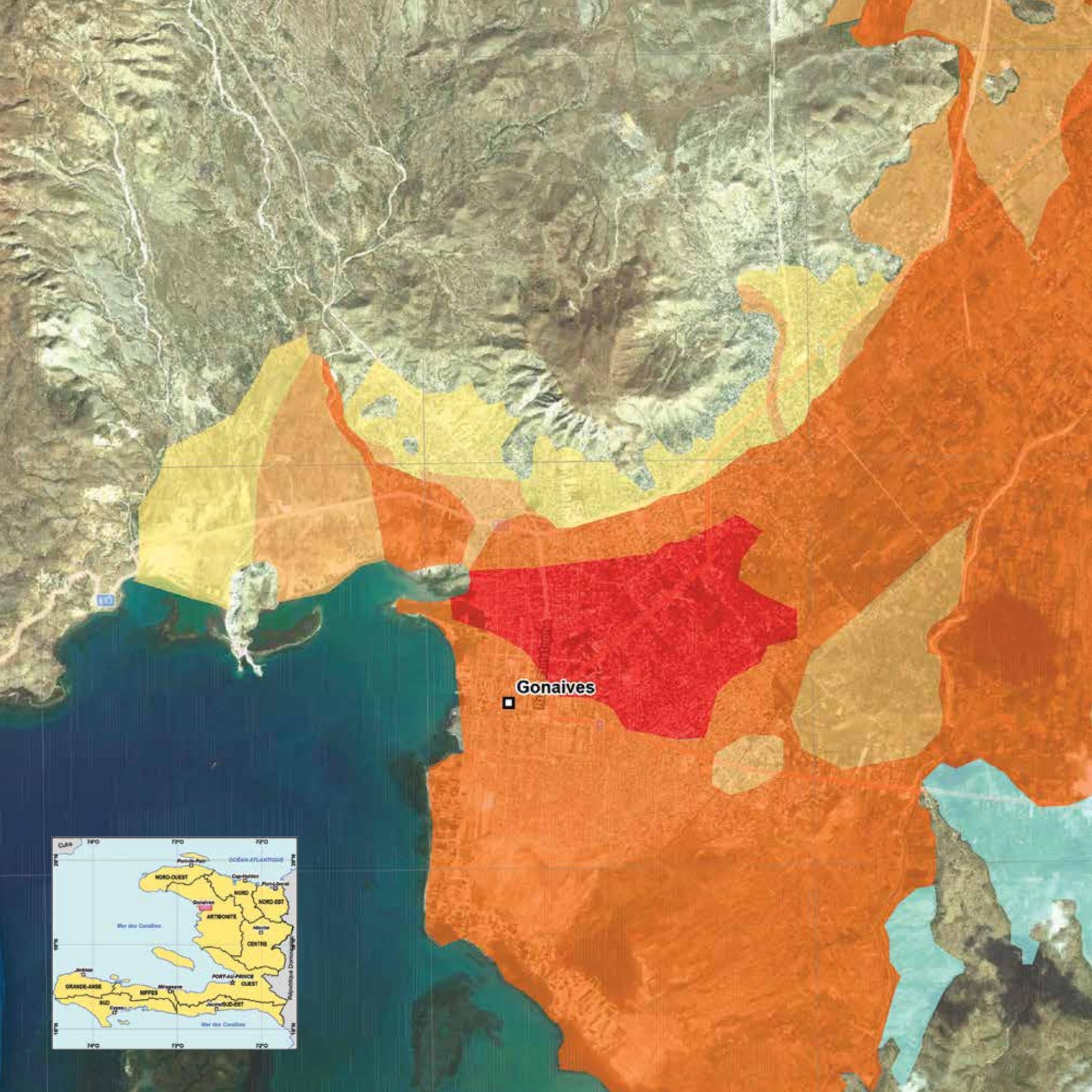
UNISDR is a powerful voice advocating for awareness of disaster risk reduction; catalyzing greater investments in risk reduction; and connecting and mobilizing people by providing guidance and tools. It also publishes the **Global Assessment Report** (GAR)—the UN's biannual flagship report on the state of disaster risk reduction, which includes contributions from GFDRR and other partners. As a repository for knowledge and research, UNISDR complements GFDRR's technical and operational focus in this area.

SENDAI, JAPAN, 2015. A spherical drone is put through its paces on the sidelines of the UN World Conference on Disaster Risk Reduction. Photo credit: The Asahi Shimbun





DRM is integral to sustainable development. With climate and disaster risk on the rise, governments and development agencies are beginning to proactively manage and incorporate risk considerations into all existing and new development activities.



Gonaives



# From Producing to Communicating and Using Risk Information

The Indian Ocean tsunami of 2004 was a defining moment for DRM globally. Since the tsunami, there has been a shift in thinking about the identification of risk—from an emphasis on the production of risk information to its use in decision making. Recognizing, assessing, and understanding risks from natural hazards and climate change are the first steps toward reducing their adverse effects. With access to comprehensive disaster risk information, policy makers and the public can better understand the potential impacts of natural hazards and carry out risk-sensitive planning and investment before a disaster strikes. In recent years, technological innovation has enabled better and cheaper methods for collecting, assessing, and communicating geospatial data. Haiti provides an excellent example of this, progressing from a situation where no maps existed of the capital city of Port-Au-Prince to assist recovery from the 2011 earthquake, to sharing its expertise in open-sourced mapping with other countries. Advances like these have led to the development of new tools to help governments and communities identify and reduce risk, prepare for disaster, invest in financial protection, and plan for resilient recovery.

**GONAÎVES, HAITI.** Map of flood hazards in the municipality.  
Reprinted from: *Atlas of Natural Threats in Haiti*

# Indonesia: Response to the Tsunami Leads to a More Integrated Approach to DRM

After the Indian Ocean tsunami, Indonesia took steps to more effectively manage risk, with better risk information as a starting point. The tsunami was the worst disaster in the country's history and galvanized the international community into action, leading to the development of approaches that comprise DRM as we know it today.

The scale of loss and destruction and the financial cost of rebuilding threw into stark relief the inadequacy of existing systems and thinking on DRM. Indonesia, where the tsunami resulted in the loss of an estimated 168,000 lives and a cost of US\$4.4 billion<sup>5</sup> in damages, became a crucible for the development of an integrated approach to DRM.

After the tsunami, Indonesia built its DRM infrastructure from the ground up, enacting legislation on disaster management,

establishing the **National Disaster Management Agency** (BNBP) and drafting the **National Disaster Management Plan** (NDMP). It prioritized the identification of risk: the government developed a national risk atlas to map exposure to natural hazards across all of the country's districts; assessed provincial- and local-level risk; and adopted open-source software for community mapping projects. This information in turn is used to inform national and local planning and budgeting.

One significant development post-tsunami has been the use of innovative risk identification tools to inform future decision making and policy—like the **Indonesia Scenario Assessment for Emergencies** (InaSAFE). Developed with the assistance of the World Bank and the Australian government, and accessible to

anyone with basic computer skills, InaSAFE is an open-source software tool that identifies risks by calculating and visualizing the spatial impact of a given hazard on communities and infrastructure. It has helped communities assess the nature and scope of the risks they face, and has been adopted as a model by countries around the world, downloaded over 200,000 times globally.

The concentration of people and assets in hazard-prone cities, and the value of assets created by economic growth, increase exposure to damage and loss. Indonesia's vulnerability to natural risks will accelerate with rapid urbanization and climate change. The lessons Indonesia has taken from the tsunami disaster and applied in more recent disasters has increased its resilience to future natural hazards.

**JAKARTA, INDONESIA: A man reads news of the earthquake that shook the Mentawai islands Photo credit: Jefri Tarigan /Anadolu Agency/Getty Images)**



**DID YOU KNOW?**

Coastal flood risk in Indonesia may increase 445 percent over the next 30 years due to urbanization alone.<sup>6</sup>

## Voices of Transformation: Decisive Action<sup>7</sup>



One of the beneficiaries of the MDF was **Hemawati**. When the earthquake that caused the tsunami struck Banda Aceh, Hemawati, a civil servant, fled her house with her two children, having recently seen a television program about a massive earthquake and tsunami. Hemawati's hasty decision saved her family. Her village, Jeulingke, was totally destroyed by the tsunami, and few of the nearly 2,000 villagers survived. Hemawati later participated in the MDF-financed housing reconstruction program. She supervised the construction of her own earthquake-resistant house, where she lives today with her husband and children. "When a large earthquake hit in April 2012, my house did not crack," she said. "It proves the house is strong."





## Aceh and Beyond

Aceh Province, where almost 130,000<sup>8</sup> people lost their lives in the tsunami, was the primary focus of Indonesia's recovery operations. The **Agency for the Rehabilitation and Reconstruction of Aceh and Nias** (BRR) was established in early 2005 and has become a model for similar agencies established elsewhere. A **multi-donor fund** (MDF) for reconstruction was simultaneously established and managed by the World Bank at the request of the Indonesian government, administering nearly \$700 million of the total \$7 billion<sup>9</sup>

in support that poured into the province, where losses amounted to 97 percent<sup>10</sup> of gross regional product. The reconstruction of the city of Banda Aceh in the post-tsunami years is well documented, and indeed remarkable. Less well known is the extent to which preparation for disaster has become integrated into the life of the community. Roads have been widened and escape routes established in densely populated areas, and children make evacuation maps at school.

**BANDA ACEH, INDONESIA, 2005.** Carpenters assist in the rebuilding of a mosque damaged in the Indian Ocean tsunami. Photo credit: World Bank

# A Comprehensive Strategy

Informed by better risk information, Indonesia has made significant progress across all areas of DRM.

## Enhanced capacity for risk identification

- Development of a **national risk atlas**
- **Risk Assessments** conducted at local and provincial levels
- 1.3 million buildings mapped since 2012 using **open-source mapping**<sup>11</sup>
- Pilot and national rollout of **Indonesia Scenario Assessment for Emergencies** (InaSAFE) and other open source tools such as **Indonesia Disaster Risk Index** (InaRISK) and **Indonesia All-Hazards Warning, Analysis and Risk Evaluation** (InaWARE)
- 75,000 urban wards targeted for risk identification and **DRM in Development** training
- Data sharing on disaster management with line ministries coordinated by BNPB

## Paradigm shift from disaster response to risk reduction

- Over 340 provincial and district **Disaster Management Agencies** (BPBDs) adhere to emergency logistics standards issued by BNPB
- Emphasis on the **relocation** of risk-prone communities
- City-level resilience pursued through **disaster and climate risk planning** in a six city pilot
- Over 7,000 facilitators trained in **community-based disaster risk management** (CBDRM)<sup>12</sup>
- **CBDRM** mainstreamed in the national community-driven development (CDD) platform

## Increasing preparedness to respond to disasters

- Resilient village and **safe school initiative**
- Launch of **One Million Safer Schools and Hospitals** campaign in 2010
- Over \$217 million in funding for **Community Driven Development** (CDD) projects<sup>13</sup>
- Development of **Indian Ocean Early Warning System**
- Development of **local contingency plans**

## Significant progress on disaster risk financing

- Ministry of Finance now coordinates **fiscal protection** against disasters
- **Funds** created to enable quicker response to national-scale disasters, including the Indonesia Disaster Fund to coordinate international assistance
- Establishment of the **Indonesia Disaster Fund** to coordinate international assistance for post-disaster recovery
- 1 percent (approx.) of **national budget** allocated to DRM<sup>14</sup>

## Government management of resilient recovery

- \$300–500 million spent annually on **reconstruction**<sup>15</sup>
- Adaptation of a **damage-and-loss assessment methodology** (DaLA)
- 300,000 **earthquake-resilient homes** built back in 18 months after the Yogyakarta earthquake<sup>16</sup>
- 6,000 **facilitators and city coordinators** trained to provide advisory assistance to communities<sup>17</sup>



JAKARTA, INDONESIA. Community mapping. Photo credit: World Bank

# Identifying and Communicating Risk

With access to comprehensive disaster risk information, policy makers and communities can better understand the potential impacts of natural hazards, and carry out risk-sensitive planning and investment before a disaster strikes. Risk information is key to good DRM, and good DRM should be part of all development planning.

**Risk assessments**, the primary means by which risk information is produced, can vary in focus and content depending on the needs of stakeholders. As climate change and urbanization create greater, more complex, and ever changing risks, multi-hazard and dynamic risk assessments have become increasingly vital. A growing priority for the DRM community is to ensure that these assessments are adopted as a global standard to inform the reduction of risk, disaster preparedness, investment planning, and resilient recovery.

In the past decade, demand for risk information has soared, and this need has been met by advances in technology that make the

information available more quickly and at a lower cost. Technical specialists, institutions, and governments around the world have worked to improve the quality and transparency of risk information, to ensure it is fit for purpose, and to enable more local engagement in its production and use.

Through a combination of crowdsourcing, big data, cloud storage, and open-source software, risks may be identified in greater detail and with more accuracy than ever before. **GeoNode**, an open-source, web-based data platform launched in 2011, enables users to access, share, and visualize geospatial data essential for understanding, communicating, and using risk information to reduce risk.

**ThinkHazard**, an online hazard identification tool, provides users with initial information about natural hazards in an area of interest, helping them to make risk-informed choices. And instruments like the **Aqueduct Global Flood Analyzer**, developed by Deltares and the World

Resources Institute (WRI), illustrates the important role the private sector has to play in this area.

Since 2010, over 160 million people in 60 countries<sup>18</sup> have gained improved access to risk information through these platforms—and this information is increasingly used as an input into decision making. The next step is to ensure that it is also used to inform sustainable and resilient development.

Information is only as good as the use to which it is put, and one of the big lessons of recent years is that unless data are understandable, they don't trigger action. Thus, risk information is increasingly tailored for the needs and concerns of various stakeholders. For example, ministries of finance may receive essential data and visualizations, while urban planners may be targeted with platforms that contain more complex information. Communities can be engaged through games or simulations to help them use risk information to make decisions.

An important advance has been the creation of communities to facilitate the sharing of information, and collaboration between stakeholders, including traditional actors like governments and NASA, and non-traditional ones, like local technologists and communities. Established in 2010, the **Understanding Risk** community has become the preeminent platform for global collaboration in the field of disaster risk assessment and communication. Through this community, networks are built, ideas are shared, and partnerships are formed to tackle the challenge of understanding and communicating risk.

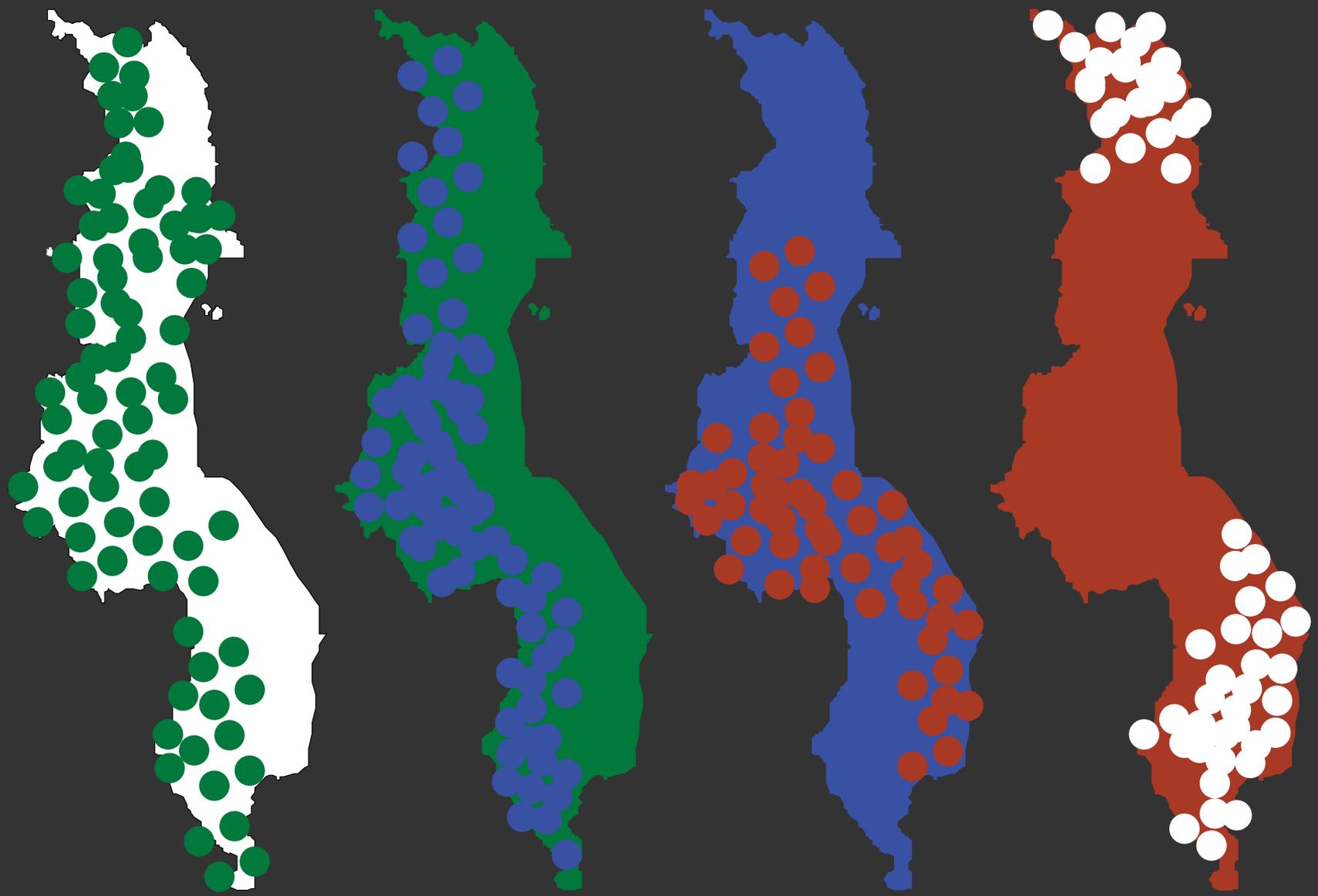
---

**“On the positive side, there is a functioning DRM structure, disaster response time is better, there are standards for reconstruction, and information systems are in place.”**

—Prof. Kuntoro Mangkusubroto, former head of the Aceh-Nias Recovery Agency (BRR)



| MALAWI: Representation of a GeoNode map , with filters.<sup>19</sup>





Risk assessments are now commonly used around the world to inform risk reduction, disaster preparedness, investment planning, and resilient recovery.

### **Risk modeling**

#### **Central America**

To establish a public risk-modeling platform that assists with estimating impacts of future disasters and developing risk-mitigation strategies.

### **Finance**

#### **Chile**

To establish prerequisites for their Global Catastrophe Mutual Bonds.

### **Education**

#### **Senegal**

To increase awareness about the risks of new settlements in hazardous peri-urban areas and inform land use planning.

## Land Planning and Infrastructure

### Yemen

To inform land use planning and infrastructure building codes in the reconstruction efforts after the 2008 floods.

## Catastrophe Insurance

### China

To create an efficient and financially sustainable catastrophe insurance system.

## Agricultural Insurance

### Bangladesh

To introduce affordable and reliable agricultural insurance for small-scale farmers.

## Disaster Planning

### Indonesia

To form the basis of the National Action Plan for disaster risk reduction.

## Response Planning

### Seychelles

To design scenarios for emergency response, emergency plans, disaster management training, and simulation exercises.

## Economic Assessment

### Mozambique

To determine the extent of economic vulnerability to droughts and floods and to identify priority mitigation measures.

### DID YOU KNOW?

In the 2007 cyclone in Papua New Guinea, a photocopied map was one of the only information resources available to the response team. Digitized maps are key to supporting an understanding of risk.<sup>20</sup>



VENICE, ITALY, 2016. Delegates at the Understanding Risk Forum examine a structural model. Photo credit: World Bank

---

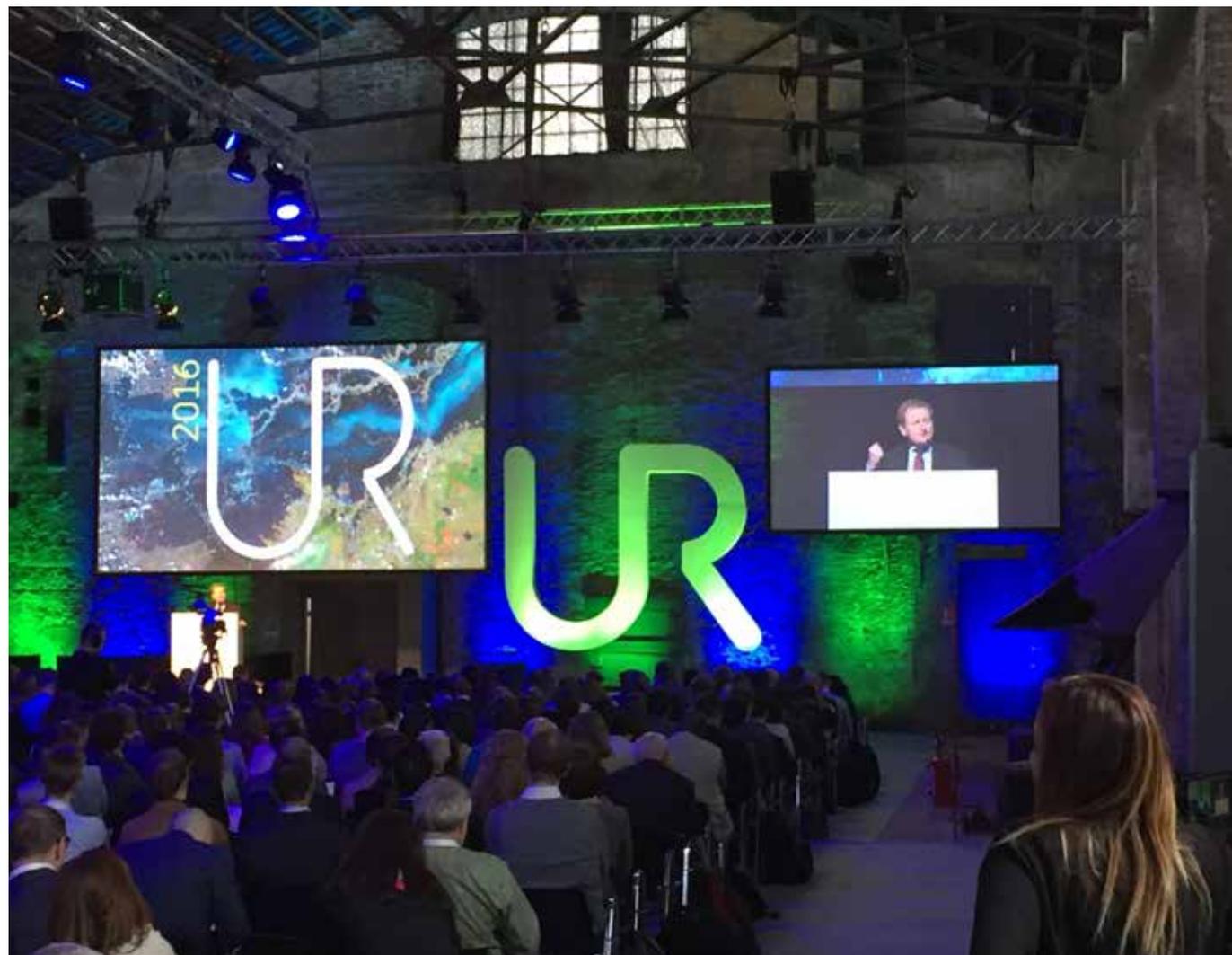
**“Through the UR community, I have met over a dozen people and organizations that I have collaborated with. We have bid projects together, developed new ideas for evolution for risk management tools, created geographic partnerships and replicated and scaled projects.”**

—Andrew Eddy, *Athena Global*

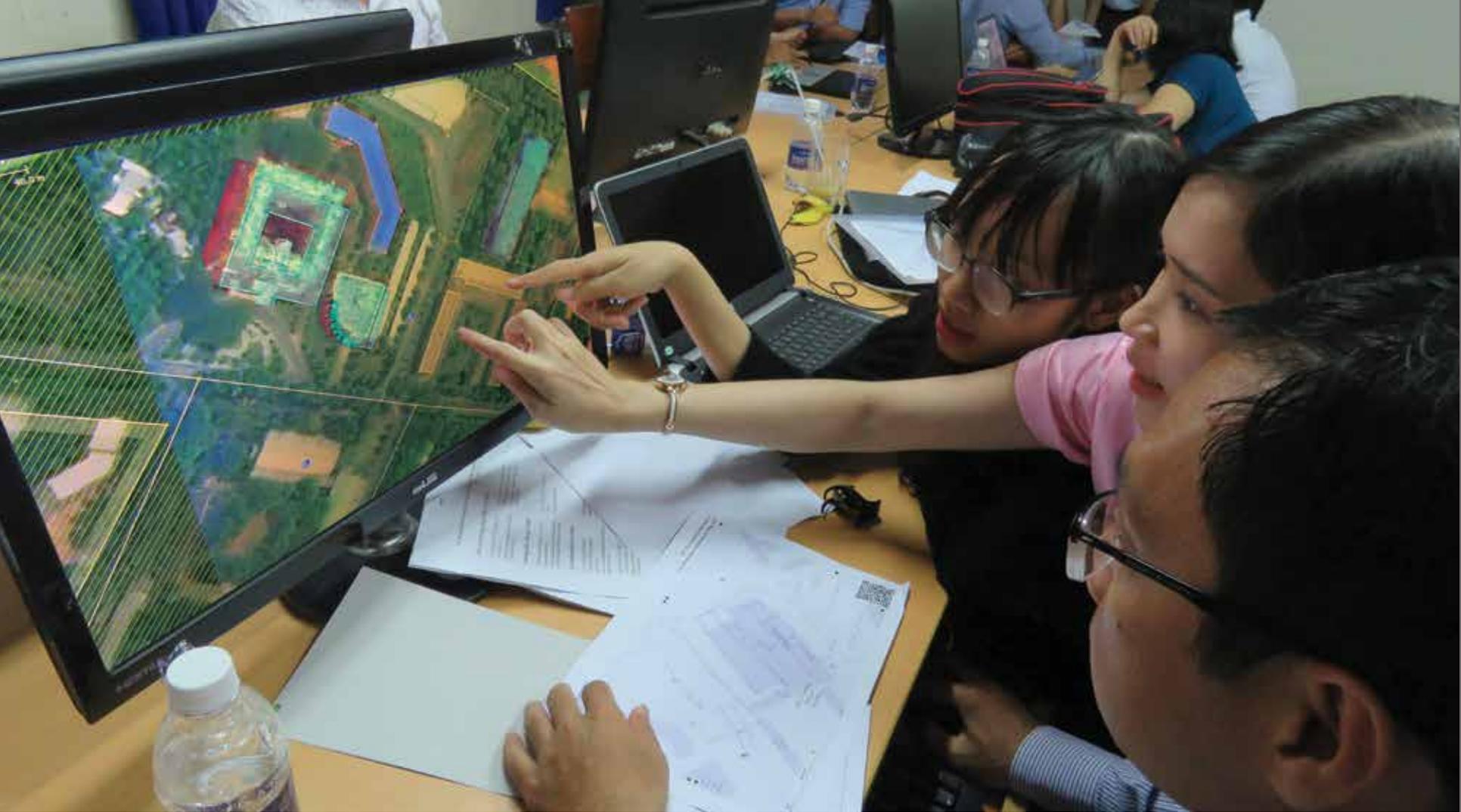
# The Understanding Risk Community

**The Understanding Risk platform enables DRM experts to share their knowledge and skills with each other, and with governments and communities.**

Understanding Risk (UR) is an open global community of over 6,800 experts and practitioners interested and active in disaster risk identification. In addition, over 12,000 users annually access resources and information via UnderstandRisk.org. The community convenes every two years at **UR Forums**, five-day events that highlight best practices, facilitate partnerships, and showcase the latest technical know-how in disaster risk identification. At the 2012 event, a delegation from Nepal learned about community mapping efforts in other countries. They initiated their open mapping project prior to the 2015 earthquake, which proved critical to the response and relief efforts, and shared their experience with representatives from over 100 countries and 350 institutions at the 2016 Forum in Venice.



VENICE, ITALY, 2016. A plenary session at the Understanding Risk Forum. Photo credit: Miki Fernandez



CAN THO, VIETNAM: Local city officials and university students collaborate and learn about innovative mapping technology with OpenStreetMap. Photo credit: Robert Banick

## OpenStreetMap: Where the Streets Have a Name

One of the biggest obstacles in improving risk identification has been a lack of reliable maps of disaster-prone areas. In recent years, the open-data movement has helped communities and practitioners identify risk through remote and community mapping.

Often called the Wikipedia of maps, **OpenStreetMap** is a global online database and user community of over one million members that allows volunteers to collaborate toward creating a free and open

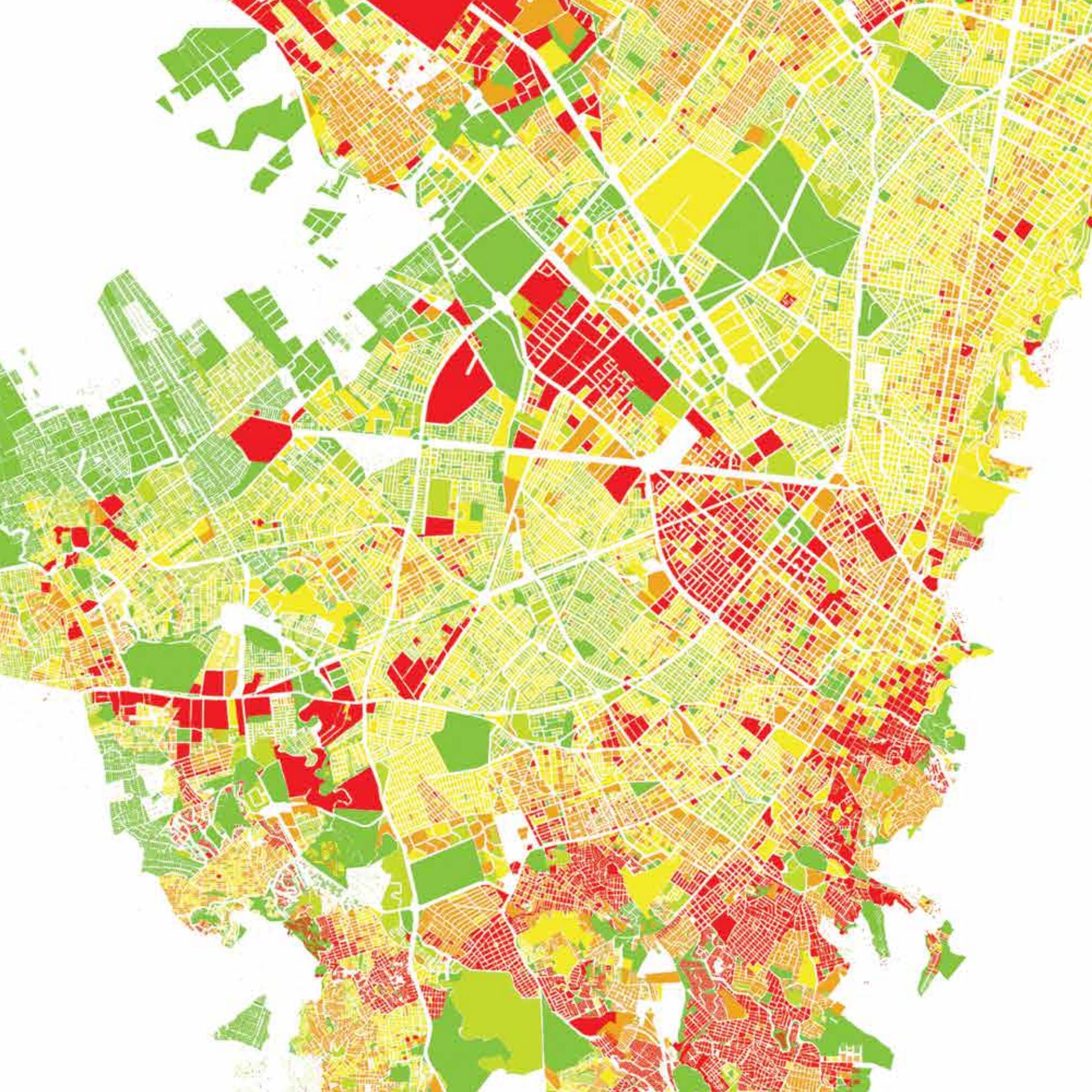
map of the world. This approach is particularly useful in vulnerable regions of developing countries, where vast areas, both urban and rural, are substantially unmapped—and where maps are critical to DRM, from risk identification to reconstruction.

In the aftermath of the 2010 Haiti earthquake, volunteers using OpenStreetMap produced the first free, open, and accurate map of Port-au-Prince, in just three weeks. The data were used to

effectively support the country's rehabilitation, recovery, and development processes for longer term sustainability. When Typhoon Haiyan struck the Philippines in 2013, 1,670 volunteers from 82 countries mobilized to make 4.5 million edits to maps of the affected areas within one month. Haiti provided 12 of the volunteers, who had already seen the benefit of this approach in their own country and who had been trained on the skills to use OpenStreetMap for response efforts.

**Humanitarian Open Street Maps (HOTS)** is a key player in the movement. Through the Missing Maps initiative, for example, developed in collaboration with organizations like the Red Cross and Medicins Sans Frontiers, as well as local nongovernmental organizations (NGOs) and the private sector, HOTS enables the mapping of the most vulnerable places in the developing world, to help communities better respond to crises affecting these areas.

Risk information is key to good risk management, and thus to development planning. As the examples in this chapter have shown, risk information needs to be understood, shared, and used by institutions, governments, and the communities they serve.





## Regional Risks, Global Solutions

**How do we calculate risk to populations or GDP in a risk model? How do we assign values to exposure data? How can we deal with the inherent uncertainties when we estimate risk?**

The **Central America Probabilistic Risk Assessment (CAPRA)** program was created to answer questions like these. CAPRA began in 2008 to create a free and open-source risk assessment platform designed for the complex needs of the region. Local CAPRA teams, often composed of experts from government, academia, and the private sector, worked independently to integrate risk information into policies and investment programs, expand studies, and provide training to other practitioners. CAPRA was an early probabilistic risk assessment

tool and has inspired a number of similar programs that are in use today around the world.

CAPRA also highlights a key priority of GFDRR and other development partners: capacity building. Twenty-six percent of CAPRA's budget<sup>21</sup> was invested in building the technical capacity of public officials and professionals in areas relating to risk identification through knowledge products, short-term learning, and knowledge exchange, all under the direction of a dedicated knowledge manager.



**SAN SALVADOR, EL SALVADOR.** Participants in a Technical Assistance Project (TAP) funded by GFDRR. Photo credit: World Bank



# From Crisis Management to Risk Reduction

Since the adoption of the Hyogo Framework in 2005, countries around the world have moved from a reactive approach after disasters to integrated policies and investments that allow them to reduce risks. The Sendai Framework takes this a step further, with emphasis on the active management of risk. This requires engagement by governments at a policy level, supported by the international community. The commitment of the Turkish and Serbian governments in the examples shows how a government can mobilize resources and people to effect changes that will substantially reduce damages and loss from future disaster. The Safer Schools project demonstrates what can be achieved when nations share their knowledge and resources to reduce risk.

**BELGRADE, SERBIA.** Preparing flood barrier at River Sava banks. Photo credit: Baloncici/Dreamstime.com



## Turkey: Building Resilience through ISMEP<sup>22</sup>

**Turkey's Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (ISMEP) provides a powerful story of urban resilience, where lessons learned from one devastating earthquake have been applied to the reduction and mitigation of future seismic risk.**

The Marmara earthquake of 1999 in Turkey claimed over 18,000 lives and left almost half a million people homeless. Employment losses in the affected area were estimated at between 20 percent and 50 percent, with a direct economic impact estimated at US\$5 billion, or 2.5 percent of gross national product (GNP). As is frequently the case, the disaster alerted the government of Turkey to the need to reduce the risks associated with similar future events.

A major earthquake in Istanbul would likely prove devastating for Turkey as a whole. The city is Turkey's financial capital, accounting for 28 percent of the country's gross domestic product (GDP), hosting

188 of its 500 largest industrial companies, and home to 14 million people. It also lies on the confluence of several major tectonic plates and carries a high earthquake risk. It's estimated that a major disaster there could cost the country as much as \$50 billion. To reduce the risk of damages and loss from a Marmara-scale seismic event in Turkey's financial capital, the Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (ISMEP) was initiated in 2005.

The project was developed by the government and aimed at improving Istanbul's resilience to future seismic shocks. Its total value was \$2.1 billion, secured from development partners, including the European Investment Bank, the Council of Europe Development Bank, the Islamic Development Bank, KfW (the German Reconstruction Credit Institute), and the World Bank.

ISMEP provides a compelling example of the critical role of administrative systems in

risk reduction. Prior to ISMEP, Istanbul's process for building permits was cumbersome and time consuming. In 2006, the Bagcilar and Pendik Municipalities were selected under ISMEP as pilot districts in its Building Code Enforcement project, which sought to make the permit application process more accountable, transparent, and consistent. Projects like this are often where the hard, unacknowledged work of risk reduction happens: for both municipalities, working with the dynamic team at the Istanbul Project coordination unit and a private software company, the process took almost 10 years.

The building permit process has been reduced to 10 days from 90, and the transparency and accountability of the new system have had the added benefit of reducing corruption. The building permit files are now available in digital format, and anyone can easily check these records. The project has also improved the

functioning of other departments, which now fall under the more efficient systems developed for the permit process. A long-term priority for ISMEP is support for better enforcement of building codes and land-use plans.

As ISMEP has demonstrated, the reduction of risk presents a community with an opportunity to minimize the worst effects of future disasters. Perhaps more importantly, it gives them a chance to create a built and administrative environment that is more sustainable, healthy, and functional in which they can enjoy their lives on all those days when disaster seems a distant possibility.

---

**“The most difficult and complicated work of a municipality is planning and building activity, which is also its fundamental duty.”**

—Ali Aydin, Deputy Mayor of Bagcilar district, Istanbul



## Voices of Transformation: A Homecoming

**Yollarin Baslangici** is a civil engineer and project manager contracted under ISMEP in the reconstruction of the Ataturk Student Dormitory—where, coincidentally, he had lived when he was at college. “The most important feature of this project is that it was built in accordance with the fire and earthquake regulations,” he says. “All of the rooms’ doors are fire resistant for 30 minutes, and the wardrobes, curtains, and other materials are also. In addition, the concrete projects and systems were designed according to the seismic methods, so the building is also earthquake resistant. ISMEP has been a significant experience for my career, because ISMEP projects are high-level projects, with technical specifications evaluated by the International Federation of Consulting Engineers (FIDIC). **This project is a source of pride for me.**”



YALOVA, TURKEY. A resident surveys the damage from the 1999, 7.6 magnitude Izmit earthquake. Photo credit: Sadik Gle

## An Architecture of Achievement: Lasting Results of ISMEP<sup>23</sup>

- Improved **technical capacity** for DRM and Emergency Response
- **Enhanced DRM infrastructure**, including vehicles, communication, and information management equipment
- **6,000 new first responders** trained and equipped
- Over **1 million community members** engaged through Safe Life training
- Over **1,250 public buildings retrofitted or reconstructed** along sustainable lines
- **14 hospitals and 60 polyclinics** reinforced to be earthquake resistant
- **26 historical complexes and 176 buildings** investigated for resistance to disaster
- Schools and hospitals increase **energy savings by 40 percent**, water use savings by 25 percent
- Accountable, transparent **building permit procedures** in place
- **3,631 civil engineers** trained in the seismic retrofitting code
- **Students and teachers** trained in the basics of emergency preparedness



# Learning Experience: The Global Program for Safer Schools

Through the **Global Program for Safer Schools** (GPSS) initiative, cooperation between governments, the private sector, and development partners is scaling up best practices in risk reduction, and helping to protect millions of children around the world against the risks of earthquakes and other disasters.

Earthquake tremors themselves don't claim lives—poorly designed and constructed buildings do. Schools are a particularly devastating example of this: natural disasters often damage or destroy school infrastructure, threatening educational opportunities and risking the lives of schoolchildren. GPSS works with a number of partners, including UNICEF, Save the Children, and engineering firms like Arup to make school facilities and the communities they serve more resilient to natural hazards.

The program seeks to reduce the physical impact of disasters on school infrastructure and minimize the disruption generated by such shocks. This is achieved by improving the quality and enforcement of building codes;

building institutional capacity for risk reduction; and integrating disaster risk reduction into the design, planning, and construction or retrofitting of schools. In close collaboration with ministries of finance, public works, and education, the program instills risk considerations into new and existing education infrastructure, bringing disaster resilience to a larger scale. It also helps to focus scarce resources on the most vulnerable students and schools.

The program is currently operational in 13 countries across five regions, and has identified 3 million vulnerable schools as part of a risk benchmarking initiative.<sup>24</sup> This sort of scale can only be achieved with the involvement of partners committing both expertise and resources to making children safer wherever they are at risk of disaster.

**BANDA ACEH, INDONESIA, 2014.** Elementary school students practice earthquake and tsunami drills. Photo credit: Ulet Ifansasti/Getty Images





#### SAFETY IN NUMBERS<sup>25</sup>

## \$110m investment

In Armenia, the government is investing \$110 million in improving the safety of 25 percent of all schools in the country, and has committed to introducing regulatory reform to update its building and retrofitting code.

## 6,000 schools

In Nepal a comprehensive structural integrity and damage assessment was undertaken to inform a prioritized investment plan from partners for the reconstruction and retrofitting of more than 6,000 school buildings.

## 1.5m safer students

In Istanbul, over 944 school buildings have been reinforced or reconstructed, providing safer conditions and better education for over 1.5 million students. Additionally, since the onset of the Syrian civil war and the refugee crisis, the government of Turkey, with support from the European Union and the World Bank, has begun construction of approximately 56 formal and informal schools in southern and southeastern Turkey, directly benefiting more than 40,000 refugee and host community children.

## 70 percent risk reduction

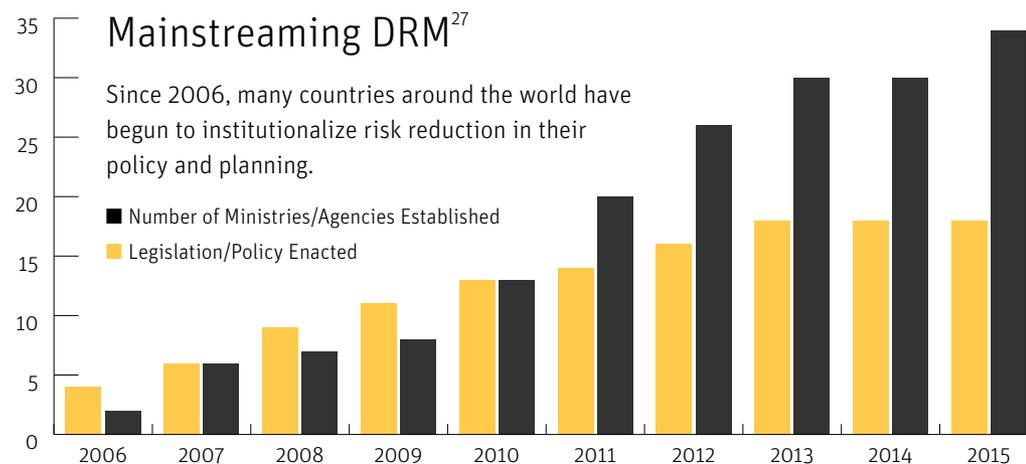
In Peru, the GPSS team worked alongside the Ministry of Education to perform seismic risk assessments for 1,969 public school facilities in 49 districts in Lima. Through a detailed disaster analysis of this data, they discovered that overall seismic risk to schools could be reduced by 70%. With support from the World Bank and Japan, the government has instituted a nationwide Structural Retrofitting Program, making more than 29,000 school facilities more resilient to earthquakes, helping protect the lives of more than 2.5 million students.



## Serbia: Regulating Risk<sup>26</sup>

**In May 2014, Serbia experienced its most severe flooding in more than a century; a recovery needs assessment revealed that the floods had affected 22 percent of the population, and estimated recovery and reconstruction needs at nearly \$1.5 billion. This catalyzed efforts by the government of Serbia to implement broad policy changes and interventions along several fronts, helping reduce the risk of loss and damage from future disasters, and providing a comprehensive model for other countries seeking to build risk reduction into their planning.**

- Serbia is on track to become the first country in the world with legislation fully aligned with the **Sendai Framework** for Disaster Risk Reduction.
- The government launched the **National Disaster Risk Management Program (NDRMP)** and DRM legislation to build resilience, reduce disaster risks, and mobilize recovery funding for priority sectors. The NDRMP is recognized as one of the most comprehensive approaches to managing disaster risk in the world.
- Finance has been raised through the NDRMP to **build capacity** for the disaster risk and crisis management system, representing a major shift on the part of the Serbian government from a reactive to a more planned approach.
- In addition, the country has adopted a National Disaster Risk Financing and Insurance (DRFI) Strategy to respond more effectively to the financial impacts of disasters, securing a Development Policy Loan with a **Catastrophe Deferred Drawdown Option (Cat-DDO)** that will provide up to \$70 million in rapid liquidity in the event of a disaster.
- **Risk identification, preparedness, and early warning** were prioritized. This included strengthening flood forecasting and hydro-meteorological monitoring, and the production of a high-resolution digital terrain model for flood risk mapping.
- To reduce future risk, the government is taking steps to strengthen its **legal and institutional framework** to improve decision making—both locally and nationally—for post-disaster reconstruction and the harmonization of investments in DRM.



The reduction of risk, supported by policy and legislation, helps minimize the worst effects of future disasters. In the last decade countries around the world have made significant progress in establishing ministries and agencies and enacting legislation, institutionalizing risk reduction in their planning.



## From an Improvised to a Planned Response

The shift from disaster response and recovery to preparedness and preventive action has helped to reduce the impact of disasters on communities around the world. Since 2007, this shift has been accelerated by massive advancements in computing power and other technologies, which has led to great improvements in forecasting and early warning systems. At the same time, some of the most significant gains have come in the form of low-tech solutions in contingency and emergency response planning, as communities themselves mobilize to prepare for disasters. Response to disasters of a similar magnitude in the Indian state of Odisha offers a hopeful example of how preparedness can reduce damages and loss. The CREWS and Africa Hydromet programs provide a road map for disaster preparedness in those states already experiencing the effects of climate change—including less-developed nations in Africa and the small island states of the Pacific.

**INDIA.** Community-driven disaster preparedness for hurricanes and cyclones. Photo credit: Pallava Bagla/Corbis via Getty Images



## Odisha: A Tale of Two Cyclones<sup>28</sup>

**The differences in the response to two cyclones in the Indian state of Odisha resulted in a dramatic reduction in loss of lives, and illustrate the advances made in early warning systems and the involvement of communities in disaster preparedness.**

Located on the Bay of Bengal, the Indian state of Odisha has almost 500 km of coastline and is particularly vulnerable to hydro-meteorological (hydromet) risks. Never was this more apparent than during the BOB 06 super cyclone of 1999, which brought storm surges of 5–6 meters up to 35 kilometers inland, and widespread flooding from the torrential rains. An estimated 10,000 people lost their lives, and 2.5 million were marooned. Over \$4.4 billion in damages was sustained—20,000 flood embankments were breached, and 1.6 million homes damaged.

By contrast, Cyclone Phailin, which hit the region with comparable force in 2013, caused an estimated \$1.4 billion in damages and resulted in the loss of 50 lives. What changed? In short, a coherent strategy on the part of government, the effective use of early warning systems, and the involvement of communities in preparations for disaster.

### A Coherent Strategy

Just one month after the 1999 cyclone, the state government established the **Odisha State Disaster Mitigation Authority (OSDMA)** to coordinate relief, restoration, reconstruction, and preparedness activities. The latter included the establishment of the **Odisha Disaster Rapid Action Force (ODRAF)** encompassing police and military units trained to respond to a range of hazards.

Preparations for future storms like Phailin took place under the management of the **National Cyclone Risk Mitigation Project (NCRMP)** and the **Coastal Disaster Risk Reduction Project (CDRRP)**. Established in 2010 as India's first preventative DRM initiative, the NCRMP—along with the CDRRP—has since broadened its original focus from Odisha and the neighboring state of Andhra Pradesh to cover eight other states that benefit from improvements in coastal resilience.

**ODISHA, INDIA.** Community-driven disaster preparedness training for cyclones and hurricanes.  
Photo credit: Gettyimages





## Together, these programs are aimed at:

- Improving early warning systems for hydrological events through the installation of communication networks;
- Strengthening response/search and rescue capabilities through manpower, training, and equipment;
- Preventing ocean waters from flooding agricultural lands through the construction of saline embankments and coastal canals;
- Improving roadways, bridges, and shelters for better resilience;
- Undertaking risk and damage assessments to better inform disaster risk reduction strategies; and
- Initiating and supporting community-based DRM (CBDRM).

Under these programs, ten coastal states are adding over 1,500 km of new evacuation roads, 30 bridges to better connect vulnerable communities, and 200 km of improvements to existing coastal embankments. They are also reducing potential disruptions of economic activity after a natural hazard. For example, in the state of Tamil Nadu, funding has been used for undergrounding electrical

cables in several villages, helping to ensure a steady electricity supply so that businesses can continue to operate.

## Early Warning

The Indian Meteorological Department and associated scientific agencies get meteorological data from several sources—land-based observations, Indian and foreign satellites, and ocean data from ships and buoys, inter alia. In recent years, modeling and forecasting has improved dramatically with the addition of computing capacity. This enabled the department to predict the likely path and scale of Phailin, helping the government to arrange the timely evacuation of almost a million people from thousands of villages and vulnerable homes to places of greater safety.

## Taking Shelter

The earlier cyclone had made people more receptive to government notifications about the approaching storm and the evacuation procedures, which were communicated through a system encompassing mass media, public address systems, and announcements in places of worship, with annual mock drills held to check the system. This system has since been

strengthened with initiatives like the distribution of 2,100 cellphones with specialized cards and apps to communicate customized warnings to local leaders and communities.

During Cyclone Phailin, 50,000 people found protection in some of the 200 newly constructed cyclone shelters. Each shelter is overseen by a committee made up of community members who are responsive to local needs. This model is being replicated in all other Indian states that are receiving new cyclone shelters built with NCRMP funding.

As a combination of urbanization and the effects of climate change place a greater burden of risk on India's coastal cities, Odisha has become a model of preparedness for other Indian states vulnerable to natural hazards.

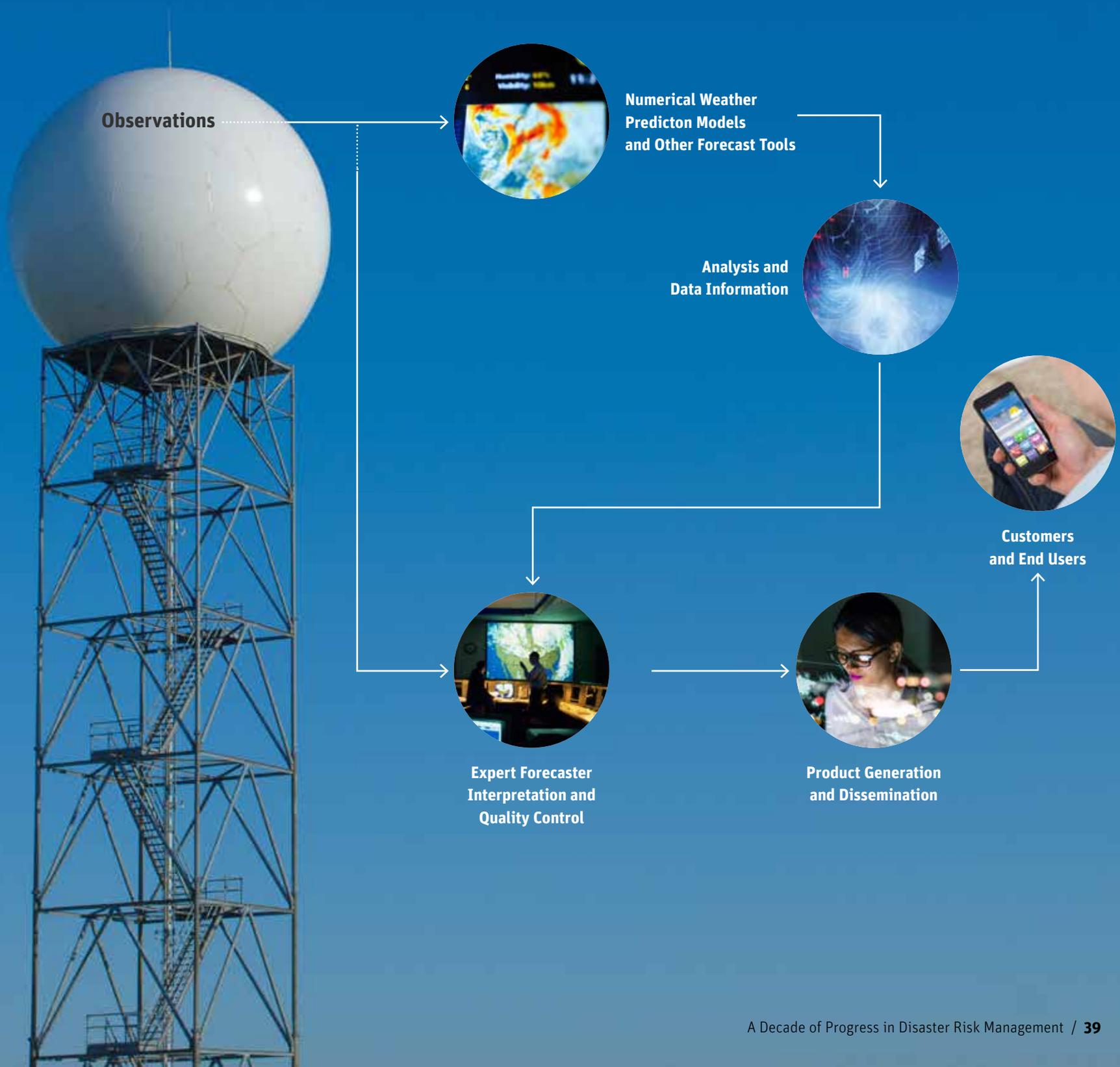
---

**“After the super cyclone, we learned that preparation is much more important than response. We started thinking of disaster management as a proactive thing, and that requires planning and prevention.”**

—Kamal Lochan Mishra, Senior official at OSMDA

## Out of the Blue: A National Meteorological Service at Work

**Effective prediction of a hydromet event is critical in mitigating its effects. A good national meteorological service is designed with its end users in mind—including businesses, institutions, and community members.**



A close-up photograph of two women in traditional Indian attire, likely sarees, looking thoughtfully to the side. The woman on the left is wearing a green and gold patterned sari, and the woman on the right is wearing a green and yellow patterned sari. Both women have traditional Indian jewelry, including bindis on their foreheads and nose rings. The background is blurred, suggesting an outdoor setting with other people.

## Women Prepared

In India, as elsewhere in the developing world, women are disproportionately affected by disasters. For example, in the 2004 Indian Ocean tsunami, women accounted for 70 percent of deaths in the coastal state of Tamil Nadu.<sup>29</sup> Women's limited participation in DRM exacerbates their vulnerability—a situation several activities under the NCRMP

and CDRRP are seeking to address by including women equally in the management of cyclone shelters and participation in youth task forces for search and rescue, first aid, evacuation, and early warning. In Andhra Pradesh, woman self-help groups under the Velugu project have been formed to manage and maintain the planned 222 multi-purpose cyclone shelters. In Odisha,

the effective community response to Cyclone Phailin was driven in part by the inclusive communication and outreach strategy that promotes a “safety culture” and empowers women and men alike. The government is now working with all the states along India's 7,500 km of coastline to replicate these models of community participation and ownership.



## Community Preparedness in Bangladesh

**“Bangladesh is a shining example of what can be achieved when you invest in local systems and volunteer networks to ensure that early warnings are acted on and that the public is risk informed.”**

—Robert Glasser, UN Secretary-General’s Special Representative for Disaster Risk Reduction

After Cyclone Bhola in 1970, when 500,000 people lost their lives in flooding and subsequent famine, Bangladesh became a byword for natural disaster in a developing context. In its response to Bhola, and to later disasters, Bangladesh has become a model for community preparedness globally. Established in 1970, with the assistance of the International League of the Red Cross, the government of Bangladesh’s Cyclone Preparedness Programme (CPP) mobilizes 60,000 community volunteers, over a third of them women, to communicate cyclone warnings to their communities, to assist in evacuation efforts, and to serve as

first-line relief workers. Since the adoption of the CPP, which is now run with the assistance of the Red Crescent Society, there has been a dramatic reduction in the number of deaths from comparable disasters, from 140,000 during the Odisha Cyclone in 1991 to only 113 in 2009. In 2016, during Cyclone Roanu, community volunteers assisted in the safe and orderly evacuation of about 500,000 people across 18 districts to cyclone shelters and other places of safety. While the advances in preparedness and in DRM have been particularly dramatic in recent years, Bangladesh reminds us that sustainable gains in these areas take time.

**AURANGABAD, INDIA.** Women at a community meeting. Photo credit: Simone D. McCourtie/World Bank

## Voices of Transformation: Communities Taking Control

In Vietnam, where 70 percent of the population is exposed to risks from multiple hazards, and where up to 1.5 percent of GDP is lost every year to disasters, the government has implemented a strategy of community-based disaster risk management (CBDRM), a holistic approach to tackling the challenges of natural hazards. “Before the project, we only had temporary houses and farms,” says **Nguyen Van Hai**, who lives in the community of Quynh Luu. “In the rainy season we were very afraid of floods. Everything was uncertain.” The strategy involves training communities to develop their own preparedness strategies and to integrate DRM into their local socioeconomic development plans. These include climate resilient maintenance on 4,700 kilometers of rural roads, and the renovation of irrigation facilities. These projects have employed tens of thousands of Vietnamese and benefited over 3 million people. The government is now investing \$500 million to roll out CBDRM projects across 6,000 communities.<sup>30</sup> “As a result of the project, we have had a lot of benefits,” reports Nguyen. “People have started to work and renovate their houses without worries about the risks in the rainy season.”

## Climate Challenge: CREWS and Africa Hydromet

With investments in early warning and community-level preparedness, two major recent initiatives are helping less developed countries become much better prepared for climate-related hazards.

**The Climate Risk and Early Warning Systems (CREWS)** initiative was launched at COP21 in December 2015 to mobilize the international community to support early warning systems in the least developed countries and small island states. A partnership between WMO, UNISDR, GFDRR, and the government of France, CREWS adopts an integrated approach, focusing on multi-hazard early warning systems to address key systemic deficiencies and build long-term capacity and sustainability.

**The Africa Hydromet program** was established in partnership with the African Development Bank, the World Meteorological Organization (WMO), the World Bank, and GFDRR. It is aimed at modernizing and strengthening hydromet service delivery in Sub-Saharan Africa through better forecasting, accessible weather data, and improved international collaboration to help prevent future disasters. Through this initiative, decision makers and implementers are able to access more accurate information more quickly, and will be able to more effectively manage disasters through the use of remote sensing and data management. Better hydromet data will also contribute to better economic productivity of weather-dependent sectors, such as agriculture, transport, water resources management, and power generation, among many others.

In September 2017, the inaugural African Ministerial Conference on Meteorology (AMCOMET)–Africa Hydromet Forum held in Addis Ababa brought together representatives from governments, public and private sectors, regional entities, development agencies, and civil society to provide strategic insight to improve hydrological, meteorological, and early warning services.

Each of these initiatives provides better hydromet information to those who need it most. Flood-prone groups such as farmers, women, and livestock herders, as well as food insecure households, are able to make more informed decisions to cope with exposure to climate variability and natural hazards.

ZULULAND, SOUTH AFRICA. Sibusiso Mbhele made this weather vane to resemble an aircraft. Photo credit: Patrick Durand/Sygma via Getty Images



A man in a light-colored short-sleeved shirt and dark trousers is watering a field of green leafy vegetables. He is holding a silver metal watering can with a long handle and a hose. The background shows a large tree and a body of water, likely the Niger River, under a bright sky. The scene is set in a rural area near Bamako, Mali.

AFRICA HYDROMET AT WORK

## Modernization in Mali

Mali, which is prone to drought, flooding, and locusts, was among the first countries in West Africa to prepare an integrated, strategic hydromet modernization plan. In 2016, \$27.5 million in funding was mobilized to support Mali's modernization of its National Meteorological and Hydrological Services (NMHS), as well as civil protection and food security services.<sup>31</sup>

BAMAKO, MALI. A man waters his vegetables near the Niger River. Photo credit: Dominic Chavez/World Bank

The shift from disaster response and recovery to preparedness and proactive risk management is helping to reduce the impact of disasters on communities around the world. As climate change affects the nature and scale of disasters like drought and floods, the preparedness of communities to prepare themselves through better warning systems and better preparedness is becoming increasingly critical.





# From Financial Products to Comprehensive Financial Protection Strategies

Disasters caused by natural phenomena cost \$520 billion in losses, and force some 26 million people into poverty each year. The rise of a volatile mix of drivers like climate change, uncontrolled urbanization, and anthropogenic factors such as conflict will further exacerbate this trend. As a result, countries are now more aware of the fiscal risk from disasters and are making more informed decisions to protect their budgets. The last decade has seen a proliferation of financial instruments and strategies available to help meet the costs of disasters. These innovations in risk financing are allowing governments to adopt more comprehensive risk financing strategies. Equipped with the right tools to protect livelihoods, investments, and sustainable development, governments are becoming more effective risk managers, rather than emergency borrowers.

MEXICO CITY, MEXICO. Photo credit: Zaharov



# Mexico: A Holistic Approach

**In Mexico, where the legal and institutional framework is increasingly informed by the concept of Holistic Risk Management (GIR), a holistic and effective approach to disaster response has evolved, one that integrates financial protection and social protection.<sup>32</sup>**

Mexico is highly exposed to a range of natural hazards, such as earthquakes, hurricanes, floods, droughts, and volcanic activity. Over the last decades, with population growth, urbanization, and the concentration of physical assets in risk areas, this exposure has increased. Unplanned and unregulated land use, lack of environmental controls, and poor building standards also contribute significantly to asset losses. In 2013 alone, disasters caused the government reconstruction costs to exceed \$4.97 billion.

## An Evolving System

Mexico's **National System for Civil Protection (SINAPROC)** was established in 1986 following the earthquake in Mexico City the previous year, in which 6,000 people died, 36,000 houses were

destroyed, and more than 65,000 suffered major damages, leaving at least 250,000 without homes. Initially designed to improve Mexico's planning, response, and recovery capacity, SINAPROC has evolved to focus on building an end-to-end DRM system encompassing risk identification, prevention, reduction, financing, and post-disaster reconstruction.

Under SINAPROC, the government established **Mexico's Fund for Natural Disasters (FONDEN)** in 1996 to support the rapid response and the reconstruction of federal and state infrastructure affected by disasters due to natural phenomena. In the mid-2000s, FONDEN evolved to become the backbone of the Mexican federal government's financial protection strategy in the face of these disasters. This led to Mexico's issuance of the world's first sovereign catastrophe bond in 2006, which was renewed in 2009 and 2012. In August 2017, it was announced that the World Bank would issue \$360 million in three-year catastrophe bonds—the largest ever issued by the Bank—to be paid out in the event of a hurricane or earthquake. In addition, since 2011, the government has purchased indemnity reinsurance coverage to

transfer portions of FONDEN's risk portfolio.

## Financing Recovery

FONDEN comprises a highly effective set of financial instruments. The Mexican government finances FONDEN, the **Fund for the Prevention of Natural Disasters (FOPREDEN)** and the **Fund for the Assistance of Climatological Contingencies**, with a combined sum of no less than 0.4 percent of the programmable spending of the annual national budget, which may vary depending on the annual budget of expenses—around \$681 million.

FONDEN finances 100 percent of the reconstruction of federal assets and 50 percent of local assets the first time it's required. If an asset remains uninsured and is destroyed again, FONDEN provides 25 percent of the replacement cost, but nothing in the event of a third disaster. This incentivizes local governments both to build back better, and to insure themselves against further loss.

Nevertheless, under FONDEN, support may be granted to the states that request it in order to develop a comprehensive risk-management strategy. FOPREDEN funds critical

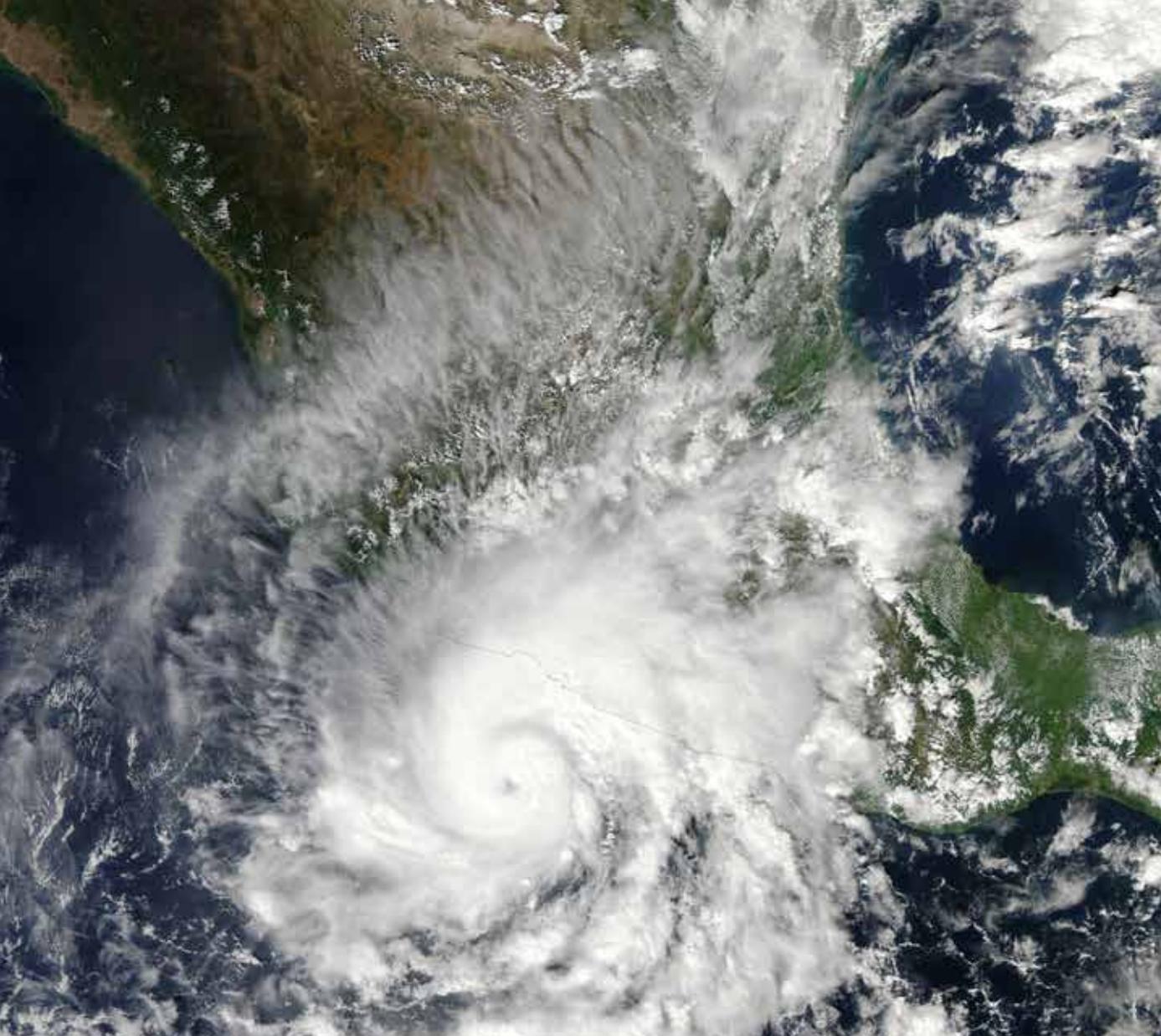
activities related to risk assessment, risk reduction, and capacity building.

One of the lasting effects of major disasters is the impact they have on GDP growth. In light of this, the main achievement of FONDEN is that it succeeds in boosting local economic activity in the year after a disaster.

## Working with Partners

A signature feature of Mexico's approach is its integration of all aspects of risk management into a larger coordinated effort. For example, the newly created **Ministry of Territorial and Urban Development (SEDATU)** promotes the mainstreaming of disaster risk management into land use and urban planning. FONDEN itself works closely with the **National Centre for Disaster Prevention (CENAPRED)**, the technical arm for the government's disaster risk reduction program.

FONDEN demonstrates that efficient fiscal protection ensures that government resources are available after a disaster to support low-income households and quickly rebuild public infrastructure.



## Voices of Transformation: Decisive Action

When hurricanes Ingrid and Manuel hit Mexican territory in September 2013, 27 Emergency Declarations were issued, which prompted the Mexican government to authorize over \$3.3 billion<sup>33</sup> through FONDEN. This resulted in a prompt response for the reconstruction of public infrastructure and low-income housing in 19 affected states, benefiting 406 municipalities. “Civil Protection officers delivered to the community food provisions, reconstruction material, shelter, medicines, and cleansing products,” recalls **Josefina Sierra Hernández**, whose home was damaged by Manuel. “We also saw that other services like communication, basic services, removal of debris, cleansing of streets and housing restoration were attended quickly.”

### WEATHERING THE STORM

#### How a Cat-DDO Works

- A Development Policy Loan with a Catastrophe Deferred Drawdown Option (Cat-DDO) is one of a broad spectrum of risk financing instruments available from the World Bank Group to help borrowers plan efficient responses to natural disasters.
- A Cat-DDO allows borrowers to prepare for a natural disaster by securing access to a financing source before a disaster strikes.
- It is a contingent loan that provides immediate liquidity following a natural disaster, while funds from other sources (e.g., concessional funding, bilateral aid, or reconstruction loans) are being mobilized.
- Funds become available for disbursement after the declaration of a state of emergency due to a natural disaster.
- To qualify, the country must have a DRM program in place.
- Under the Cat-DDO, borrowers can secure immediate access to financing up to \$500 million or 0.25 percent of GDP, whichever is less.

**MEXICO.** Hurricane Raymond became the first major hurricane of 2013 in either the Atlantic or Pacific basin when it reached category 3 status on October 21. Photo credit: NASA

### DID YOU KNOW?

**Between 1999 and 2016, Mexico approved almost \$20.7 billion for the reconstruction of public infrastructure and low-income housing.<sup>34</sup>**

# Sharing the Load: Pooling Risk in the Pacific and Caribbean

Separated by a continent and thousands of miles of ocean, the island nations of the Pacific and Caribbean share many characteristics and challenges. Not least of these is the threat of disaster caused by natural phenomena—from storms and flooding, seismic and volcanic activity, and, more recently, the effects of climate change. Such disasters cost Pacific Island countries more than \$280 million per year.<sup>35</sup> This impact is exacerbated by the fact that few if any of these nations have the economic scale to shoulder the financial cost of recovery.

In 2007, in response to requests from countries in the Caribbean region, where the cost of the 2017 hurricane season alone is likely to exceed \$400 billion, the World Bank and other partners assisted in the establishment of the **Caribbean Catastrophe Risk Insurance Facility** (CCRIF). It was the first ever multi-country risk pool, allowing participating countries to purchase catastrophe risk insurance coverage as a group at a significantly lower cost than if each country purchased the

insurance independently. CCRIF was restructured in 2014 to allow for the total segregation of risk, and to facilitate expansion into new products and geographic areas, including Central America.

Today it operates with 17 participating countries, providing members with insurance coverage of over \$500 million. CCRIF provides member countries with immediate liquidity following disasters: when the 2010 earthquake struck Haiti, CCRIF was the first institution able to mobilize emergency funds, within the first two weeks of the disaster. To date, CCRIF has paid out over \$120 million to 13 governments.

The CCRIF served as the model for the **Pacific Catastrophe Risk Assessment and Financing Initiative** (PCRAFI), the pilot for which was also launched in 2007. The PCRAFI facility, which is cofinanced by the government of Japan and the EU, is based in the Cook Islands. It is managed by the beneficiary countries, and is supported by the **PCRAFI Technical Assistance Program**. This is a series of activities designed to strengthen the institutional

capacity of the facility itself, as well as national- and regional-level organizations and the ministries of finance of beneficiary countries.

PCRAFI has also seen an estimated reduction of 50 percent in the premiums paid by participating countries—proving that the international reinsurance market is willing to provide catastrophe risk insurance to small island countries at competitive prices. In early 2017, PCRAFI was extended with a project which increases financial resilience by providing rapid response emergency funds immediately after natural disasters, and further technical assistance to support finance ministries in developing their disaster risk financing strategies.



---

**“PCRAFI is a major advancement in the region to mitigate against the financial impacts caused by extreme climate, weather related, and geological hazards. Countries have full ownership of the PCRAFI Facility . . . designing financial instruments that fit national disaster risk financing strategies.”**

—Dame Meg Taylor, Secretary-General of the Pacific Islands Forum

## Disaster Risk Finance



Infrastructure and  
Urban Development



Energy  
and Water



Climate and Disaster  
Risk Management



Financial Market  
Development



Public Debt and  
Risk Management



Macro and Fiscal  
Stability



Social  
Protection



Agriculture  
and Food Security

## Protecting Livelihoods



Financial Protection  
for Governments

**\$3.4 billion**

in risk financing solutions provided by the World Bank Group to vulnerable countries, often leveraging financial markets.



Agricultural Insurance  
for Loss of Crops and Livestock

**34 million**

farmers benefited from increased insurance coverage and faster claims payments in India through improvements to the National Agricultural Insurance Scheme.



Property Catastrophe  
Risk Insurance

**\$70 million**

for 21,000 claims were paid by the Turkish Catastrophe Insurance Pool.



Disaster Risk Finance  
for Scalable Social Protection

**3.1 million**

more people benefited from Ethiopia's Productive Safety Net Program during the 2011 Horn of Africa drought.



# Panama: Institutionalizing Risk Financing

A growing priority in recent years has been to shift responsibility for disaster risk financing from the technical ministries to the Ministry of Finance. In 2014, Panama implemented a comprehensive framework for disaster risk financing and insurance with a dedicated risk management unit within the Ministry of Economy and Finance; this unit informs public policies on DRM and engages relevant stakeholders. Panama is the first country in the world to adopt such a strategic framework through a law; other Latin American countries have expressed interest in following the country's example.

PANAMA. Construction works for the Panama Canal expansion project. Photo credit: Gerardo Pesantez/World Bank



Disaster risk financing has become an integral part of DRM, helping meet the cost of disaster without compromising development goals, fiscal stability, or well-being.



## From Reconstruction to Building Back Better

As disasters increase, driven by climate change and a rapidly urbanizing population, proactive planning has become more critical to resilient recovery. This involves the assessment of damage, economic losses, and recovery needs after disasters, and the planning, financing, and implementation of a recovery program. These roles have been increasingly adopted by national governments and communities, where the impact of one disaster leads to more resilient recovery to prepare for when the next one strikes. Nepal's recovery efforts after the Kathmandu valley earthquakes of 2015 illustrate both the benefits of this approach and the challenges of implementation. Djibouti provides an example of what is possible when the national government fully commits itself to recovery, while the case of Ukraine shows how methodologies developed for disaster recovery may be adapted for reconstruction efforts in fragile and conflict states.

**MELAMCHI, NEPAL, 2016.** Survivors of the Ghoroka earthquake viewing new houses at the Giranchaur integrated settlement. Photo credit: Narayan Maharjan/NurPhoto via Getty Images



# Nepal: From the Ground Up

**The 2015 earthquakes in Nepal exposed gaps in the country's preparedness for disaster and provided valuable lessons for future events. They also galvanized the government and communities to create a robust framework for resilient recovery, assisted by international partners.**

In April and May 2015, two high magnitude earthquakes rocked the Kathmandu Valley, claiming nearly 9,000 lives and leaving 3.5 million people homeless. In total, the disaster affected an estimated eight million people, pushing a million into poverty.

To better understand the scale of the disaster's impact and the scope of recovery needs, the government of Nepal conducted a post-disaster needs assessment (PDNA), launching it in mid-May 2015 with support from 40 international partners. The PDNA was conducted by 250 experts in a record time of seven weeks, assisted by a PDNA Guide (See *Djibouti: Season of Hope*).

Damage was estimated at \$5.15 billion, losses at \$1.9 billion, and recovery needs at \$6.7 billion—about a third of Nepal's GDP.<sup>36</sup> The findings of the PDNA led to the International Conference for Nepal's Reconstruction, where the government secured over \$4 billion in pledges toward recovery and reconstruction needs.

## Challenges of Reconstruction

When the earthquakes struck, the country did not have a single agency leading DRM efforts. This impeded coordination immediately after the disaster. There were similar difficulties during reconstruction: the National Reconstruction Authority (NRA) was initially established by temporary decree, and when this lapsed, the NRA lost its authority. Further setbacks occurred with a change in government, and the upshot was that a year of recovery was lost. Political tensions at the time with neighboring India also saw delays at the border of vital supplies for

both recovery and reconstruction. All of this makes the case that it is important before disaster strikes to have clear institutional arrangements to manage the recovery process.

The housing sector was hit hardest by the earthquakes, and the government's recovery plans included the design of a large homeowner reconstruction program in 14 of the most affected districts. The program received over \$550 million in pledges from a range of different partners, including Japan International Cooperation Agency (JICA), the World Bank, Canada, Switzerland, and others. Through the program, the government has channeled housing grants to allow owner-driven housing reconstruction in target areas. More than 550,000 beneficiaries have enrolled in the program, receiving over \$270 million in housing grants for the construction of multi-hazard resistant houses, which themselves will enhance Nepal's ability to improve long-term disaster resilience.

**KATHMANDU, NEPAL, 2015. Local residents walk on the rubble of collapsed houses completely destroyed by the earthquake at Bhaktapur Durbar Square. Photo credit: Mumbaipho | Dreamstime.com**



## Voices of Transformation: A Sturdier Future



**Rukmedi Adhikari's** family lost their home in Thansingh during the quake. As beneficiaries of the Earthquake Housing Reconstruction Project, they have been able to build a new home that will better withstand the impact of such future disasters. “Our house collapsed completely when the earthquake struck,” says Rukmedi. “They are giving us financial aid and that is why we have started building the house now. Once we started, we thought it better to build a concrete house. I started it as I thought it would be better to take a loan and invest in a concrete house rather than the one with the old structure. Hopefully the new house will be able to protect us from the earthquake. The engineers have helped us build the house. I think everyone is happy that they are receiving the money to build their houses.”

Again, a lack of planning and coordination delayed the onset of reconstruction. After the disaster, both the government and international partners agreed that a census of affected households was necessary before funds could be disbursed. Indecision and disagreement on budgetary issues delayed the training of students to conduct the census. With the delay of the survey itself, many families spent the harsh Nepali winter in temporary accommodation—and this triggered an entirely new emergency operation. With procedures in place for such surveys, and an existing database for the quality of housing, much hardship and expense might have been avoided.

### Children First

Schools in the Kathmandu valley were particularly badly affected by the disaster: the earthquakes resulted in the collapse of 5,000 schools, damage to 30,000 classrooms, and the disruption of education for 1 million children. Through the Global Program for Safer Schools, the government

of Nepal is accessing grants and technical support to assist in the resilient recovery of this critical sector, improving both the safety and quality of education facilities. Its efforts in this regard were enhanced by the OpenCities Kathmandu program, which prior to the disaster had mapped nearly 3,000 schools and health facilities, and trained 1,500 volunteers in mapping vital infrastructure.

In a poor country like Nepal, a natural disaster of this magnitude casts a long shadow, impacting a range of issues, which might include human trafficking, mental health, tourism, rental and property costs, public and private debt, and strain on the health care system. Recovery in Nepal will take many years and faces significant challenges, including the mountainous rural terrain where so many communities were impacted, political instability, and constraints upon service delivery. Despite these challenges, the government has taken many positive steps toward resilient recovery, from the establishment of the NRA to support for owner-driven housing reconstruction.

**KASKI, NEPAL.** Students at the Shreeshitalacom Lower Secondary School. Photo credit: Simone D. McCourtie/World Bank







## Djibouti: Season of Hope

A PDNA conducted in Djibouti after a devastating drought provides a model for post-disaster assessment in other nations facing drought—like the one currently ravaging East African countries, including Kenya, Somalia, and Ethiopia.

A nation of fewer than 900,000 people on the Horn of Africa, Djibouti is a mainly agricultural economy, and highly susceptible to drought. The drought of 2008–2011 saw food prices climb 50 percent as pastoralists lost up to 80 percent of their livestock.<sup>37</sup> In 2011, the world's first PDNA after a drought was conducted there. The results mobilized \$43 million of international funding for drought-

mitigation measures, including a \$3 million water project to better manage resources in rural areas, and a \$5 million national safety net to ease financial stresses caused by disasters—an idea being applied successfully in larger countries like Ethiopia.

The PDNA also brought national actors together to share information and collaborate. Since the drought, six national authorities, including the ministries of Finance, Interior, Housing, Higher Education and Research, Transport, and Health, have been working together to improve Djibouti's resilience to natural hazards.

### DID YOU KNOW?

The world's first PDNA after a drought resulted in the collection of \$43 million for mitigation efforts in Djibouti.



## Iraq: Rebuilding after Conflict

Establishing the reconstruction needs of a country in the aftermath of conflict can be dangerous and harrowing work. Dr. Qusay Raof, Director General of the Central Statistical Organization of Iraq's Ministry of Planning, led a team of 1,000 government employees deployed to gather information for a Damage and Needs Assessment (DNA) after the defeat of ISIS in 2017.

“Our researchers, statisticians and engineers worked relentlessly and at great personal cost to access some high-risk areas,” he says. “We had to secure safe passage to sites, avoid landmines, face being ambushed and shot at, sometimes even kidnapped.”

Simultaneously, World Bank staff were assessing data from social media, satellite imagery and existing reports, for the assessment that would be used to fast-track Iraq's recovery. The DNA assessed the effects and

impact of the Iraq conflict across 19 sectors and thematic areas like key infrastructure, service delivery, social, livelihoods, production, and other cross-cutting sectors, in order to identify recovery and reconstruction needs.

Led by the government of Iraq with support from the World Bank, the assessment estimated Iraq's cost of reconstruction and recovery needs at US\$88 billion. Of this sum, more than \$30 billion has already been pledged by 62 governments and international financial institutions at the Kuwait International Conference for the Reconstruction of Iraq.

The Iraq DNA is the World Bank's most comprehensive study using a combination of ground data and innovative remote-based technology to date, and could be replicated to serve as a model for recovery efforts in other conflict situations around the world.

**KARBALA, IRAQ.** A boy flies a kite near the facade of a building under reconstruction. The city was heavily damaged in the insurrection of 1991. Photo credit © Shepard Sherbell/CORBIS SABA/Corbis via Getty Images



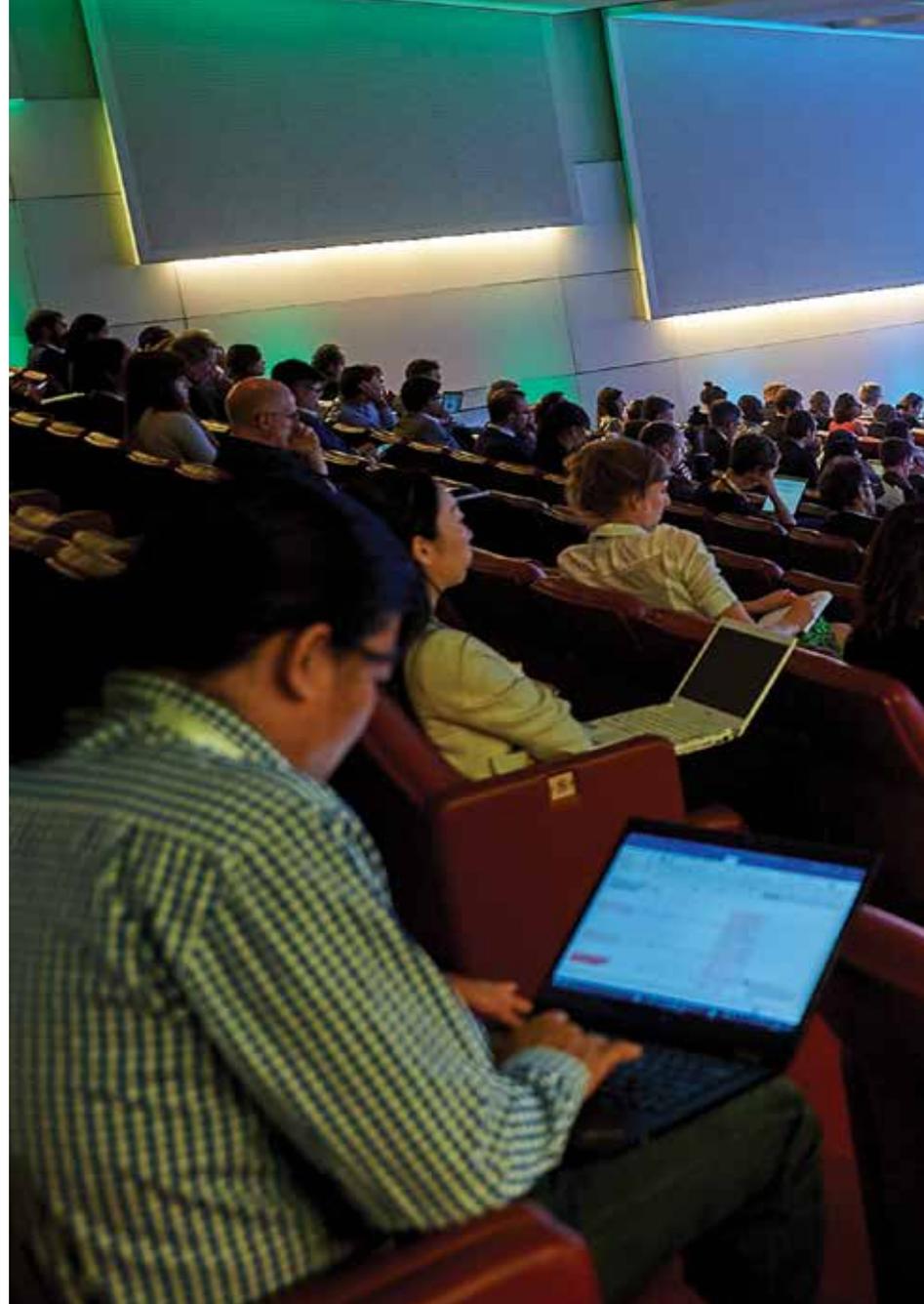
# Lessons from Recovery Processes

**The last decade has seen a proliferation in initiatives aimed at assisting countries to achieve resilient recovery after disaster, from PDNAs to knowledge sharing tools and global forums.**

The EU and GFDRR collaborate closely with the UN on **post-disaster needs assessments** (PDNAs). In 2008, the three partners signed the Tripartite Joint Declaration on Post-Crisis Assessments and Recovery Planning (The Tripartite Agreement) to help harmonize and better coordinate post-crisis response frameworks. The three institutions have collaborated on more than 40 post-disaster assessments. The **World Reconstruction Conference** (WRC) is convened by the partners and brings together hundreds of experts and practitioners from governments, international organizations, NGOs, academia, and the private sector to share their best practices and lessons on recovery, and explore the nexus between resilient recovery efforts and sustainable poverty reduction.

The first PDNA using the current technology was conducted by Bangladesh, after Cyclone Sidr

in 2007. The tool was based on the earlier **Damage and Loss Assessment** (DaLA) methodology pioneered by the United Nations' Economic Commission for Latin America and the Caribbean (ECLAC), and was developed in partnership between the EU, the United Nations Development Programme (UNDP), GFDRR, and others. It has since been adopted as an internationally recognized protocol for government-led assessments of damages, economic losses, and needs from natural disasters, and as the starting point for the development of a recovery strategy. The PDNA Guide, developed in partnership by GFDRR, the World Bank Group, the EU, and the UNDP, provides governments with detailed assistance on evaluating damage, loss, and needs, to help them better understand the impact of disaster, and present preliminary recovery and reconstruction strategies. Recent innovations include the **Rapid and Remote Assessment Methodologies**, which may be used in situations where information on damages and needs is required prior to a full PDNA, or where it is not feasible



to conduct a PDNA. This method utilizes technology, such as remote sensing and social media analytics, and has routinely been used in areas like conflict zones, where access is difficult.

The Recovery Hub is a web-based 'one-stop shop' for resources that help enhance timely and effective disaster recovery processes. It

utilizes the **Disaster Recovery Framework**, launched at the 2015 Sendai conference in partnership with the EU and the UN, which outlines proven tactics for achieving effective recovery and resilience building. It incorporates new lessons learned from recovery efforts and offers a flexible methodology that countries can adapt to their own context.



RUSSELS, BELGIUM, JUNE 2017. Delegates in a plenary session at World Reconstruction Conference 3 (WRC3). Photo credit: World Bank

# A Decade of Damage and Needs Assessments



## DID YOU KNOW?

Since 2012, Damage and Needs Assessments have informed more than \$5B in recovery funding, reaching several million people in more than 50 countries.<sup>38</sup>

INDIA. A woman dries a sari on the river side. Photo credit: ertyo5ertyo5

In the last ten years, GFDRR has assisted in over 50 damage and needs assessments in most regions in the developing world, and in every type of disaster.

Paco Alvarez/Oxfam International



2010: El Salvador

Tropical storm Ida and landslides

Total losses:

**\$314.8 million\***

Recovery costs:

**\$105.9 million**

Alain Zino/World Bank



2008–2011: Kenya

Drought

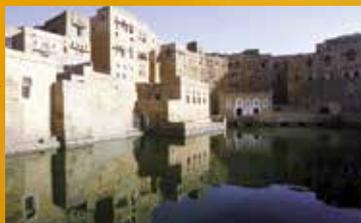
Disaster risk reduction needs:

**\$2.1 billion**

Recovery costs:

**\$310 million\***

Flore de Preneuf/World Bank



2008: Yemen

Tropical storms and floods

Total losses:

**\$1.6 billion**

Recovery costs:

**\$1.06 billion\***

Bill Lyons/World Bank



2014: Bosnia and Herzegovina

Flooding

Reconstruction costs:

**\$1.5 billion**

Recovery costs:

**\$255 million\***

thinkphoto



2015: Nepal

Gorka earthquake

Recovery costs:

**\$6.7 billion\***

AusAID



2010: Samoa

Tsunami

Total losses:

**\$1.6 billion\***

Recovery costs:

**\$418.6 million**

\* estimated



Photo credit: Emma Phillips, World Bank

LILONGWE, MALAWI, 2012. Trainees learn how to conduct PDNAs after severe flooding. Photo credit: Emma Phillips/World Bank



## Acting Local: Capacity Building in Malawi

Both the Hyogo and Sendai Frameworks identified capacity building in DRM at global, regional, national, and sub-national levels as a priority, and significant progress and investments have been made by donors and development partners in this area in the last ten years.

Almost a quarter of GFDRR's investment is now going into over 300 projects aimed at raising awareness, enhancing skills, improving consensus, fostering coalitions and networks, and facilitating decision making. These activities occur in tandem with other projects—for example, in risk identification or preparedness—and their beneficiaries include governments and institutional counterparts, community groups, DRM professionals, and the private sector.

One such project was the Malawi Post-disaster Needs Assessment and Recovery Framework. After the floods of January 2015, the Malawian government approached the World Bank to assist with a PDNA. Rather than conducting the assessment and delivering its results to the government, the

World Bank adopted the policy of training local stakeholders as PDNA specialists. Building on earlier training conducted in 2012, the Bank assisted in the training of 75 individuals, including 20 members of NGOs and government departments who had previously been involved in the 2012 training and were now assigned the role of team leaders. Malawi created disaster recovery frameworks for drought and flooding so that it is better-prepared to recover from the recurrent disasters faced by the country.

There is unexplored potential for donors and international agencies to work more closely together on coordinated programs of system-wide, multi-scale capacity strengthening within and across countries. The mainstreaming of DRM in program design requires further emphasis, and more attention needs to be paid to building capacity at the sub-national government level. However, the case of Malawi demonstrates how a relatively modest investment of resources may have long-term benefits in building national and local resilience.

Globally, there has been a shift in the last 10 years from post-disaster crisis management to a more proactive approach in planning for recovery, underpinned by the widespread adoption of post-disaster needs assessments as a starting point.





## From Disaster Reduction and Recovery to Protecting Livelihoods

Sometimes, despite the best efforts of communities and international organizations, disaster strikes a country, hitting those sectors which are most critical to development. Strengthening the resilience of these key sectors is essential in building overall resilience. Equally important is improving the resilience of the population. This may be achieved by a range of measures, from policies such as increasing access to financial services, to disaster risk and health insurance, and to the expansion of social safety nets, which make it easier for people to absorb, cope with, and recover from damages caused by natural disasters. In Ethiopia, the government has begun to integrate DRM into its social safety net program, strengthening the resilience of the poor and offering some protection of development gains. Globally, the focus is shifting to the resilience of sectors critical to development, from health to energy and transportation.

**SIRE DISTRICT, ETHIOPIA.** Mother of children at a day-care center funded under the Productive Safety Nets Program (PSNP). Photo credit: Binyam Teshome/World Bank

# Ethiopia: Spreading the Net

**Ethiopia's government has taken a proactive approach to include DRM in its development agenda, through an innovative project integrating DRM with the country's social protection program.**

Ethiopia is prone to drought, and its population vulnerable to the aftermath—including food insecurity and the depletion of household assets. Historically, aid efforts were concentrated on providing food for the hungry. Since 2005, however, a more holistic approach has been taken. Ethiopia's **Productive Safety Net Program** (PSNP) provides food or cash transfers to about 8 million regular beneficiaries in chronically food insecure districts,<sup>39</sup> in exchange for labor on projects aimed at building community resilience through the implementation of public works projects, or unconditionally in the case of labor-poor households.

The PSNP is aimed at preventing the irreversible impacts of food insecurity, especially on health, encouraging households to engage in soil and water conservation activities to enhance productivity of land, and to participate in livelihoods interventions to increase household income. These investments aim to build the resilience of program clients. Between 2008 and 2014, almost 650,000 households graduated from the program, which has been shown to reduce by a quarter the impact on food consumption in case of drought.

The main innovation of the PSNP is its capacity to “scale up” during bad years. When a drought occurs, the number of beneficiaries of the scheme and the transfers they receive increase automatically. This characteristic makes the PSNP act as a quasi-insurance scheme, increasing support to the population during bad years. And

because the scale-up is automatic, with an appropriate budgetary process to manage additional social expenditure, it does not require a long political process, ensuring that people receive support when they need it.

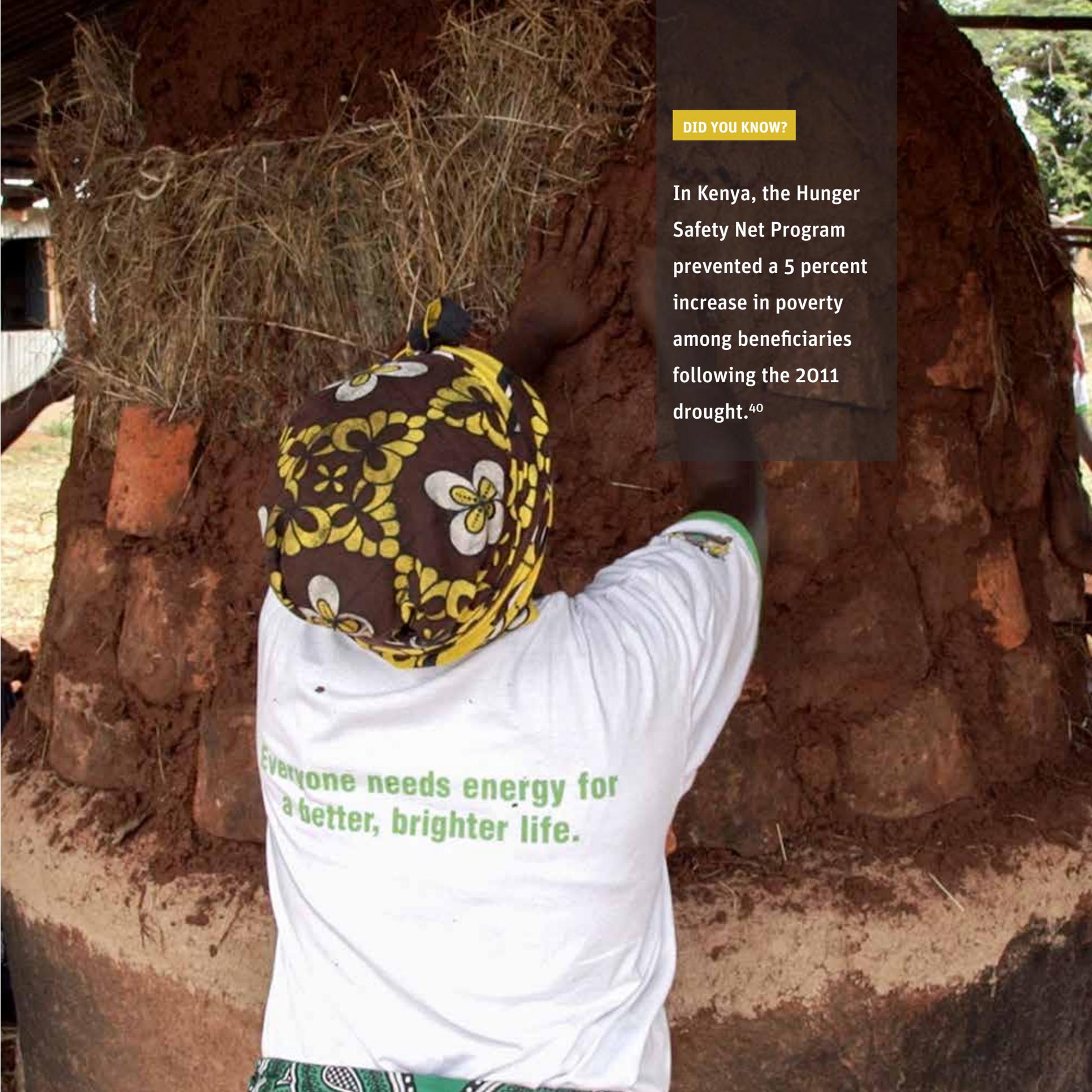
Ethiopia's DRM policy and the **DRM Strategic Program and Investment Framework** (DRM-SPIF) aims to reduce disaster risks and the impact of disasters through the establishment of a comprehensive and integrated DRM system. Within this DRM framework, the PSNP is seen as a key instrument to deliver the objectives of the policy and strategy by improving food security and living standards among the most vulnerable and food insecure populations in Ethiopia. The program also contributes to the further development of the country's early warning system, and supports the development of risk profiles and contingency plans. This progress signifies major early

steps in reframing the country's DRM practice toward a proactive approach rather than responsive, post-disaster action.

Advances in technology have assisted in the integration of DRM with social safety nets in Ethiopia. **Livelihoods Early Assessment and Protection** software, a multi-hazard forecasting and early warning system, enables faster responses to disasters, better sharing of weather forecasts, and easier coordination of risk reduction procedures. In addition, four new Local Area Networks (LANs) speed up the sharing of information and the development of disaster risk profiles.

As drought once again stalks East Africa, the livelihoods and assets of Ethiopia's poor will be threatened. Through social protection and the management of risk, they may prove more resilient to these threats.

KISUMU, KENYA. A woman at work in a community stove production business. Photo credit: Peter Kapuscinski/World Bank



**DID YOU KNOW?**

In Kenya, the Hunger Safety Net Program prevented a 5 percent increase in poverty among beneficiaries following the 2011 drought.<sup>40</sup>





# Sector-Specific Resilience

**Some of the sectors most at risk when disaster strikes are those most critical to development. Increasingly, the identification of priority sectors informs strategies for social protection and resilient recovery, as these examples show.**

## Transport

When heavy rains and the onset of Cyclone Komen caused heavy flooding and landslides in 12 out of 14 states in Myanmar in 2015, the government, together with international partners, conducted a rapid PDNA across 14 sectors. The transport sector was found to be the most impacted public sector, with landslides having cut off road access in many areas. Building on the results of the PDNA, the Flood and Landslide Emergency Recovery Project (\$200 million)<sup>41</sup> supports resilient recovery of road infrastructure in target areas.

## Education

Disasters force poor households to make choices that have

**RWANDA. Dry hills and valleys terraced by communities under an innovative landscape reform program designed to retain topsoil, nutrients, and water for greater yields and more productive farming.**  
Photo credit: A'Melody Lee/World Bank

detrimental long-term effects, such as withdrawing a child from school or cutting health care expenses. In Guatemala, Storm Stan increased the probability of child labor by more than 7 percent<sup>42</sup> in areas hit by the storm. This illustrates the importance of social protection for the poor, and the need to build the resilience of the education sector against shocks.

## Health

Natural disasters cause injuries, illness, and permanent disabilities, pushing households into poverty and forcing people to borrow in order to access health care. Comprehensive health insurance is not beyond reach for citizens in even the poorest countries: Rwanda's Mutuelles de Santé insurance scheme now covers around 98 percent of the population,<sup>43</sup> dramatically reducing both infant and adult mortality.

## Energy

In Sub-Saharan Africa, less than 10 percent of hydropower potential has been tapped. That represents 400 GW of undeveloped power—enough to quadruple the continent's existing capacity.<sup>44</sup>

Globally, multipurpose hydropower projects can improve local water resource management, increase water security, provide irrigation and flood management services, and make important contributions to both climate change mitigation and adaptation—improving the resilience of communities to disasters.

## Agriculture

In agrarian economies, development gains are uniquely vulnerable to the risk of natural disaster. In Uganda, 79 percent of poverty reduction from 2006 to 2013 was in households whose main income was from agriculture.<sup>45</sup> It's estimated that a 10 percent reduction in rainfall would reduce by 24.2 percent the crop income available to the poorest 40 percent of Uganda's households. As a result, the Ugandan government has taken steps to integrate poverty relief and disaster planning: the Northern Uganda Social Action Fund is aimed at providing income support and building resilience through a mechanism to quickly scale assistance to poor and vulnerable households following disasters.





## Upward Mobility: Innovations in Financial Inclusion

Around the world, poor people tend not to have access to bank accounts. Instead, they hold most of their assets in material form—for example, in the value of their home, or in livestock—assets which are particularly vulnerable to natural disaster. Financial inclusion targeting poor people through microfinance and products designed for their needs can be a powerful risk-reduction strategy, helping poor people save in safe forms and diversify their risk, and allowing them access to credit, which accelerates and improves recovery and reconstruction. In the past decade, progress in expanding

access to financial institutions has been rapid, and new technologies offer further opportunities to enhance financial inclusion at low cost. Mobile money is one such technology: with mobile phones almost universally adopted, people once excluded from the formal financial system—like women, poor people, young people, and those living in rural areas—now have access to mobile money accounts. This allows them to diversify their assets through savings, and to access financial products such as insurance—improving their resilience against the risk of disaster.

**PHNOM PENH, CAMBODIA.** A motorcycle taxi driver transports a trader and dry goods to the market. Photo credit: World Bank



AL-SAFTAWI, GAZA, 2017. A man with his son walks through floodwater after heavy rainfall.  
Photo credit: Ezz Al-Zanoon/NurPhoto via Getty Images



Although much can be done to reduce the risk of disaster, it can never be eliminated, particularly in a world where the worst effects of climate change have yet to be experienced. Amid this uncertainty, a more resilient population is critical in reducing the impact of disaster on the cycle of poverty.



# From Disaster Risk Management to Resilient Development

In August and September 2017, three powerful hurricanes hit the Caribbean, the Gulf of Mexico, and Florida, devastating island nations like St. Martin and Antigua and Barbuda, inundating the city of Houston and causing widespread flooding and a collapse of the power grid in Puerto Rico. Flooding in South Asia caused the deaths of 1,300 people, and displaced an estimated 40 million. Wildfires raged in Canada and nine western states in the U.S., destroying over 8 million acres of forest. In Mexico, a powerful earthquake hit Mexico City, with more than 200 deaths reported and hundreds of homes destroyed. In this increasingly uncertain world, building the resilience of communities and countries is critical in breaking the cycle of disasters, and advancing the twin goals of the reduction of poverty and the promotion of shared prosperity.

**SAINT VINCENT AND THE GRENADINES.** Sunrise over the Atlantic Ocean.  
Photo credit: Kittiplace | Dreamstime.com

# DRM and Development

**The advances in DRM documented in this report are examples of what can be done when local knowledge is combined with the expertise and resources of international institutions. However, in order to protect development gains from disaster, it is necessary to bring initiatives like these to scale globally, adapting them to local conditions in countries and communities all around the world.**

In recent years, institutions have shifted away from the tendency to treat disasters as random and unavoidable interruptions in development, toward seeing them as risks to be managed as part of development. Sustainable development cannot be achieved simply by adding a layer of risk management onto existing or future projects. Instead, it requires strengthening the ability of people, institutions, and economies to manage, mitigate, and absorb residual risks and unavoidable shocks.

As this report has shown, the growth of DRM into a pillar of sustainable development has been the work of a network of organizations, businesses, governments, and communities.

Institutions like the World Bank, UNISDR and United Nations Framework Convention on Climate Change (UNFCCC), and the Red Cross, together with regional or national bodies like the EU and the government of Japan, have contributed their particular strengths in bringing the management of risk into the development agenda. Within this network of complementary partnerships, GFDRR has its own role to play.

GFDRR has had a direct impact on the growth of World Bank Group into one of the largest and most influential development actors in DRM. It has provided the seed funding needed for project preparation, knowledge development, and analytical tools, and has helped shift the mindset within the Bank, integrating DRM within the development agenda. It has been central in creating a knowledge base for the international DRM community, both collecting and communicating data, and has played an indirect advocacy role through technical excellence and best practice.

GFDRR's position within the World Bank allows it to finance engagements that leverage larger

development operations and influence development policies. GFDRR has fostered innovation and assisted in bringing it to scale, while facilitating partnerships, communities of practice, and the building of political consensus between countries for resilient development. A priority now is to engage Ministries of Finance and other key line ministries to institutionalize DRM within national and local government structures.

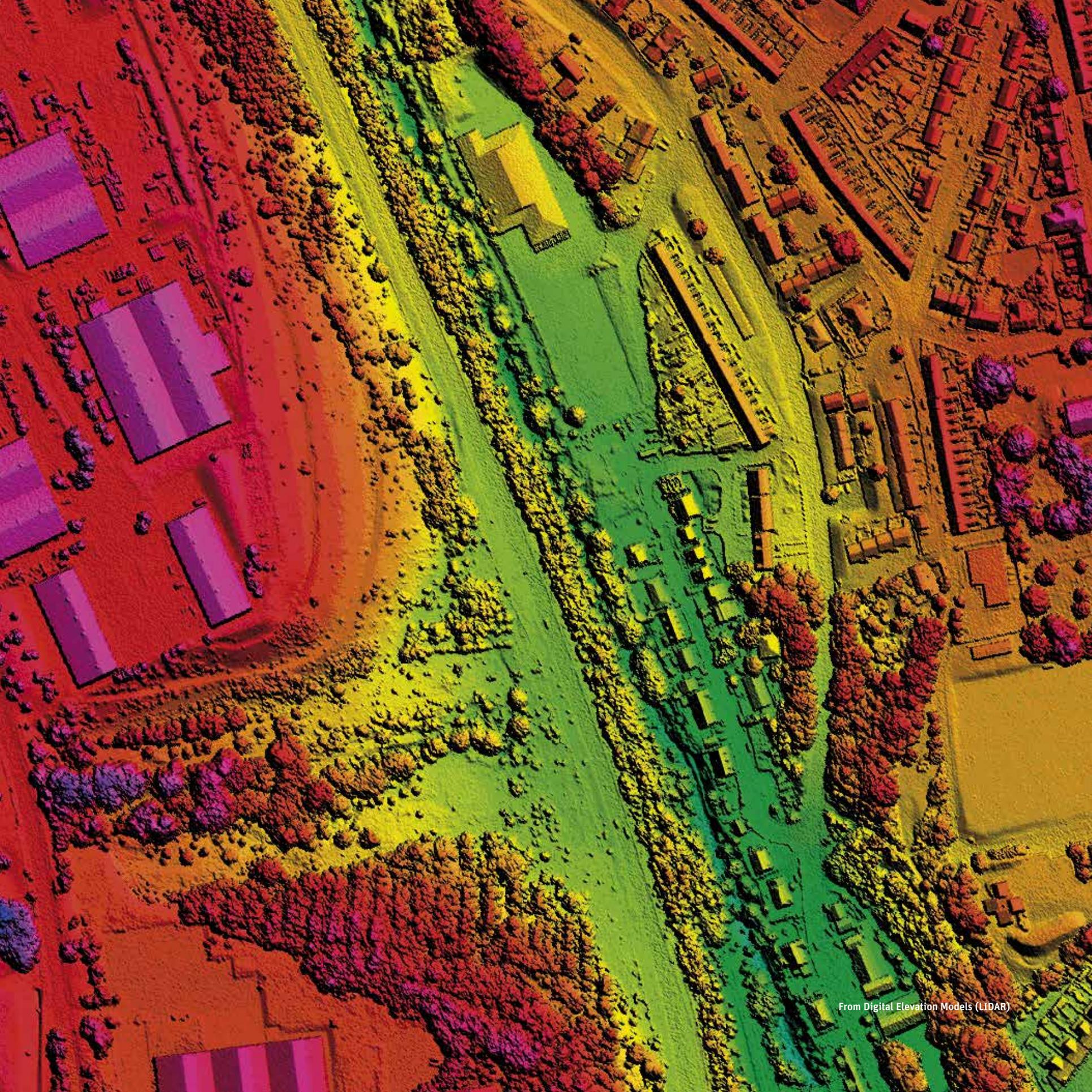
Climate change and rapid and uncontrolled urbanization are perhaps the two greatest threats to sustainable development. Together with partners in the international community and in the countries and communities most at risk, GFDRR is advancing a strategy to anticipate and mitigate the impact of these forces.

Rapid and uncontrolled urbanization means that cities will need investments of more than \$4 trillion per year in infrastructure merely to keep pace with expected economic growth, and an additional \$1 trillion will be needed to make this infrastructure climate resilient. Together with the urban development team of the World Bank and partners in the Medellin Collaboration, GFDRR will support

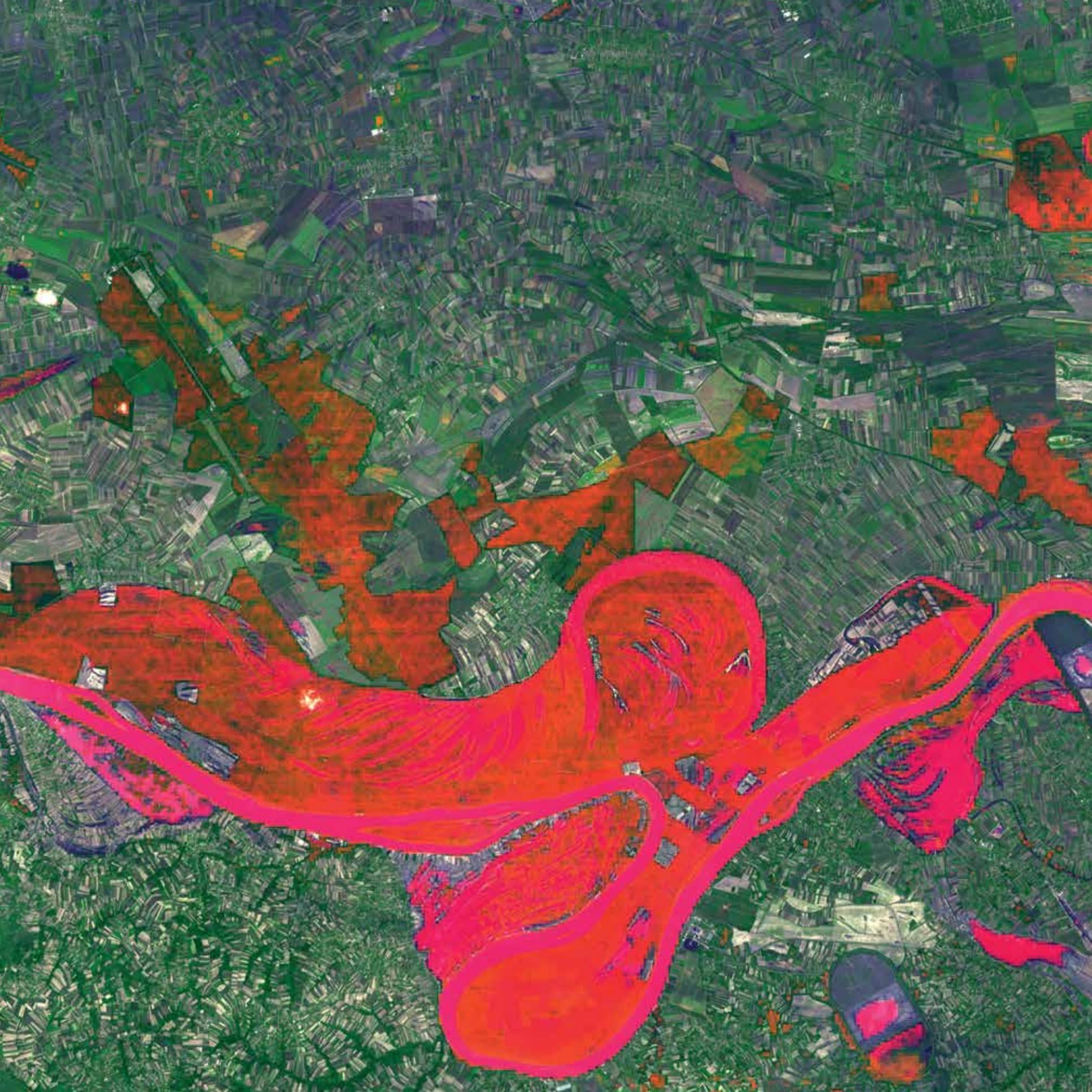
35 cities over the next three years through the City Resilience Program in developing and implementing resilience plans. The program aims to support a doubling of the World Bank program on urban resilience and to leverage up to \$1.5 billion over the next three years from public and private resources.

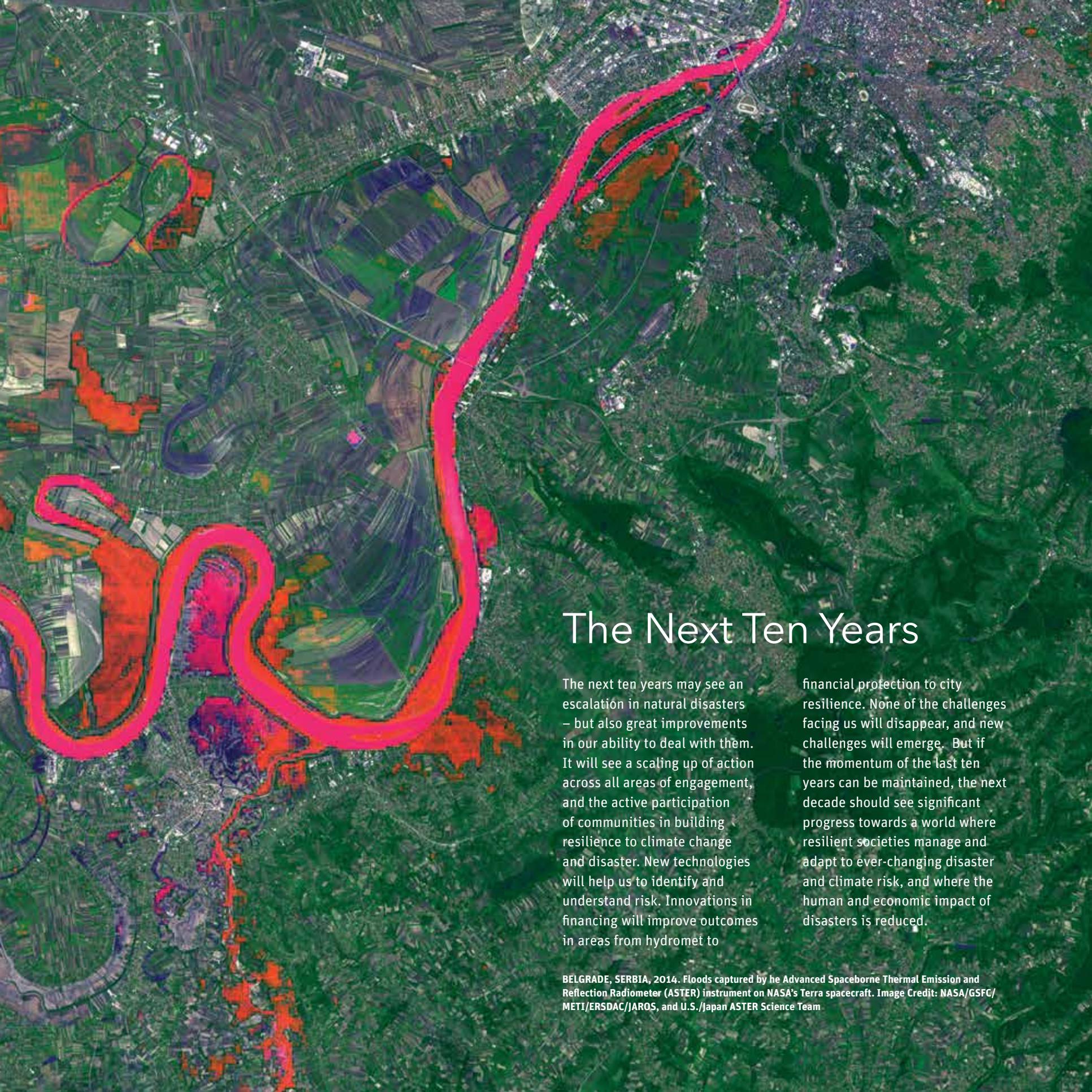
Climate change amplifies the risk of disasters and increases their impact on the world's poor. With expected shifts in rainfall patterns, melting snow-packs and glaciers, stronger tropical cyclones, and rising sea levels, climate change is becoming a core development challenge. Over half of GFDRR's grants now include components relevant to climate change resilience, and this number is growing steadily: over the next three years, GFDRR will enable up to \$3 billion in climate resilience investments from development partners.

In the next decade, GFDRR will work to deepen these partnerships, and to intensify its action on the ground through the development of knowledge, tools, and methodologies for jointly addressing climate and disaster risk in development programs.



From Digital Elevation Models (LIDAR)





## The Next Ten Years

The next ten years may see an escalation in natural disasters – but also great improvements in our ability to deal with them. It will see a scaling up of action across all areas of engagement, and the active participation of communities in building resilience to climate change and disaster. New technologies will help us to identify and understand risk. Innovations in financing will improve outcomes in areas from hydromet to

financial protection to city resilience. None of the challenges facing us will disappear, and new challenges will emerge. But if the momentum of the last ten years can be maintained, the next decade should see significant progress towards a world where resilient societies manage and adapt to ever-changing disaster and climate risk, and where the human and economic impact of disasters is reduced.

BELGRADE, SERBIA, 2014. Floods captured by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument on NASA's Terra spacecraft. Image Credit: NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team

## Promoting open access to risk information

- Risk results from risk modelling will be commoditized and mass produced so people can access information on their risk in any place in the world.
- A plethora of open source tools to model, access, and understand risk will be available. New ways of communicating risk analysis to the public will be available, which help establish the information's credibility and enable comparison between relative risks.
- Real-time risk and crisis-management information will be based on incoming data streams such as satellites, drones, self-driving cars, and cell phones, and processed by machine learning algorithms to generate forecasts of exposure and vulnerability changes.

## Promoting resilient infrastructure

- With the help of development institutions like the World Bank, countries will formulate enabling policies and investment programs, integrating climate and disaster risk into infrastructure development strategies, in areas like energy, transportation, water, and waste management.
- Infrastructure will be developed to respond and evolve to threats of climate hazard-induced structural or systemic failure.
- Contingency planning and financing for early recovery will help price the risk faced by lifeline-critical infrastructure and allow for better financial planning that contributes to increasing the resilience of infrastructure.

## Scaling up the resilience of cities

- Cities will create value through public investments in infrastructure to reduce vulnerabilities and increase resilience.
- Institutions will provide a more bankable flow of projects and programs to a growing set of interested private sector investors.
- Resilient housing will become a new focus area for growing cities.

## Strengthening hydromet services and early warning systems

- New technologies for remote sensing, high-power computation, and crowdsourcing will increasingly be used in weather forecasting. This will increase the resilience of a greater number of developing countries by reducing the impact of weather and climate related hazards.
- The national hydromet services of developing countries will focus on providing weather and climate services to users, supported by capacity building and the introduction of a new business model.
- Vulnerability of societies to weather and climate extremes will be further reduced by efficient, people-centered early-warning systems, with public and private sectors working together to provide high quality demand-driven weather and climate services.

## Deepening Financial Protection

- Risk management of climate and disaster shocks (as well as other complex shocks) will be fully integrated in government decision making through a pro-active risk management function driven by the Ministry of Finance.
- Financial support will be targeted at the most vulnerable beneficiaries (e.g., through contingency plans and in-country systems) and provided more timeously, including through tranches before a disaster strikes (forecast-based financing).
- Big data, increasingly user friendly models, and better risk visualization will make risk data easily accessible to financial decision makers.
- Universal financial access, including better use of fintech and digital payments systems will enable access to (contingent) finance for disaster response by everyone.

## Building resilience at the community level

- Community-driven development projects and adaptive social protection initiatives will enable communities to lead resilience efforts.
- Vulnerable and marginalized populations will continue to be at the core of community resilience, and efforts will intensify to address the gender dimensions of disaster and climate risk management, and to promote women's empowerment for broader resilience strengthening.
- Community engagements and social protection will reach at least 15 million people by 2021.

## Deepening engagements in resilience to climate change

- Disaster risk management, resilience building, resilience reconstruction, and climate change adaptation will be fully integrated in country institutions, to ensure synergies can be captured between these objectives.
- Databases, tools, and methods for risk management will be updated so that future changes in climate will be considered in the design of all long-lived projects, such as transport infrastructure or energy systems.
- Infrastructure asset management systems will be updated so that maintenance is improved and coupled with regular retrofitting to adjust to ever changing climate conditions.

## Enabling resilient recovery

- Resilient recovery will be integrated in the legal, policy and planning frameworks of vulnerable countries and cities as part of 'risk- informed' development.
- Building back better will become standard recovery practice, measurably lowering the vulnerability of people and assets.
- Gender equality and women's empowerment will be systematically integrated in all recovery processes.
- Vulnerable and fragile countries will achieve a minimum level of preparedness to respond to crises, including strengthened civil protection systems for emergency response.
- Rapid and remote assessment techniques will replace the PDNA process to deliver quick and reliable results for planning and implementing recovery.





## Through Risk, to Resilience

**“The last 10 years have been marked by a series of achievements in every area of DRM, from the identification of risk to the development of social safety nets. Countries and communities have taken meaningful steps to reduce their vulnerability, supported by development institutions, civil society, and the private sector. However, much still needs to be done. As the growth in risk is exacerbated by uncontrolled urbanization and climate change, there is a need to accelerate progress in order to build the resilience of communities and preserve development gains.”**

**—Laura Tuck, Vice President for Sustainable Development, World Bank**

**THE PHILIPPINES.** Children participating in a mangrove reforestation program aimed at protecting coastal communities from storm surges. Photo credit: Kai Avila

## Endnotes

1. Hallegatte, Stephane, Adrien Vogt-Schilb, Mook Bangalore, and Julie Rozenberg. 2017. *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters*. Climate Change and Development Series.
2. Ibid.
3. Munich Re. 2015. *El Niño curbs losses from natural catastrophes in 2015*.
4. Hallegatte, Stephane, Mook Bangalore, Laura Bonzanigo, Marianne Fay, Tamaro Kane, Ulf Narloch, Julie Rozenberg, David Treguer, and Adrien Vogt-Schilb. 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. Climate Change and Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-0673-5. License: Creative Commons Attribution CC BY 3.0 IGO.
5. BRR and International Partners. 2005. *Aceh and Nias One Year After the Tsunami—The Recovery Effort and Way Forward*, Bandah Aceh: BRR.
6. Simpson, Alannah, Simone Balog, Stuart Fraser, Anne Himmelfarb, Brenden Jongman, and Keiko Saito. 2016. *The Making of a Riskier Future*. Washington, DC: World Bank.
7. Redmond, Kate, Roslaeen Cunningham, David Lawrence, and Nur Raihan Lubis. 2013. *The Power of Partnerships—The Multi-Donor Fund in Post-Disaster Aceh and Nias*, Washington DC: MDF.
8. BRR and International Partners. 2005. *Aceh and Nias One Year After the Tsunami—The Recovery Effort and Way Forward*, Bandah Aceh: BRR.
9. Ibid.
10. Ibid.
11. Simpson, Alannah, Anne Himmelfarb, Rick Murnane, Emma Phillips, Robert Reid, and Keiko Saito. 2016. *Understanding Risk in an Evolving World*, Washington DC: World Bank.
12. Gunawan, Iwan, Jan Sopaheluwakan, Saut Aritua Hasiholan Sagala, Hoferdy Zawani, Suryani Amin, Ruby Mangunsong, and Julian Tumiar. 2016. *Building Indonesia's resilience to disaster: experiences from mainstreaming disaster risk reduction in Indonesia program*, Washington, DC: GFDRR.
13. GFDRR. 2016. *Stories of Impact: Building Resilient Communities Across Indonesia*, Washington DC: World Bank.
14. GFDRR
15. GFDRR. 2017. *Country Profile: Indonesia*, Washington DC: World Bank.
16. Soraya, George. 2016. *Indonesia: Turning to Unity for Rebuilding Communities after Natural Disasters*, Washington DC: World Bank.
17. GFDRR. 2016. *Stories of Impact: Building Resilient Communities Across Indonesia*, Washington DC: World Bank.
18. 2016. *GFDRR Annual Report 2016: Bringing Resilience to Scale*, Washington, DC: World Bank
19. www.geonode.org
20. Simpson, Alannah, Simone Balog, Stuart Fraser, Anne Himmelfarb, Brenden Jongman, and Keiko Saito. 2016. *The Making of a Riskier Future*. Washington, DC: World Bank.
21. GFDRR. 2016. *Reviewing the Impact of Capacity Building in GFDRR* Washington, DC: World Bank.
22. Various Authors, 2015, *ISMEP Success Stories*, Washington, DC: World Bank.
23. Ibid.
24. 2016. *GFDRR Annual Report 2016: Bringing Resilience to Scale*.
25. GFDRR. 2015. *Thematic Note: Global Program for Safer Schools*, Washington DC: World Bank.
26. GFDRR. 2016. *Stories of Impact: Amplifying Serbia's Financial Resilience Against Natural Hazards*, Washington DC: World Bank.
27. GFDRR.
28. GFDRR. 2016. *Stories of Impact: Building Coastal Resilience in India*, Washington DC: World Bank.
29. GFDRR. 2016. *Stories of Impact: Increasing Women's Role in Disaster Risk Management Across India*, Washington DC: World Bank.
30. GFDRR. 2016. *Stories of Impact: Mainstreaming Disaster Resilience in Vietnam*, Washington DC: World Bank.
31. *GFDRR Annual Report 2016: Bringing Resilience to Scale*.
32. Hofliger, Rubem, Francis Ghesquiere, Olivier Mahul, and Salvador Perez. 2012. *Fonden: Mexico's Natural Disaster Fund—A Review* Washington DC: World Bank.
33. GFDRR.
34. GFDRR.
35. GFDRR. 2016. *Stories of Impact: Strengthening Financial Resilience in the Pacific*, Washington DC: World Bank.
36. GFDRR. 2016. *Nepal's Road to Recovery*, Washington DC: World Bank.
37. GFDRR. 2014. *Stories of Impact: Managing Drought, Sustaining Growth in Djibouti*, Washington DC: World Bank.
38. GFDRR. 2016. *Thematic Note: Quicker, More Resilient Recovery*, Washington DC: World Bank.
39. World Bank. 2013. *Ethiopia's Productive Safety Net Program (PSNP) integrating disaster and climate risk management*, Washington DC: World Bank.
40. Hallegatte, Stephane, Mook Bangalore, Laura Bonzanigo, Marianne Fay, Tamaro Kane, Ulf Narloch, Julie Rozenberg, David Treguer, and Adrien Vogt-Schilb. 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. Climate Change and Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-0673-5. License: Creative Commons Attribution CC BY 3.0 IGO.
41. GFDRR. 2016. *Stories of Impact: Roads to Recovery in Myanmar*, Washington DC: World Bank
42. Hallegatte, Stephane, Adrien Vogt-Schilb, Mook Bangalore, and Julie Rozenberg. 2017. *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters*. Climate Change and Development Series.
43. USAID. 2013. *Health Insurance Profile, Rwanda*. Washington DC: USAID.
44. World Bank. 2017. *Understanding Poverty: Hydropower*, Washington DC: World Bank.
45. World Bank. 2016. *Agriculture: A Driver of Growth and Poverty Reduction*, Washington DC: World Bank.





[www.gfdr.org](http://www.gfdr.org) The Global Facility for Disaster Reduction and Recovery (GFDRR) is a global partnership that helps developing countries better understand and reduce their vulnerabilities to natural hazards and adapt to climate change. Working with over 400 local, national, regional, and international partners, GFDRR provides grant financing, technical assistance, training, and knowledge sharing activities to mainstream disaster and climate risk management in policies and strategies. Managed by the World Bank, GFDRR is supported by 33 countries and 11 international organizations.