Revealing Risk, Redefining Development

Global Assessment Report
on Disaster Risk Reduction

United Nations

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2011 Global Assessment Report on Disaster Risk Reduction:
Revealing Risk, Redefining Development

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Foreword

The second edition of the United Nations *Global Assessment Report on Disaster Risk Reduction* is a resource for understanding and analysing global disaster risk today and in the future. Large and small disasters, ranging from the catastrophe in Haiti in January 2010 to the recent impacts of floods in countries such as Benin or Brazil, continue to demonstrate the intimate relationship between disasters and poverty.

Meanwhile floods in Australia and the devastating earthquake that hit Christchurch, New Zealand in early 2011 have shown how the economies and populations of developed countries are also increasingly exposed. The recent events in Japan point to new and catastrophic risks that need to be anticipated. While global climate change provides a backdrop to many of these events, they expose unresolved development problems that governments could and should address.

Drawing on new and enhanced data, the 2011 report explores trends in disaster risk for each region and for countries with different socio-economic development. At the same time, over 130 governments are engaged in self-assessments of their progress towards the Hyogo Framework for Action (HFA), contributing to what is now the most complete global overview of national efforts to reduce disaster risk.

Progress is mixed. Mortality risk, from floods and tropical cyclones, is now trending down in all regions, as countries invest in improved early warning and preparedness. But economic loss risk and damage to homes, schools, health facilities and livelihoods is trending up. While the economies of many low- and middle-income countries are growing, it will take longer to tackle risks in a sustainable manner and develop institutions that successfully manage risks.

Nevertheless, the report delivers some very good news: countries all over the world, from Indonesia and Mozambique to Panama and Yemen, are significantly improving their knowledge about disaster losses. Governments are using existing development instruments, such as conditional cash transfer and temporary employment programmes, in innovative ways to reach millions of risk-prone citizens. Public investments in infrastructure, health and education are becoming more risk-sensitive. These strategies have the potential to reduce disaster risk and achieve the objective of the HFA, which is critical to the achievement of the Millennium Development Goals and to adapt to global climate change.

Seriously addressing disaster risk will be one of the hallmarks of good governance in the years to come. I encourage not only governments but all concerned citizens and organizations to study and make use of the recommendations of the *2011 Global Assessment Report on Disaster Risk Reduction*, which indeed helps to reveal risk and redefine development.

Ki Moon Ban

Ban Ki-moon
Secretary-General of the United Nations

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Coordinating Lead Author

Andrew Maskrey, Coordinator, Global Assessment Report on Disaster Risk Reduction, United Nations International Strategy for Disaster Reduction, Geneva, Switzerland

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Preface

The *2011 Global Assessment Report on Disaster Risk Reduction* (GAR11) highlights the political and economic imperative to reduce disaster risks, and the benefits to be gained from doing so. Importantly, it offers guidance and suggestions to governments and non-governmental actors alike on how they can, together, reduce disaster risks.

Many countries have made commendable progress in reducing mortality risk, at least for weather-related hazards. Deaths from floods and tropical cyclones are concentrated in Asia, but the mortality risk is now declining. Unfortunately, far less progress is being made addressing other disaster risks, and the cost of disaster-related economic loss and damage is still rising. Damage to housing, local infrastructure and public assets such as schools and health facilities is soaring in many low- and middle-income countries. Drought risk is also still poorly understood and badly managed.

Governments report successes in strengthening their capacities to prepare for and respond to disasters, but admit having difficulty addressing the drivers responsible for increasing risk. Few governments are investing sufficiently to reduce recurrent losses that affect public assets or low-income households, or to protect themselves from future catastrophic loss. Even fewer have appropriate risk governance arrangements in place. Unfortunately, despite the growing interest shown by governments at the second session of the Global Platform for Disaster Risk Reduction in June 2009,[1] many countries have yet to find a clear political and economic imperative to 'invest today for a safer tomorrow'.

The previous *Global Assessment Report on Disaster Risk Reduction* (GAR09) provided compelling evidence to show how certain drivers increase disaster risks, including badly planned and managed urban and regional development, degraded ecosystems, and poverty. It also highlighted how disaster losses can feed back into other outcomes such as deteriorating health and education, and broader and deeper poverty.

Reducing disaster risk is thus critical to the achievement of the Millennium Development Goals, and addressing underlying risk drivers is also vital to climate change adaptation, especially in the short- and medium-term.

Public investment is typically 3–15 percent of GDP in low- and middle-income countries (UNFCCC, 2007). In 2008 for example, it was US$5.7 billion or 4.5 percent of GDP in Morocco, and US$9.6 billion or 15 percent of GDP in Ethiopia (World Bank, 2010a). How sensitive such investments are to risk strongly influences whether disaster risk will decrease or increase over time.

Any decision to invest public resources in disaster risk management (DRM) involves trade-offs with other priorities in which the same resources could have been invested. At present, most countries do not systematically account for the cost of recurrent disaster losses, let alone the cost of indirect impacts on health, education and productivity. Even fewer comprehensively estimate the maximum losses they may incur. As such, governments are poorly positioned to assess the trade-offs implicit in their public investment decisions, and have difficulty justifying increased investment in DRM. By navigating in a sea of risks without a compass, public resources are constantly being diverted to rehabilitate or reconstruct damaged or destroyed assets, and disasters continue to surprise governments without adequate contingency measures in place.

A lack of data alone, however, does not explain the weak imperative to invest in reducing disaster risks. Although there has always been a strong political incentive for disaster response, the incentives for risk reduction are far more difficult to leverage. Recurrent losses in localized disasters, which mainly affect the assets and livelihoods of low-income households and communities, rarely have the gravity to translate into significant political momentum for risk reduction. Given short-term political time horizons and the tendency to strongly discount low-probability future losses, the political incentive to address catastrophic risk may be equally elusive. Addressing underlying risk drivers may involve tackling politically charged issues such as land ownership or water rights. Also, it is often easy to evade political responsibility and accountability for avoidable losses, and attribute disaster risk to historical causes or factors such as climate change – over which individual governments may have little or no control.

Any further progress in reducing disaster risk and adapting to climate change, therefore, depends on clearly identifying the political and economic imperatives to invest in DRM, and on strengthening the necessary risk governance capacities in order to do so.

GAR11 explores these challenges. It highlights the need for systematic accounting of disaster losses and impacts, and comprehensive assessment of disaster risks. These are critical transformative steps that allow governments to visualize and assess the political and economic trade-offs. The economic imperative to invest is becoming increasingly clear. Case studies commissioned for this report confirm that making public investment risk-sensitive is generally less costly than retaining disaster risks and absorbing the losses. Putting in place risk financing mechanisms to anticipate catastrophic risk strengthens fiscal stability and reduces the political risk of being seen as unprepared. Being able to see these trade-offs does not automatically generate political incentives, but it does mean that decisions *not* to invest in DRM are taken consciously and with eyes wide open.

Innovative approaches are also emerging that suggest a new risk governance paradigm, such as the adaptation of existing policies and development instruments in areas such as public investment planning and social protection. These not only address underlying risk drivers, but also facilitate significant up-scaling of initiatives otherwise impossible with individual projects and programmes, by building on existing institutions and capacities and harnessing significant volumes of public investment. Furthermore, additional political incentives accrue by acknowledging the 'developmental by-products' of improved infrastructure and services. Creative partnerships between civil society and central and local governments in urban areas are also generating innovative ideas. These are critical, given that future disaster risk will largely be determined by how towns and cities are planned and managed.

The kind of institutional and legislative arrangements that many countries have adopted to manage their disaster risks may be effective in responding to disasters, but they do not necessarily address the underlying risk drivers. Reforming these arrangements is therefore essential to further progress. This report discusses the case for locating policy responsibility for disaster risk management in a ministry with political responsibility for national planning and public investment, and with leverage and influence over development sectors. It also discusses the case for appropriately distributing responsibilities across governance scales, and for strengthening mechanisms to ensure accountability and partnerships with civil society.

What's new in GAR11?

Risk trends by region and income group

An updated version of the powerful global risk model developed for GAR09 has been used to analyse trends in mortality and economic loss risk for major weather-related hazards such as tropical cyclones and floods. This identifies trends for geographic and income regions, showing where, why and which risks are increasing. This information is complemented by a new index, the DARA Risk Reduction Index (DARA, 2011; Lavell et al., 2010), which measures and compares the capacity of different countries to address underlying risk drivers identified. Factors that condition resilience to disaster loss are also revisited.

GAR11 also outlines a range of emerging, very low-probability and hard-to-measure risks, which countries should begin to anticipate and prepare for.

More representative geographical coverage

All the national disaster databases used to analyse extensive risk in GAR09 have been updated for GAR11, providing two years of new data. In addition, there has been significant progress in building disaster loss databases, for example in Chile, El Salvador, Guatemala, Indonesia, Jordan, Mozambique, Panama, the Syrian Arab Republic and Yemen. This means a larger and more compelling analysis of extensive risk has been possible, with a more representative geographical coverage. New case studies also provide further insights into underlying risk drivers.

Disaster impacts on child welfare and displacement

GAR09 featured a detailed set of studies on the interactions between disaster risk and poverty. GAR11 builds on that analysis with a comprehensive study of how disasters impact on child welfare and development, and the implications of this on DRM policy. Additional case study material also opens a window on how disasters cause internal displacement.

Drought risk

GAR11 includes a specific focus on drought risk, one that is poorly understood and receives inadequate attention both nationally and internationally. After an overview of the challenges in identifying and measuring drought risk, a set of country case studies examines the development drivers that translate meteorological drought into losses and impacts in agriculture and other sectors. It also points to the adoption of standards for measuring drought risk that can contribute to improving its identification and management.

The 2009–2011 HFA Progress Review

Currently, 133 countries are reviewing their progress towards the objectives and goals of the Hyogo Framework for Action (HFA) for 2009–2011. At the time of writing, 82 countries and territories have submitted progress reports that provide unique insights into how governments themselves view disaster risk management. Governments reviewed their progress against each of the Priority Areas of the HFA, and also provided detailed information on challenges in critical areas such as investment and risk assessment with much supporting evidence. The 2009–2011 HFA Progress Review has already assembled the most important global reference currently available on disaster risk management at the national level.

Assessing the costs and benefits of DRM

Case studies from Colombia, Mexico and Nepal apply an innovative approach to risk modelling. By measuring and stratifying the full spectrum of extensive and intensive risks, they illustrate the real magnitude of recurrent and future maximum disaster losses faced by governments. This enables the visualization of the political and economic trade-offs, costs and benefits internalized in different strategies, and highlights why it is more cost-effective to invest today for a safer tomorrow.

Innovation in development practice

GAR11 reviews how governments are scaling up DRM by adapting existing development instruments, such as national planning, public investment systems and social protection mechanisms. It also critically examines other instruments where significant barriers still exist, such as land use planning, building codes and ecosystem management, and where new approaches need to be adopted based on partnerships with civil society.

Risk governance capacities

Finally, GAR11 has undertaken a critical review of the institutional and legislative arrangements for DRM at national and local levels, including a discussion of key issues such as political authority, decentralization and accountability, to provide guidance on how governments can adopt effective governance arrangements for DRM.

How to use this report

In addition to the print edition, GAR11 has also been designed as an interactive electronic report, structured around a set of background papers and databases provided by many institutional and individual contributors. This provides authoritative evidence for the findings and recommendations, and interactive applications allow users to explore this data for themselves.[3]

Key definitions

This report uses a widely accepted model, in which **disaster risk** is considered to be a function of **hazard**, **exposure** and **vulnerability**. Disaster risk is normally expressed as the probability of loss of life or destroyed or damaged assets in a given period of time. Generic definitions of these and other terms are available in the UNISDR Glossary,[2] while the way these terms are used in GAR11 is explained below.

GAR11 uses the term **physical** (rather than natural) **hazard** to refer to hazardous phenomena such as floods, storms, droughts and earthquakes. Processes such as urbanization, environmental degradation and climate change shape and configure hazards, which mean it is becoming increasingly difficult to disentangle their natural and human attributes. **Major hazard** is used to refer to global or regionally important hazards such as earthquakes, tsunamis, flooding in large river basins and tropical cyclones. **Localized hazard** is used to refer to smaller-scale hazards such as flash or surface water flooding, fires, storms and landslides, which tend to affect particular localities. **Exposure** is used to refer to the location of people or economic assets in hazard-prone areas. **Vulnerability** is used to refer to their susceptibility to suffer damage and loss, due for example to unsafe housing and living conditions. **Resilience** is used to refer to the capacity of systems (such as a household, economy or community) to absorb or buffer losses, and recover.

Extensive risk is used to describe the risk of low-severity, high-frequency disasters, mainly but not exclusively associated with highly localized hazards. **Intensive risk** is used to describe the risk of high-severity, low-frequency disasters, mainly associated with major hazards. **Emerging risk** is used to describe the risk of extremely low-probability disasters associated with new patterns of hazard and vulnerability. **Underlying risk drivers** are development-related processes such as badly planned and managed urban and regional development, environmental degradation and poverty, which shape risk patterns and trends.

Disaster risk reduction (DRR) describes the policy objective of reducing risk. **Disaster risk management (DRM)** describes the actions that aim to achieve this objective. These include **prospective risk management**, such as better planning, designed to avoid the construction of new risks; **corrective risk management**, designed to address pre-existing risks; **compensatory risk management**, such as insurance and risk transfer, designed to avoid disaster losses spilling over into poverty and other outcomes, and; **disaster management** measures such as preparedness and response. **Risk governance** is used to describe how national or local governments, civil society and other actors organize DRM, for example through institutional arrangements, legislation and decentralization, and mechanisms for participation and accountability.

Notes

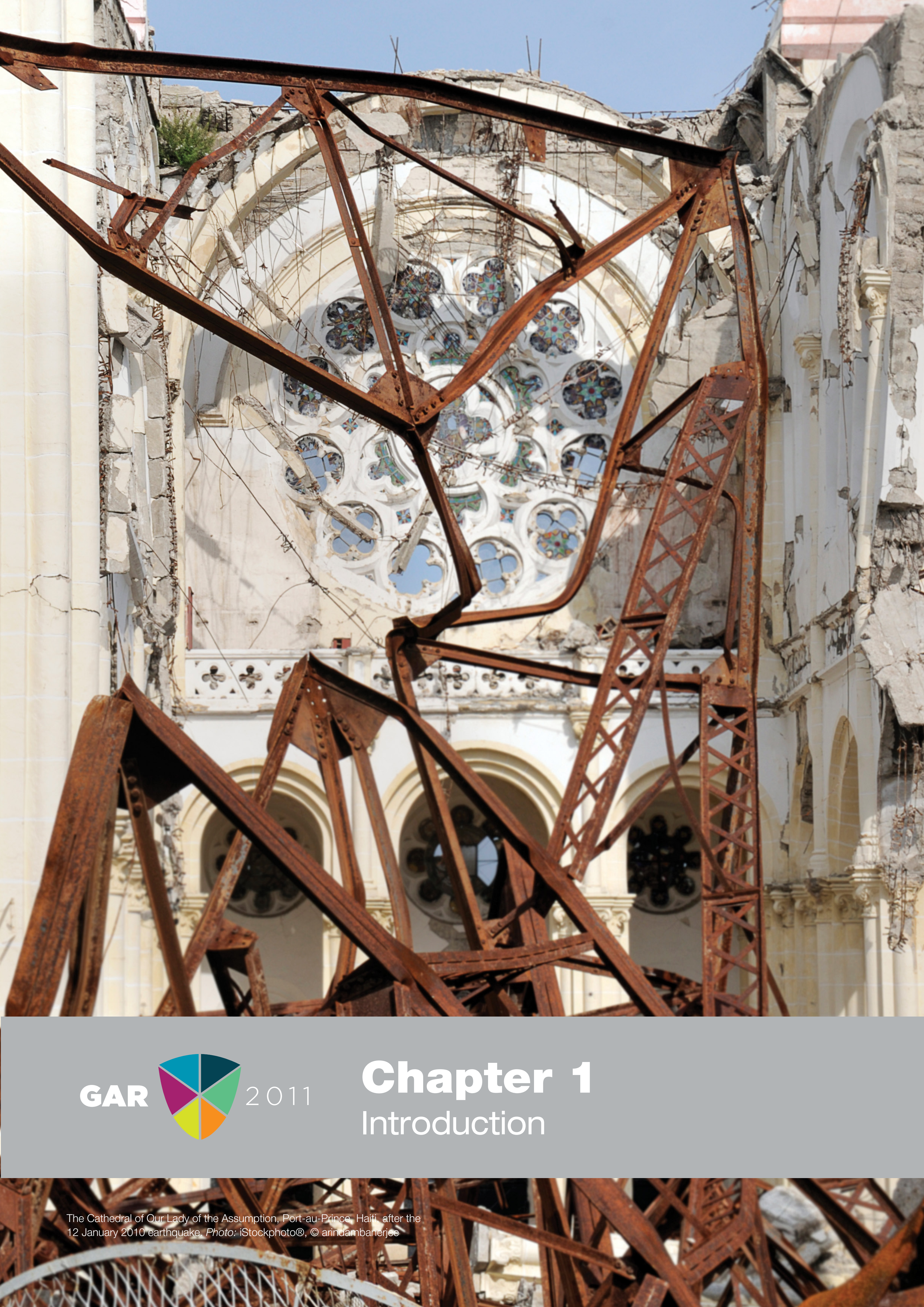
1 Held on 16–19 June 2009 in Geneva, Switzerland, it was attended by 1,668 participants from 152 governments and 137 organizations. The Chair's Summary recorded that "since the first session of the Global Platform in 2007, there has been a dramatic increase in political will in all regions to address disaster risk, across both developed and developing nations and [in] both governments and civil society organizations."

2 UNISDR, 2009. *Terminology on Disaster Risk Reduction*. Geneva, Switzerland: UNISDR. http://unisdr.org/eng/terminology/UNISDR-Terminology-English.pdf.

3 Visit www.unisdr.org/gar or www.preventionweb.net/gar.

GAR 2011

Chapter 1
Introduction



The Cathedral of Our Lady of the Assumption, Port-au-Prince, Haiti, after the 12 January 2010 earthquake. *Photo:* iStockphoto®, © arindambanerjee

Chapter 1 Introduction

1.1 Unveiling disaster risk

Earthquakes, tsunamis, tropical cyclones, floods and droughts are physical events which can be measured and modelled. Although their causes and impacts are increasingly well understood, the escalating losses associated with these events indicate that most governments have yet to find effective ways of reducing and managing the risks they pose.

Father José de Cevallos was adamant. The earthquake, tsunami and fires that destroyed Lisbon in 1755 were natural events. In contrast, the earthquake and tsunami that destroyed Lima and its port of Callao in 1746 were acts of God, divine retribution for the city's libertine population (Walker, 2008). In an early example of disaster research, the conclusions of the Augustine priest, based on a study of ancient, biblical and contemporary references, were published in 1757, in Seville, Spain (Box 1.1).

The destruction of Lima, one of the most important cities in the Americas, together with a major European capital in a space of only nine years seriously disrupted the economies of Spain and Portugal, and led to intense debate on the causes of such disasters. The twin catastrophes of Lima-Callao and Lisbon marked a turning point in the way disasters were looked at and understood.

Historical evidence shows that societies have always incorporated a degree of risk management into their technological systems, urban infrastructure and cosmology. In Peru, for example, the Chimu culture portrayed the social and economic impacts of El Niño on vast adobe tapestries in the coastal city of Chan Chan (Pillsbury, 1993). Cuneiform tablets from the 17th century BC explain Babylonian cosmology and history via the epic of Atrahasis, a Noah-like hero who survived repeated floods (Lambert et al., 1969; Dalley, 1989). The Western Zhou of China interpreted disasters as signs that their rulers had lost Heaven's mandate (Shaughnessy and Loewe, 1999).

Four hundred years before the destruction of Lima-Callao and Lisbon, the North African philosopher and historian Ibn Khaldūn was already theorizing on the relationships between nature, physical hazards, development and political systems (Ibn Khaldūn et al., 1967). But it was only in the 18th century AD that an era of scientific enquiry into the causes of natural disasters was truly ushered in. The destruction of Lisbon inspired Voltaire to ridicule the view of a world overseen by a benevolent and omnipotent deity. Kant also wrote some of the first papers of this period speculating on the natural causes of earthquakes, while Rousseau started to identify the social causes of risk.

Another two hundred years passed before tectonic plate theory became scientific orthodoxy. This and other discoveries gradually led to today's acceptance that earthquakes, tsunamis, tropical cyclones, floods and droughts are physical events that can be measured and modelled.

Whereas physical hazards are increasingly well understood, the escalating losses associated with them indicate that contemporary societies still find it difficult to prevent hazards from becoming disaster risks. Peru and Indonesia, for example, are among the countries that could be hit by a devastating once-in-500-years tsunami with a height of more than six metres (UNISDR, 2009). Compared to the 6,000 people exposed to the 1746 tsunami in Callao, the city now has a population of more than 800,000. Indonesia has more than five million people and 2 percent of its GDP located in tsunami-exposed areas.

Stocks of risk and risk construction

All governments are responsible for assets, some of which will be risk-prone. Governments have explicit responsibility for the safety of publicly

Box 1.1 A tale of two disasters

On the evening of 28 October 1746, Lima was shaken by a violent earthquake. Out of a population of 50,000, only about 1,000 people died. But at about 11 pm, a tsunami devastated the neighbouring port of Callao, destroying the port itself and sweeping miles inland. In contrast to Lima, only a handful of Callao's 6,000 inhabitants survived.

Lima was then the most important city in South America, and the port of Callao exported gold and silver to Spain. The disaster was unprecedented for the Spanish in the region, and posed a critical economic threat to the colonial power.

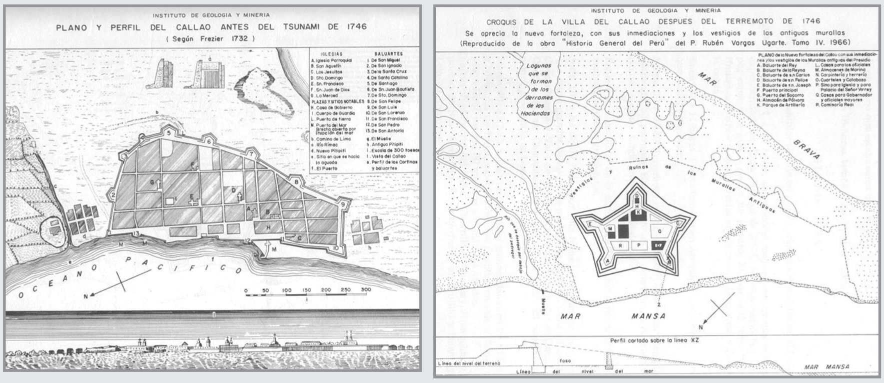


Figure 1.1
Callao, Peru, before and after the 1746 tsunami: the left hand map shows Callao before the tsunami while the right hand map shows the new fortress that was built in Callao surrounded by the remains of the city walls

The Viceroy of Peru, José Antonio Manso de Velasco, was given orders to rebuild Lima as soon as possible. An efficient administrator, he rapidly restored order. His reconstruction plan, designed by French mathematician Louis Godin, was published in early 1747 and included detailed proposals to reduce vulnerability by widening streets and lowering building height. Unfortunately, Manso de Velasco lacked the political authority to overcome opposition to the plan from Lima's aristocracy and religious authorities, and Spain never provided the required tax relief and financing needed for the reconstruction. Godin's proposal to restrict building height to one story was abandoned, as was the Viceroy's intention to reduce the number of monasteries and convents in the city. As a compromise, the authorities permitted the rebuilding of second floors with earth-rendered bamboo rather than adobe bricks, a measure that greatly reduced future earthquake losses in the city.

Nine years later, on the morning of 1 November 1755, Lisbon was struck by a catastrophic earthquake followed by a tsunami and fires, which caused its near total destruction. It is estimated that between 30,000 and 40,000 of Lisbon's population of 200,000 lost their lives, and that 85 percent of the city's buildings were destroyed. Unlike Manso de Velasco in Lima, the Prime Minister of Portugal, the Marques of Pombal, had far greater political authority and was able to repress religious opposition to his reconstruction plan. Explicitly accepting that the earthquake and tsunami had natural causes, Pombal used the reconstruction process to radically reorganize the city, giving it a more rational layout.

(Source: Pérez-Mallaína, 2008; Walker, 2008)

owned assets, including schools, hospitals and clinics, water supplies, sanitation, electricity grids, communication networks, roads, bridges and other parts of the national infrastructure. At the same time, they have a responsibility for protecting the lives, livelihoods and uninsured private assets of households and communities after disasters.

This stock of risk-prone assets is socially constructed, often over long periods by layers of decisions and consequent investments by individuals, households, communities, private businesses and the public sector, to different degrees and at different scales (Maskrey, 1996; Oliver-Smith, 1999). Physical hazards may be modified accordingly: for example, a decision to drain wetlands may increase the occurrence of flooding in a city downstream. The number of people and the value of assets exposed may increase due to decisions to locate economic and urban development in hazard-prone areas. Low-income urban households living in flood-prone areas may accept vulnerability to flooding as the 'least bad' of a set of heavily constrained options.

Whereas public investment usually represents only a small proportion of total investment in a country (UNFCCC, 2007), governments play a key role in shaping these risk construction processes through their own investments in infrastructure and public services, and through planning and regulation. Public investment is particularly important for the welfare of low-income households and communities, whose risk is often characterized by structural poverty and a deficit of services and infrastructure.

As new development decisions and investments interact with the existing stock of public risk, they have impacts which may not be immediately apparent. It may be years or even decades before these impacts manifest, in loss of life, destroyed livelihoods, or damaged infrastructure. If these losses go unmanaged, they may have further and longer-term effects such as increasing poverty, declining human development and reduced economic growth.

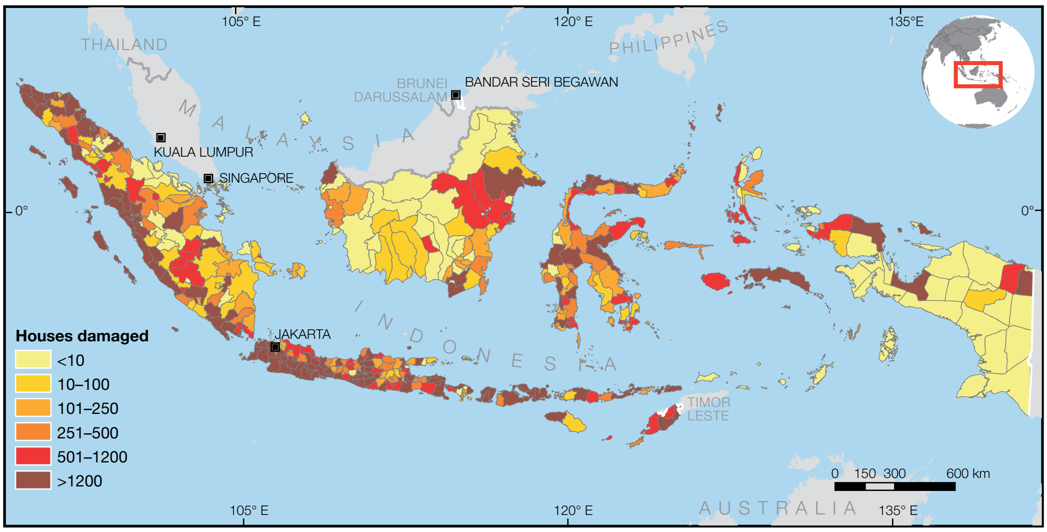
Extensive risks

The vast majority of these losses and impacts are extensive in character, occurring throughout a country's territory (Figure 1.2). As risk accumulates over time, it manifests as a large and rising number of localized disasters, mainly associated with storms, flooding, fires and landslides, and linked to climate variability. These localized disasters may account for only a small proportion of overall disaster mortality but, closely mirroring development processes (UNISDR, 2009), they are responsible for significant damage to housing, crops, livestock and local infrastructure, and particularly affect low-income households and communities.

Intensive risks

When extensive risk accumulates in areas prone to major hazards, such as earthquakes, tsunamis, tropical cyclones or flooding in large river basins, it paves the way for infrequent but highly destructive intensive disasters. Disasters, such as those associated with the 2010 earthquake in Haiti which reportedly killed 222,517 people and injured another 310,928 (UNOCHA, 2010), or Hurricane Katrina in the USA in 2005 which caused losses estimated at US$125 billion (EM-DAT, 2011a), are responsible for the vast majority of global mortality and direct economic loss, but only

Figure 1.2
Houses damaged and destroyed in extensive disasters in Indonesia, 1970–2009



(Source: DIBI, 2010)

occur relatively infrequently in any one place. The *2009 Global Assessment Report* noted that between 1975 and 2008, 0.26 percent of the disasters recorded in the EM-DAT database accounted for 78.2 percent of all the recorded mortality (UNISDR, 2009). Historically, as the examples of Lisbon and Lima-Callao illustrate, many societies have suffered catastrophic loss from such intensive manifestations of risk, for which they seemed to be neither prepared nor adapted.

Hazard and risk estimates, largely produced by and for the insurance industry, provide increasingly sophisticated models of the probable maximum losses associated with major hazards. Other studies identify areas where, for example, major earthquakes could occur (Aon Benfield, 2010). As this information becomes more widely available to governments, there are fewer and fewer excuses to be as unprepared as Manso de Velasco or the Marques of Pombal in 18th century Lima and Lisbon.

Nonetheless, there are still important gaps in our knowledge. In 1356, a strong earthquake destroyed Basel, Switzerland, but historical and instrumental records do not go back far enough to provide a reliable guide to the largest earthquakes that could occur in Central Europe (Stewart, 2003). In other regions, inadequate monitoring of climatic, seismic and volcanic activity may lead to an underestimation of hazard. In Central America, for example, the imbalanced distribution of weather stations, which are concentrated on the Pacific coast, may lead to poor forecasting and monitoring of drought on the Caribbean side of the isthmus (Brenes Torres, 2010).

Emerging risks

Even if these knowledge gaps can be filled, existing assumptions about disaster are being increasingly challenged, as new drivers of risk emerge and interact.

Between 1601 and 1603 Russia suffered the worst famine in the country's history. It is estimated that over 100,000 people starved to death in Moscow alone and perhaps two million in Russia as a whole (Borisenkov and Paseckij, 1988). It was only recently, however, that climate researchers established a conclusive link between the failure of harvests in Russia in 1601 and the ash cloud produced by the catastrophic explosion of the Huaynaputina volcano in southern Peru on 19 February 1600

Box 1.2 'Synchronous failure': the earthquake, tsunami and nuclear crisis in Japan, March 2011

On 11 March 2011, a massive earthquake producing intensities of up to XII on the Modified Mercalli scale occurred 130 km off Japan's eastern coast causing a tsunami that, together, may have killed more than 20,000 people. The Great East Japan Earthquake also disrupted critical sections of Japan's power grid, including the power supply needed to cool the spent fuel at the Fukushima Daiichi nuclear power plant. Back-up generators kicked in but were disabled when the tsunami struck the plant, which was located on the coast. The loss of power to the nuclear plant and the inability to cool the spent fuel appear to have led to partial meltdowns of at least three of the plant's reactors, causing the worst nuclear disaster since that at Chernobyl in 1986.

The earthquake, its aftershocks, the tsunami and the nuclear emergency illustrate what a 'synchronous failure' looks like: a multi-sectoral system's collapse. The full consequence of the trauma and costs will not be known for years to come. However, in the immediate aftermath of the disaster, it became evident that even in this highly sophisticated and well-prepared society, the impact of physical hazards on infrastructure can quickly lead to outcomes normally associated with poorer countries: large-scale food and water shortages, shelter crises and logistical collapse.

(Source: Kent, 2011)

Box 1.3 Heat wave and wildfires in western Russia and Ukraine in 2010

In 2010, western Russia experienced the hottest summer since the beginning of systematic weather data recording 130 years ago. Lack of rainfall in early 2010 and July temperatures almost 8°C above the long-term average led to parched fields, forests and peat lands that posed a high wildfire risk. Analysis of satellite data reveals that most fires started in agricultural areas and around villages, but dry lightning storms also caused some severe forest and peat-land fires.

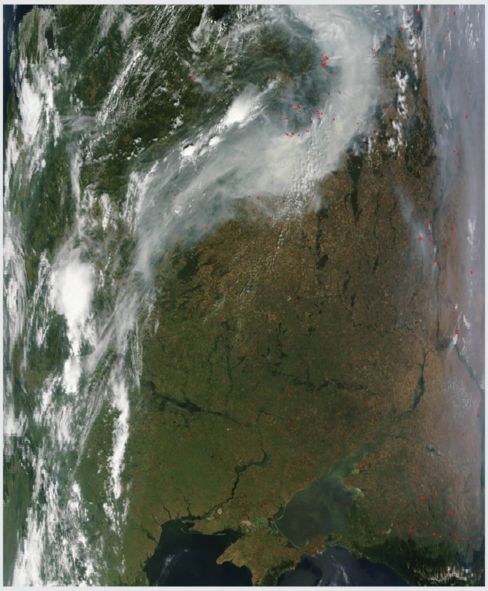
One of the most significant effects of the fires, which affected around 800,000 hectares in western Russia between July and September 2010, was the persistent near-ground air pollution. Moscow and its surroundings, with more than 15 million inhabitants, were covered by smoke for many weeks. People with cardiovascular and respiratory diseases, the elderly and the very young were particularly affected. During and after the wildfires, Russia's mortality rate increased by 18 percent. In August alone, 41,300 more people died as compared to August 2009, due to both the extreme heat and smoke pollution. The direct losses from fires in western Russia included the deaths of more than 50 civilians and firefighters, some 2,000 houses burnt down including more than 30 villages completely destroyed, large areas of crop land ruined, and more than 60,000 flights cancelled or delayed. The medium- to long-term effects of smoke pollution on morbidity and premature mortality, however, have not yet been calculated.

Social and economic change has greatly increased the risk posed by wildfires in rural western Russia. Traditional agricultural and pastoral livelihoods have declined, accompanied by the migration of young people to cities. Many villages are now primarily weekend or summer retreats, reducing responsibility for the careful and sustainable management of surrounding forests. National responsibility for forestry in the former Soviet Union had been highly centralized with strong control and management. The subsequent decentralization of these responsibilities and the exploitation of forests by the private sector may have also contributed to declining standards of forest management and protection, increasing wildfire risks.

Figure 1.3

Impact of forest and wildfires in Russia and Ukraine, 2010 (satellite images: MODIS sensor on NASA's Terra and Aqua satellites)

Multiple forest fires in Nizhny Novgorod Oblast (26 July 2010)



Smoke plume drifting from Nizhny Novgorod Oblast (Russia) to Kiev (Ukraine) (1 August 2010)

Total loss of gardens and smallholder agricultural land in Mokhove village, Lukhovitski district, Moscow region (after 30 July 2010)

(Source and images: GFMC, 2010)

(Thouret et al., 1997; Briffa et al., 1998; de Silva and Zielinski, 1998; Thouret et al., 2002).

Like this example of a disaster caused by an event on the other side of the world, a growing number of potential and plausible risks are either so difficult to identify or have such profound potential consequences, that it is difficult to find an entry point for risk modelling and analysis. Very low-probability hazards, such as geomagnetic storms or volcanic eruptions affecting global weather systems, have always existed. However, there may be no precedent for the emerging risks associated with these hazards as research reveals the increasingly complex vulnerabilities related to the growing interconnection and interdependency of modern societies. As such, there is a growing probability of 'simultaneous crisis' where different hazards occur at the same time, 'sequential crisis' where hazards trigger cascading disasters in a range of interlocked systems, and 'synchronous failures' where different risks converge and interact (Box 1.2).

In 2010, western Russia experienced a 'sequential crisis' as a severe drought created conditions for wildfires, exposing layers of new and emerging vulnerabilities that cascaded into impacts in areas as diverse as health and air traffic for which there was no historical precedent (Box 1.3).

1.2 Extreme events or extreme risks?

Countries with weak governance are likely to find it difficult to address the underlying risk drivers. These include badly managed urban and regional development, the degradation of hazard-regulating ecosystems such as wetlands, mangroves and forests, and high levels of relative poverty. With some exceptions, these tend to be low- and lower-middle-income countries.

Extreme hazards and events are not synonymous with extreme risks. When similar numbers of people are affected by hazards of similar severity, wealthier and poorer countries generally experience radically different losses and impacts (Box 1.4) (UNISDR, 2009). GAR09 highlighted that poverty is both a cause and consequence of disaster risk. Across all the major hazards, poorer countries with weaker governance tend to experience far higher mortality and relative economic loss compared to wealthier countries with stronger governance. Mortality risk, for example, is approximately 225 times greater in low-income countries compared to OECD countries when similar numbers of people are exposed to tropical cyclones of the same severity (Peduzzi et al., 2011). Governance refers to the actions, processes, traditions and institutions by which authority is exercised and decisions are taken and implemented. Whereas relative wealth is a key determinant, governance factors such as the strength of democracy (Keefer et al., 2010), inequality (UNISDR, 2009) and voice and accountability (UNISDR, 2009), all play roles in the social construction of risk.

The quality of a country's governance appears to have a significant influence on the underlying drivers of risk. Drivers identified in GAR09 include badly planned and managed urban and regional development, the degradation of hazard-regulating ecosystems such as wetlands, mangroves and forests, and increasing poverty and inequality (UNISDR, 2009). These drivers interact through multiple feedback loops and together translate hazards into disaster risk.

Figure 1.5 presents a composite index that measures the quality of governance and how well countries are addressing these three underlying risk drivers. Countries with weak governance and that have great difficulty addressing underlying drivers are, with some exceptions, mostly low- and lower-middle-income countries. Those at the bottom of the index, such as Haiti, Chad or Afghanistan, are also experiencing conflict or political instability. This index thus provides insight into whether a country's risk governance capacities and arrangements are effective in addressing underlying risk drivers.

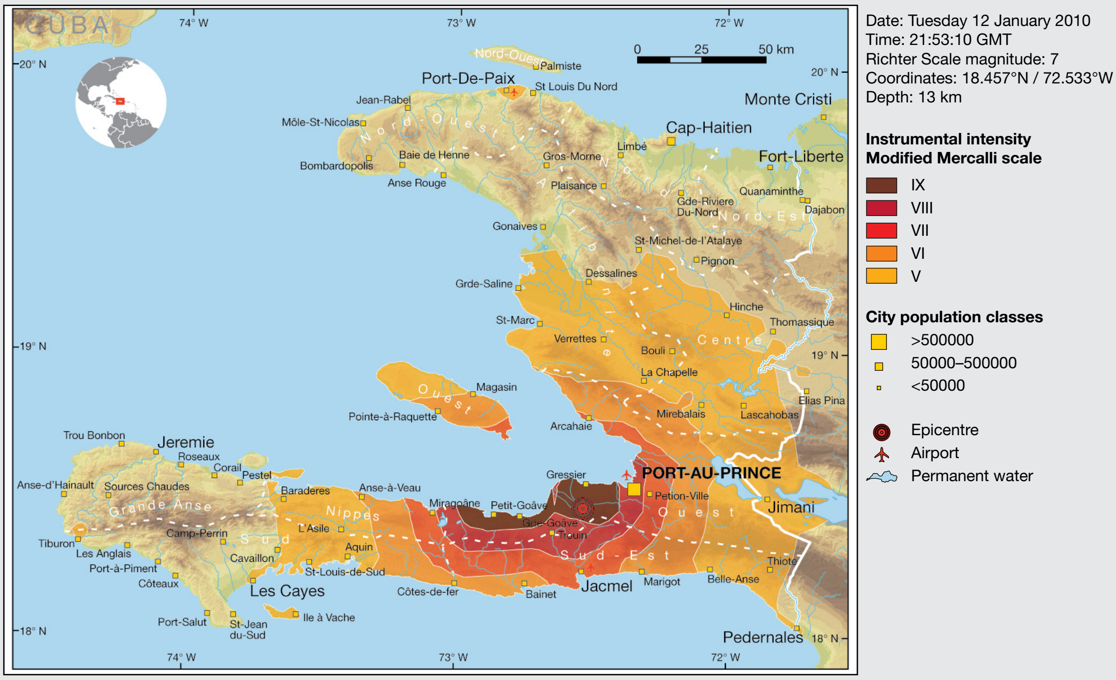
Box 1.4 Haiti, Chile and New Zealand, 2010

Extreme hazards are translated into risk through exposure and vulnerability, as tragically illustrated in all its dimensions by the earthquake that struck Haiti on 12 January 2010. The earthquake produced severe intensities of VII to IX on the Modified Mercalli scale, and mortality was very high, with 222,517 fatalities (UNOCHA, 2010).[1] This high death toll reflected the exposure of large numbers of people, and vulnerability factors such as extreme poverty, corruption, a fragile democracy, and a lack of earthquake experience in a country where they only occur infrequently (Keefer et al., 2010).

In contrast, the 27 February 2010 earthquake in Chile was by any standards an extreme event, releasing five hundred times more energy than the earthquake in Haiti the previous month. However, it only killed 486 people, a fraction of those who died in Haiti. In contrast to Haiti, exposure was lower, and Chile has a history of dealing with earthquakes. It is also an upper-middle-income country with a consolidated democracy and low levels of corruption.[2]

The earthquake that hit Christchurch, New Zealand, on 3 September 2010 also produced intensities of up to IX on the Modified Mercalli scale. However, only some 500 buildings were destroyed and no lives were lost. While an estimated 154 people were killed in another earthquake on 22 February 2011 (New Zealand, 2011), the low casualty rate in both events reflects tough building regulations, strict enforcement, and experience in dealing with earthquakes.

Figure 1.4
Shakemap of Haiti Earthquake in 2010



(Source: UNEP/GRID-Europe, 2010)

Economic studies (Albala-Bertrand, 1993; Kahn, 2005; Noy, 2009; Cavallo et al., 2010) provide conflicting evidence as to how and when disasters affect productivity, capital growth, employment, inequality and other macroeconomic parameters (Moreno and Cardona, 2011). However, evidence indicates that poorer countries with weak governance have less capacity to absorb and recover from disaster loss, and less ability to prevent losses spilling over into other parts of the economy (Noy, 2009). The penetration of catastrophe insurance in such countries is also still incipient. Although there are a growing number of parametric crop insurance schemes (World Bank, 2009), these reach less than 5 percent of eligible households in India, and only 17 percent in Malawi (Cole et al., 2008; Giné et al., 2008).

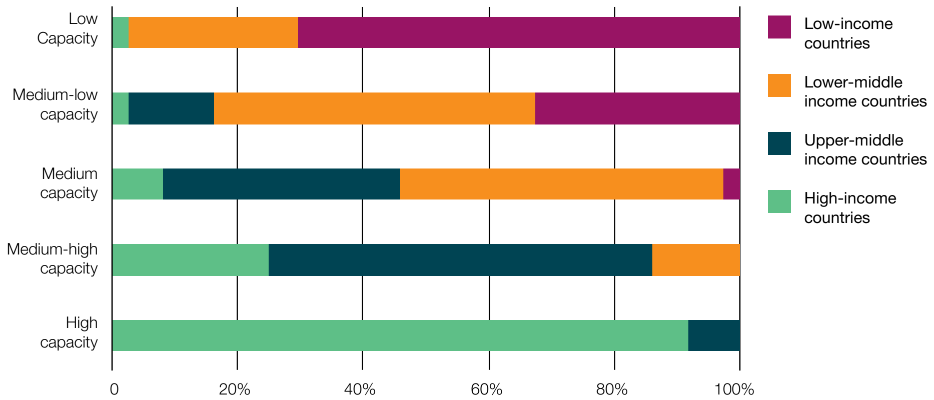


Figure 1.5

Risk governance capacity and World Bank country classification

This composite graph displays countries' risk governance capacities and their relative wealth by World Bank income regions. Approximately 90 percent of the countries with the strongest capacities are high-income countries. In contrast, low- and lower-middle income countries account for more than 95 percent of the quintile with the lowest capacities. These rankings derive from an analysis of indicators of the disaster risk drivers identified in GAR09: poverty, weak urban and local governance, ecosystem degradation, and government effectiveness and accountability. Each quintile is then subdivided based on the number of countries per World Bank category within it.[3]

(Source: DARA, 2011; Lavell et al., 2010 (adapted by UNISDR))

Within countries, different localities also have widely varying risk governance capacities. As Figure 1.6 shows, whereas Hurricane Mitch engulfed a large part of Central America in October 1998, most mortality in Honduras, the worst-affected country, was concentrated in a relatively small number of highly vulnerable and exposed municipalities. Following the hurricane, poorer households lost a greater proportion of their assets than wealthier households and had significantly more difficulty in recovering (Morris and Wodon, 2003; Carter et al., 2006).

1.3 Reducing disaster risk

The main opportunities for reducing risk lie in reducing vulnerability. This means addressing the underlying risk drivers by strengthening risk governance capacities. Extensive risks are largely shaped by these drivers. In contrast, intensive risks are more heavily determined by the location, severity and frequency of the associated hazard, meaning that there are limits to vulnerability reduction.

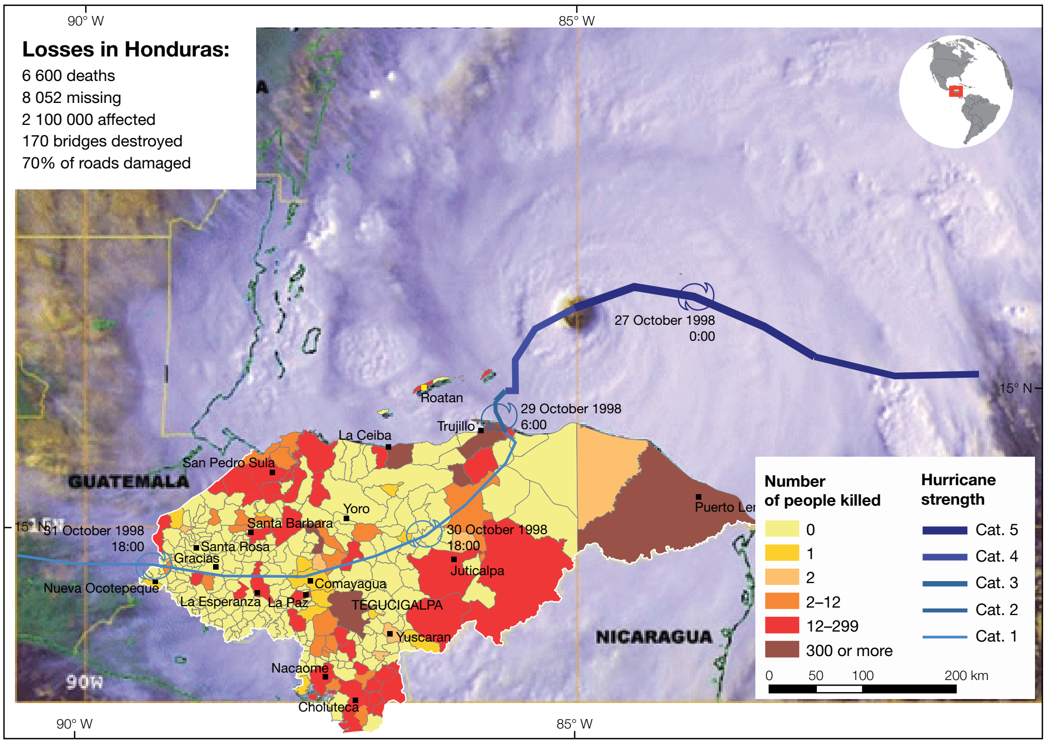
Governments cannot influence the severity of droughts, earthquakes, tsunamis and tropical cyclones, except in the case of weather-related hazards through international action to mitigate climate change. Similarly, the exposure of people and assets is largely fixed by the location of historical investments in infrastructure, urban and economic development, as well as by social and cultural attachment to place, or by geographical constraints such as on small islands. If hazard severity and exposure cannot be reduced, the main opportunities for reducing risk lie in reducing vulnerability.

Extensive risks are largely shaped by underlying risk drivers and can thus be more easily reduced by a strengthening of risk governance capacities. In contrast, intensive risks are more heavily determined by the location, severity and frequency of the associated hazard, meaning that there are limits to how much risk can actually be reduced.

In the case of tropical cyclones, for example, the variation in mortality appears to be affected by a combination of three factors: the severity of the cyclone, the number of people exposed, and GDP per capita, the latter being a reasonable proxy indicator of a country's vulnerability. As Table 1.1 shows, GDP per capita explains 91 percent of the variance in mortality risk with Category 1 cyclones, but only 37.1 percent with powerful Category 4 cyclones. In contrast,

Figure 1.6

Translating hurricane hazard into disaster risk: the impact of Hurricane Mitch in Honduras, 1998. Number of people killed



(Source: Image (NOAA, 1998); Damage (COPECO, 1998); Hurricane path (USGS, 1998). Collage by UNISDR)

the numbers of people exposed explains only 9 percent of the risk variance with Category 1 cyclones, but 62.9 percent with Category 4 cyclones. The implication is that if a country reduces its vulnerability, it can significantly reduce the mortality risk associated with Category 1 cyclones. Reducing the risk associated with Category 4 cyclones, however, particularly when accompanied by storm surges in low-lying coastal areas, is far more challenging (Table 1.1).

This does not imply that intensive risk cannot be reduced. All intensive risk is underpinned by vulnerability to some degree. As highlighted by the impact of Category 5 cyclone Yasi in Australia in February 2011, sound disaster management can go a long way to minimize mortality, even in the case of very severe cyclones. However, reducing vulnerability to very severe hazards may have unacceptably high costs and trade-offs. In the Cayman Islands, for example, building regulations specify resistance to a Category 3 cyclone. Increasing standards to withstand Category 4 or 5 cyclones would lead to an exponential increase in the cost of building, making the country less attractive for investment.

Table 1.1 Contribution of cyclone severity, exposure and vulnerability parameters to tropical cyclone risk

Risk factors	Correlation	Category 1	Category 2	Category 3	Category 4
Population exposure	Positive	9.0%	46.4%	45.1%	62.9%
GDP per capita	Negative	91.0%	53.6%	46.3%	37.1%
Distance to city	Positive	Not significant	Not significant	8.6%	Not significant
	Total	**100%**	**100%**	**100%**	**100%**

Tropical cyclone severity is measured on the Saffir-Simpson scale in five Categories. Category 5 cyclones occur very infrequently but are the most destructive, while Category 1 cyclones are more frequent but less severe.

(Source: UNEP, 2010)

In practice, these trade-offs are often already reflected in codes and regulations. Many building codes specify protection against earthquakes that occur once every 475 years but not those which occur less frequently, and national insurance regulators may require insurers to have reserves (including reinsurance) to cover risks up to a return period of 1,500 years (see Chapter 5). Different countries value the trade-offs in different ways, however. The Netherlands, for example, has constructed its dykes to resist a 10,000-year storm surge (ECA, 2009), but in most low- and middle-income countries, such investments are not affordable even if they were technically feasible and politically important.

In the case of destructive tsunamis, as illustrated by the examples of Lisbon and Callao and recently in Japan, vulnerability may be almost binary: meaning that all people exposed to the hazard are vulnerable, irrespective of income and capacities. In the case of large cities exposed to tsunamis that may reach the shoreline in a matter of minutes,[3] the effectiveness of early warning is relative. The 11 March tsunami may have killed more than 20,000 people in Japan, which has a highly regarded tsunami early warning system with six decades of experience. Also, even where civil engineering works that could protect a city against tsunamis are technically possible, the costs of their construction and maintenance would not necessarily make economic sense given long return periods (World Bank, 2010a).

It is not only the severity of hazards such as these that makes intensive risks more difficult to reduce. It is also the unexpectedness of events for which there may be no historical precedent, at least in living memory, and for which societies are thus not prepared. All other factors being equal, earthquake mortality for example, is lower in countries that experience more earthquakes, and is higher where earthquakes occur only infrequently (Keefer et al., 2010). In the absence of frequent major earthquakes, governments are less likely to find political incentives to invest in disaster risk management. If a major earthquake does occur, the absence of such investment leads to higher actual mortality.

1.4 Climate change adaptation

The challenge of adapting to climate extremes gives increased urgency to addressing underlying risk drivers, reducing vulnerability and strengthening risk governance capacities. If disaster risks can be reduced, then the magnifying effect of climate change will also be reduced, and adaptation will be facilitated. The contemporary tendency to characterize all weather-related disasters as manifestations of climate change underplays the role of the underlying risk drivers, and may point policy and planning in the wrong direction.

Climate change is gradually altering average temperature, sea level, and the timing and amount of precipitation, with potential for more drastic changes if carbon emissions are not successfully limited and reduced. Climate change also contributes to more frequent, severe and unpredictable weather-related hazards such as droughts, tropical cyclones, floods and heat waves (IPCC, 2007). Therefore, climate change adaptation can be understood as: (a) adapting to gradual changes in average temperature, sea level and precipitation; and (b) reducing and managing the risks associated with more frequent, severe and unpredictable extreme weather events, including those for which there may be no historic precedent.

Adapting to gradual changes in climate averages is a medium- to long-term process, involving long-term planning of investments in strategic infrastructure that take into account changing climatic conditions. For example, new hydroelectric plants and urban drainage systems need to account for future changes in rainfall, and investments in both urban and agricultural development need to take into account expected changes in water availability and rising sea levels.

However, the degree to which any society is adapted to its climate is socially constructed rather than environmentally determined (Berger and Luckmann, 1966). Countries that may find it most difficult to adapt are likely to have fewer resources to invest in new infrastructure and technologies, have limited social protection systems in place, and experience food insecurity, high vulnerability to disasters and extreme trade limitations (Corrales, 2010).

As Box 1.5 highlights, it is worth remembering that until the 19th century, much of the population of pre-industrial Europe was *maladapted* to its climate, and as a result, suffered devastating famines. It was only with the technological and material changes that accompanied the industrial revolution that Europe *adapted*.

Changing climate averages, such as decreasing precipitation or higher temperatures, can threaten development and thus may increase vulnerability and undermine resilience in many high-risk countries and regions. Climate change also modifies hazard intensity, frequency, patterns and seasonality. Countries will thus have to spend more time dealing with the unfamiliar, such as glacial lake outburst floods (GLOFs), even allowing for improvements in forecasting and early warning.

Reducing and managing the risks associated with more frequent, severe and unpredictable extreme weather events is fundamentally similar to DRM. Although attention is currently focused on how climate change is altering weather-related hazards, climate risks in the short term will be shaped by existing

Box 1.5 Adaptation and climate variability

Until the industrial revolution, the material and technological basis of agricultural production in Europe barely supported the subsistence needs of most households, even in years with good harvests. Climate variations such as colder and damper summers typically led to lower yields and crop losses, and were rapidly reflected in drastic increases in mortality and decreases in marriage and birth rates.

Agricultural productivity increased by approximately 60–65 percent between the 13th and 19th centuries (Braudel, 1979), but Europe was still constantly devastated by famines. France, for example, experienced 89 major famines between the 10th and 18th centuries (Braudel, 1979), not including the likelihood of many hundreds of localized famines. Technological limitations meant that it was impossible to transport large volumes of food and energy over long distances (Harvey, 1996), and most urban centres were therefore dependent on their immediate hinterland for food and firewood. This not only limited their growth but made them as vulnerable as rural areas to shortfalls in agricultural production.

The failure of cereal harvests associated with climate variability had drastic demographic impacts. It is estimated that the population of France fell by 1.3 million in 1693–1694, after several years with cold and wet summers devastated cereal production (Le Roy Ladurie, 2004). The following century, 196 days of rain between December 1769 and November 1770 had equally disastrous impacts. The number of births in rural France fell from 896,000 in 1769 to 829,000 in 1771, the number of marriages fell from 232,000 to 175,000, and there were at least 100,000 famine-related deaths (Le Roy Ladurie, 2006).

From the latter half of the 18th century onwards, famine risk was reduced by European industrialization and urbanization. Between 1772 and 1775, for example, British cereal imports increased by a factor of 26 (Le Roy Ladurie, 2006), buffering the impact of local production shortfalls.

The year of 1816 was the “year without a summer” in the Northern Hemisphere. On 10 April 1815, the Tambora volcano erupted in Indonesia. The resulting cold summer in Europe provoked failures in cereal production comparable with previous crises. However, the demographic impact in industrializing France was minimal, if compared to that of 1693–1694 or 1770–1771. In France, the number of deaths in 1817 was only 18,500 greater than in 1816 or 1818. In contrast, the increase in mortality in less industrialized regions of Europe may have been as high as 40 percent (Le Roy Ladurie, 2006).

risk patterns and increasing exposure of people and their assets, as much as by climate change itself (ECA, 2009). From that perspective, the contemporary tendency to characterize weather-related disasters as manifestations of climate change underplays the role of the underlying risk drivers, and may point policy and planning in the wrong direction.

As with DRM in general, the challenge of adapting to climate extremes requires increased attention to underlying risk drivers, reducing vulnerability, and strengthening risk governance capacities. If disaster risks can be reduced, then the magnifying effect of climate change will also be reduced and adaptation facilitated.

1.5 Strengthening risk governance capacities

Governments need to invest in anticipating, reducing and transferring the different levels of extensive, intensive and emerging risks. However, political and economic incentives required for this may be lacking, and risk governance capacities may be inadequate for the task. Contemporary societies need to strengthen their risk governance capacities in order to reduce those risks that can be reduced, transfer those that cannot, and anticipate and prepare for emerging and realistic risks that cannot be easily identified or measured.

Prospective risk management (Lavell and Franco, 1996; Lavell et al., 2003) refers to actions that ensure that development does not add new risks to the stock of risk-prone assets. There are many examples. Land use planning can be used to steer urban development away from high-risk areas. Improved building standards can be used to reduce vulnerability in new construction. Enhanced water management can reduce drought risk. Ecosystems that mitigate hazards, such as forests, wetlands and mangroves, can be protected.

Corrective risk management refers to removing risks that are already present before they manifest as loss. This may include relocating highly exposed and vulnerable settlements, adapting and upgrading existing facilities such as schools and hospitals, or restoring degraded ecosystems. Prospective and corrective risk management are not mutually exclusive, because risk itself is constantly changing. Housing, infrastructure networks and cities as a whole are processes more than things, and investment is constantly being made in their renewal, renovation, remodelling, and replacement of component parts. Renewing obsolete infrastructure to a higher specification for example, or introducing strengthened structures when remodelling an old building, are corrective and prospective at the same time.

As already highlighted, it is generally easier to reduce extensive risks. The more intensive risks, which may not be practically or cost-effectively reduced, have to be addressed through compensatory risk management. This can include risk transfer mechanisms such as insurance and reinsurance, contingent financing complemented by social protection measures at the household level, such as conditional transfers and temporary employment programmes. These measures do not reduce risk per se,[4] but compensate for loss, avoiding the spill-over of impacts into other areas such as health, education, nutrition and productivity. Disaster management mechanisms at different scales, including early warning systems, preparedness, rapid response and recovery measures, also play key roles in reducing loss of life and injury, and avoiding poverty outcomes.

For many governments faced with known and urgent risks, it may be difficult to justify investment in protecting against future unknowns. However, developing plausible future risk scenarios is the first step in a process of identifying and anticipating what might happen, before then developing strategies to manage them. The 2003 heat wave in Europe, which killed more than 14,800 people in France alone (Pirard et al., 2005), highlighted that even wealthy countries with strong risk governance capacities can find if difficult to deal with unfamiliar hazards for which they are neither adapted nor prepared. As Box 1.6 highlights, improved awareness of future risks and preparedness could have greatly reduced the impact of the volcanic ash cloud that largely closed down European airspace in April 2010. After the 2003 European heat wave, France put in place a sophisticated early warning system to anticipate the impacts of future weather extremes (Pascal et al., 2006), which has subsequently served as the model for a regional early warning system (Auld, 2008).

Each country has its own unique risk profile or signature with different kinds and proportions of extensive, intensive and emerging risks. To reduce their risks, therefore, governments will normally need to adopt a mix of prospective, corrective and compensatory risk management strategies, together with strategies to manage disasters and anticipate emerging risks.

Unfortunately, without systematically accounting for disaster losses and impacts, and comprehensively assessing the full range of risks they face, few countries have been able to find the political and economic incentives to identify the costs and benefits and trade-offs that could inform a balanced and effective portfolio of risk management strategies. As Chapter 2 of this report shows, countries that have invested in strengthening their disaster management capacities have witnessed a steady decline in mortality risk, at least with respect to weather-related hazards. However, the institutions and capacities for risk governance in most countries still appear inadequate to address the risks associated with the rapid increase in asset exposure that, particularly in the last decade, has been fuelled by rapid economic growth in many low- and middle-income countries. Although these countries have strengthened their capacities and reduced their vulnerabilities, these improvements have proved largely insufficient.

The catastrophes of Lima-Callao and Lisbon catalysed the scientific study of physical hazards. But, as Manso de Velasco and the Marques of Pombal discovered when they were rebuilding their cities, reducing disaster risk is primarily an issue of identifying the political and economic incentives and negotiating trade-offs – as true today as it was then. Although much has changed over the last 250 years, if the objective of the Hyogo Framework for Action (HFA) is to be achieved, if progress is to be made towards the UN's Millenium Development Goals, and

Box 1.6 Unexpected or unprepared?

The volcanic ash cloud that affected Europe in April 2010 is estimated to have caused US$521 million in lost GDP in the United Kingdom alone and US$4.7 billion in global GDP (Oxford Economics, 2010). Although the disaster was called an unprecedented and unexpected event, it was neither. Rather, it illustrates the challenges posed by risks for which governments are not prepared.

Volcanic activity in Iceland comparable to the 2010 Eyjafjallajökull eruption is not unusual, occurring every 20 to 40 years on average (Sammonds et al., 2010). This volcanic activity becomes a problem for Europe when it coincides with north to north-westerly air movements, which occur only 6 percent of the time. Thus, whereas the ash cloud could be considered unusual, it was far from unprecedented, and not unexpected. In fact, the volcano had been in eruption for four weeks before the ash cloud reached the airspace of the United Kingdom on 15 April, which was more than ample time to have put into effect contingency plans, had these existed. The losses caused were largely due to a failure to anticipate the risks, meaning that countries were taken by surprise.

if adaptation to climate change is to be possible, that challenge still remains.

Fortunately, a new paradigm in disaster risk reduction is starting to emerge, largely driven by innovations in loss accounting and risk assessment, in the adaptation of development planning and investment instruments and in risk governance by those governments that have recognized the importance of *investing today for a safer tomorrow*. An opportunity to reduce disaster risk now begins to open: learning from, building on, and up-scaling these innovations; revealing risk and redefining development.

Notes

1 The real death toll may be much lower. Some commentators have cited 40,000–50,000 (Suárez et al., 2010). Disaster mortality rates may be drastically over-reported, even by international organizations (UNISDR, 2009).

2 Chile had the lowest level of corruption in Latin America according to the *2009 Corruption Perceptions Index* (CPI), and was ranked the 25th least corrupt country in the world (Transparency International, 2009).

3 Notwithstanding this affirmation, in tsunami-exposed Pagang, Indonesia, building artificial hills has been proposed, called Tsunami Evacuation Raised Earth Parks (TEREPs), that would allow the vertical evacuation of people in the case of a tsunami warning (GeoHazards International, 2010). However, the effectiveness of this approach has yet to be proved in practice.

4 Though, if well designed, they can incorporate incentives for risk reduction and create community assets that reduce vulnerability.

GAR 2011

Chapter 2
Revealing risk

A submerged bus near the town of Dadu, Pakistan, during the July–August 2010 floods.
Photo: Andrew McConnell/Panos Pictures

Chapter 2 Revealing risk

Disaster risks can increase or decrease over time according to a country's ability to reduce its vulnerability and strengthen risk governance capacities.

In recent decades, countries in all regions have strengthened their capacities to reduce mortality risks associated with major weather-related hazards such as tropical cyclones and floods. Despite more and more people living in flood plains and along cyclone-exposed coastlines, mortality risk relative to population size is falling. In East Asia and the Pacific, for example, it is now only a third of what it was in 1980.

In contrast, many countries are struggling to address other risks. Economic loss risk to tropical cyclones and floods is growing as exposure of economic assets increases, outstripping reductions in vulnerability. Losses suffered by low-income households and communities due to frequently occurring extensive disasters are often under-recorded and are increasing rapidly. The improvement in risk governance capacity and reduction in vulnerability in low- and middle-income countries as they develop, are insufficient to address the run-away increase in asset exposure, particularly in countries that are experiencing rapid economic growth.

Underlying risk drivers continue to increase risk, such as poverty, badly planned and managed urban and regional development, and ecosystem decline. Whereas the links between risk and poverty are well established, new evidence confirms that disaster losses particularly affect child welfare and development, and contribute to internal displacement. These impacts, which are rarely properly accounted for, highlight the need for disaster risk management (DRM) policies sensitive to the needs of children and the displaced.

2.1 Disasters under construction

Dhaka's rapid expansion highlights how drivers such as badly planned and managed urbanization, ecosystem decline, and poverty, accumulate risk over time.

Dhaka, Bangladesh. The 1897 Assam earthquake (also known as the Great Indian Earthquake), one of the largest ever recorded in South Asia, caused extensive damage to the city's buildings and infrastructure (Al-Hussaini, 2003). At that time, Dhaka's metropolitan population was less than 100,000. Now it is estimated to be around 15 million. However, it is not only the 150-fold increase in exposed population that has led to Dhaka's current level of earthquake risk. The city has also been unable to address the processes that shape and accumulate that risk over time.

Many areas surrounding central Dhaka are flood prone during the rainy season, and until recently were occupied by natural water bodies and drains, vital to the regulation of floods. Land use planning instruments such as the Dhaka Metropolitan Development Plan restrict development in many of these areas. Despite the Plan, these areas are still being rapidly urbanized through private- and public-sector projects (Box 2.1).

Box 2.1 Constructing earthquake risk on wetlands

Large areas of Dhaka are highly susceptible to liquefaction during earthquakes, and many have been used as construction sites for buildings and infrastructure in recent decades. Figure 2.1 shows the shrinking and disappearance of water bodies (circled) in one such area, West Dhaka, between 1996 and 2009.

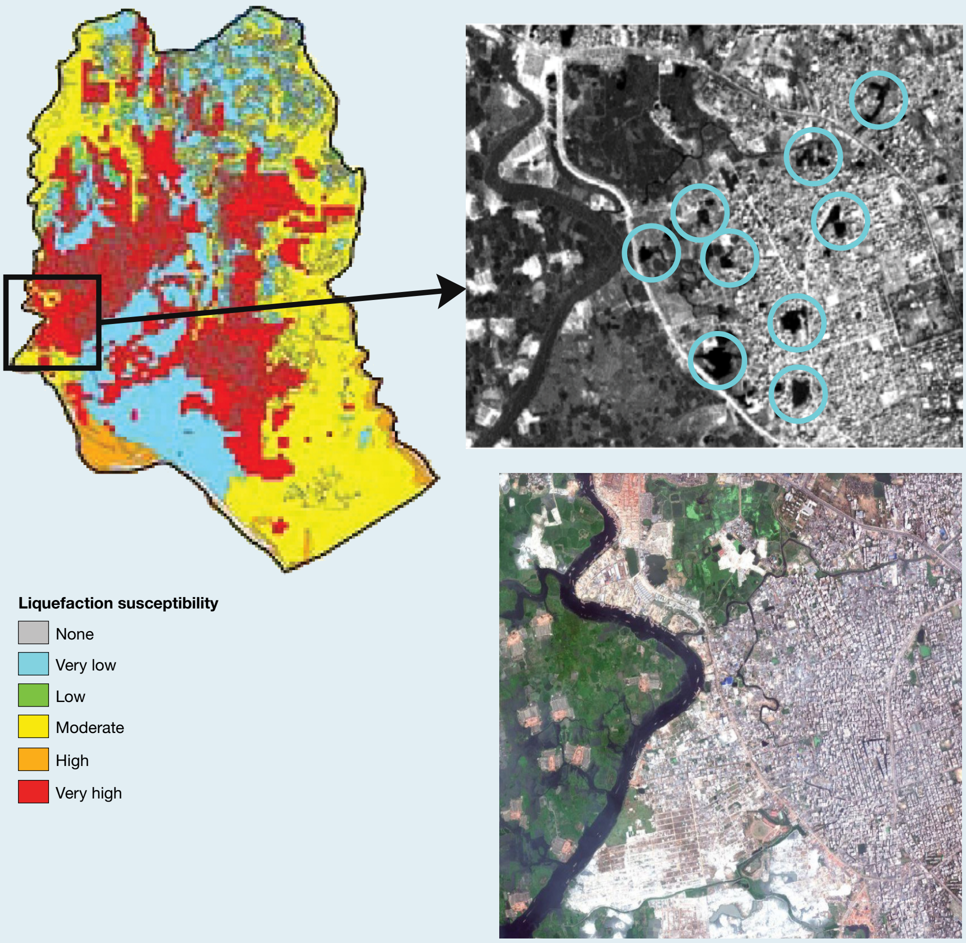


Figure 2.1
Areas of Dhaka susceptible to liquefaction and change in water and the built environment in West Dhaka between 1996 and 2009

(Source: Rahman, 2010, adapted from IRS Image 1996 and Google Earth)

Destroying retention ponds and drains increases risks of seasonal flooding just as building in drained wetlands increases earthquake risk. During an earthquake, sands and silts can liquefy to the point where the soil no longer supports the weight of buildings and infrastructure, which may subsequently collapse or suffer heavy damage. Dhaka's wetlands, drained and filled with sand for housing development, are prime candidates for liquefaction.

With little contemporary experience of earthquakes, Dhaka is vulnerable and ill-prepared. The older part of the city is home to densely populated, multi-storey, unreinforced brick buildings predisposed to heavy damage in a strong earthquake (Paul and Bhuiyan, 2010). And despite guidelines for earthquake-resistant construction, faulty design and poor quality materials and workmanship mean that many modern reinforced concrete buildings are also vulnerable.

An innovative cyclone shelter programme has helped Bangladesh dramatically reduce cyclone mortality since the 1970s. In the past four decades, Bangladesh has been struck by three severe cyclones: Bhola (1970), Gorky (1991) and Sidr (2007). Bhola caused an estimated 300,000 deaths and Gorky was responsible for more than 138,000. The death toll for Sidr, however, was 'only' around 4,000 (EM-DAT, 2010a).[1] Unfortunately, the disaster management capacities that have reduced cyclone mortality have not been able to address earthquake risk in Dhaka. Consistent with this, Bangladesh's Hyogo Framework for Action (HFA) report (see Chapter 4 for more on HFA reporting) highlights that although there is an Earthquake Zoning Plan for Dhaka, its enforcement and general urban improvement remain major challenges. Dhaka's expansion vividly illustrates how drivers such as badly planned and managed urbanization, ecosystem decline and poverty interact to build risk over time (UNISDR, 2009).

Until recently there was only one seismic observatory in Bangladesh (in Chittagong in the country's southeast), although in recent years seismic monitoring capacity has increased, with new observatories in Sylhet, Rangpur and Gazipur (Paul and Bhuiyan, 2010). This means that earthquake hazard in the area may not be fully understood, despite the certainty of a severe earthquake one day. With its population growing at around 6 percent annually, risk can only increase unless vulnerability is drastically reduced.

Dhaka highlights the complex processes that configure risk and the challenges they pose for effective disaster risk governance. For example, extensive risk associated with flooding can contribute to intensive risk associated with earthquakes (see the Preface for definitions of extensive and intensive risk). However, apparent success in reducing mortality from tropical cyclone disasters has not translated into improvements in the management of earthquake risk. The multiple feedback loops that exist among urbanization, ecosystem decline, poverty and governance, configure risk while simultaneously obscuring causality. In attempting to reduce risks associated with a range of hazards, authorities must make trade-offs between them.

To begin to unravel the complexity of multiple interrelated risk drivers, this chapter explores global trends in the mortality and economic loss risk associated with tropical cyclones and floods (Box 2.2), and with the losses and damages associated with extensive risks. It also examines the impacts of disasters on children and on internal displacement, and introduces a number of potential emerging risks.

Box 2.2 Updating the global risk analysis

GAR09 analysed global patterns of mortality risk and economic loss risk for tropical cyclones, floods, landslides and earthquakes, and the underlying risk drivers that explained those patterns. In GAR11, all the datasets used in the global risk analysis have been updated to 2010 and can be explored for tropical cyclones, floods and landslides using the online Global Risk Data Platform (www.preventionweb.net/gar). The same methodology and statistical models that underpinned the GAR09 analysis of global risk have been used for GAR11, given that two years of additional data is unlikely to lead to significant changes in the value of the statistical regressions (Peduzzi et al., 2010).[2]

Following an in-depth revision of the earthquake risk model,[3] it was decided not to update the earthquake risk analysis until new datasets from the United States Geological Survey and the Global Earthquake Model become available. GAR11, therefore, does not include an earthquake risk analysis.

GAR11 explores trends over time between 1970 and 2010 for tropical cyclones and floods for World Bank geographic and income regions.[4] These trends are explored using modelled disaster risk rather than recorded disaster losses which do not provide a solid platform for estimating trends. Most recorded losses are concentrated in a very small number of infrequent intensive disasters with long return periods. The occurrence of one or more intensive disasters in any given decade, therefore, distorts any underlying trend. In addition, trends identified using reported losses also reflect improved disaster reporting over time. Satellite data indicate that on average, between 142 and 155 countries have been hit by tropical cyclones every year since 1970 (Table 2.1).[5] However, the number of internationally reported cyclone disasters tripled between the 1970s and 2010. This trend is only partly due to increasing exposure and cyclone severity; it is mostly induced by improved reporting and access to information (Peduzzi et al., 2010, 2011).

Table 2.1 Trend of tropical cyclones reported versus tropical cyclones detected by satellite during the last four decades.

	1970–1979	1980–1989	1990–1999	2000–2009
Number of tropical cyclones (TCs) as identified in best track data (average per year)	88.4	88.2	87.2	86.5
Number of countries hit by TCs as detected by satellite (average per year)	142.1	144.0	155.0	146.3
Number of disasters triggered by TCs, reported by EM-DAT (average per year)	21.7	37.5	50.6	63.0
Reported disasters as a percentage of number of countries hit by TCs	15%	26%	33%	43%

The trend analysis estimates changes in vulnerability and exposure. Although factors such as climate change and variability and environmental degradation influence hazard levels, data limitations mean that, in the case of floods, hazard has been treated as constant. In contrast, thanks to a new and more complete data set, changes in the frequency and severity of tropical cyclones have been accounted for in the calculation of tropical cyclone exposure (Tables 2.3 and 2.5 and Figure 2.10). Tropical cyclone risk (Figures 2.12, 2.15 and 2.17) has been estimated using modelled exposure and modelled tropical cyclone frequency based on observations from 1970 to 2010. It is expected that trends in extreme hazards will be addressed in more detail in the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), which is scheduled for publication in 2011.

2.2 Global disaster risk trends

As the case of Dhaka illustrates, earthquake mortality risk may be increasing, particularly in countries experiencing rapid urban growth. In contrast, mortality risk associated with major weather-related hazards is now declining globally, including in Asia, where most of the risk is concentrated. Although the number of people exposed to tropical cyclones and floods continues to increase, countries are successfully reducing their vulnerabilities and strengthening their disaster management capacities. In East Asia and the Pacific, mortality risks for both floods and cyclones are now about one third of what they were in 1980, relative to the size of the region's population: a major achievement. South Asian countries have struggled to reduce mortality risks, but these have also fallen over the last decade.

2.2.1 Weather-related mortality risk remains highly concentrated in countries with low GDP and weak governance

Figures 2.2 to 2.7 show an updated global distribution of mortality risk for three weather-related hazards (tropical cyclones, floods and rain-triggered landslides). In these maps, the areas of highest risk correspond to areas where high concentrations of vulnerable people are exposed to severe and frequent hazards. The risk model highlights that flood mortality risk is highest in rural areas with a dense and rapidly growing population in countries with weak governance; cyclone mortality risk is highest in isolated rural areas with low GDP per capita;[6] and landslide risk is highest in areas with low GDP per capita. For all weather-related hazards, countries with low GDP and weak governance tend to have drastically higher mortality risks than wealthier countries with stronger governance.

2.2.2 Exposure to floods and tropical cyclones is increasing rapidly, growing fastest in low-income countries

Between 1970 and 2010, the world's population increased by 87 percent (from 3.7 billion to 6.9 billion). In the same period, the average numbers exposed to flooding every year increased by 114 percent (from 32.5 to 69.4 million annually).[7] Relatively speaking, ever more people are living in flood plains, suggesting that the economic advantages of living in such an environment must outweigh the perceived risks of flooding. Populations in cyclone-prone areas are also growing, highlighting the attractiveness of tropical coastlines for tourism as well as for economic and urban development in general.[8] Global physical exposure to tropical cyclones almost tripled (increasing by 192 percent) between 1970 and 2010.

Low- and lower-middle-income countries not only have the largest proportion of their population exposed to floods, but their exposure is also growing faster than in middle-income and Organisation for Economic Co-operation and Development (OECD) countries (Figure 2.8). More than 90 percent of the global population exposed to floods live in South Asia, East Asia and the Pacific (Table 2.2), but exposure is growing most rapidly in sub-Saharan Africa. In contrast, exposure is increasing only marginally in OECD countries whereas in eastern and south-eastern Europe and Central Asia it is stable, reflecting a broader trend of demographic changes.

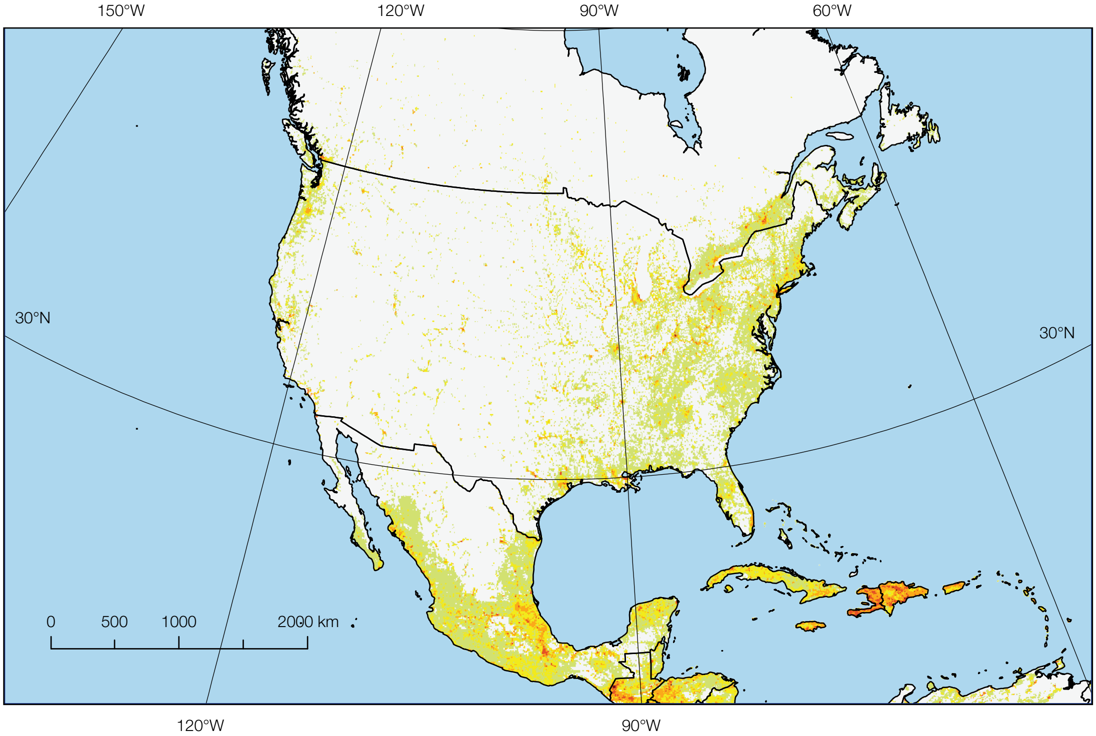


Figure 2.2

Mortality risk distribution from weather-related hazards (tropical cyclones, floods and rain-triggered landslides) in North America and the Caribbean as modelled

Figure 2.3

Mortality risk distribution from weather-related hazards (tropical cyclones, floods and rain-triggered landslides) in South America and the Caribbean as modelled

Figure 2.4

Mortality risk distribution from weather-related hazards (tropical cyclones, floods and rain-triggered landslides) in Europe as modelled

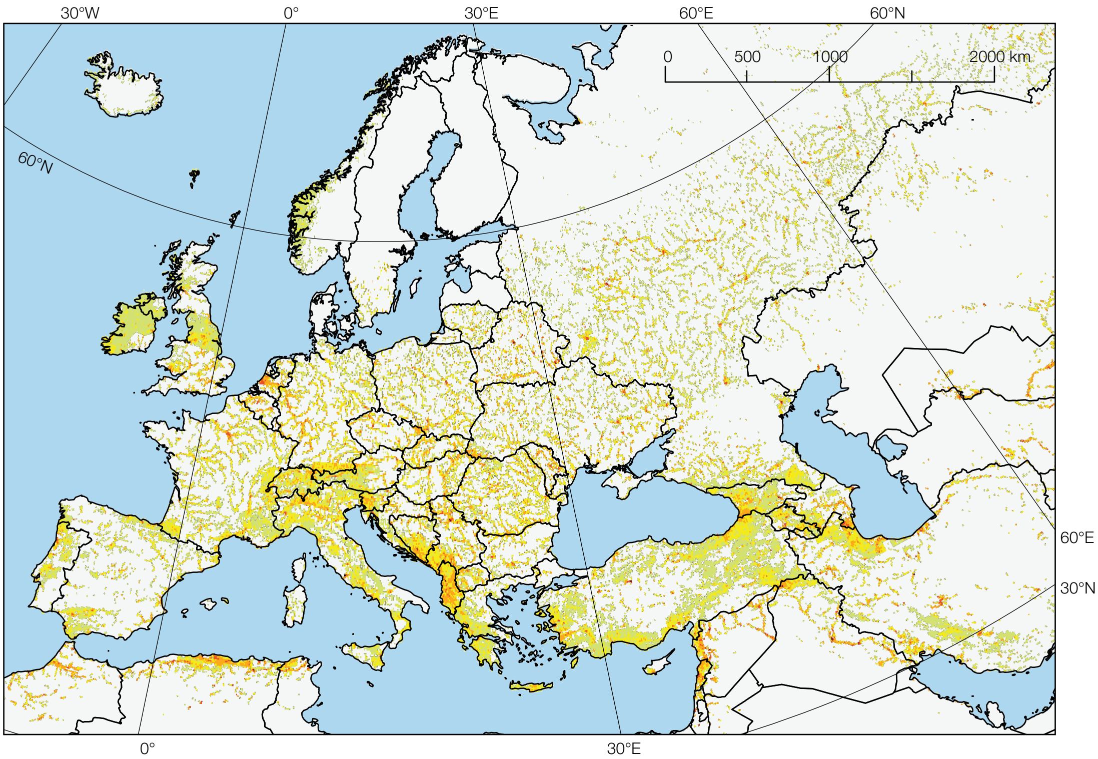
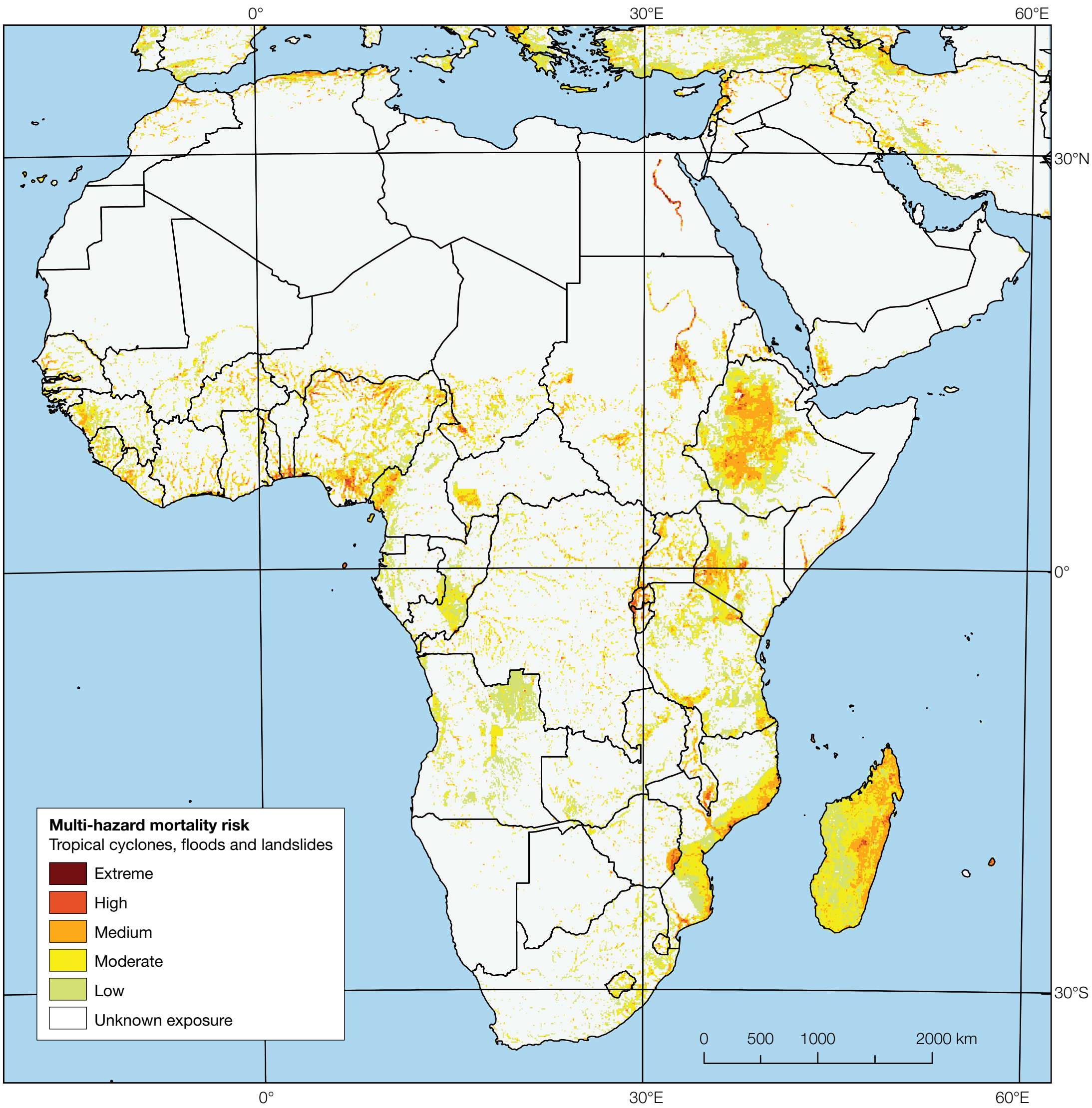


Figure 2.5

Mortality risk distribution from weather-related hazards (tropical cyclones, floods and rain-triggered landslides) in Africa as modelled



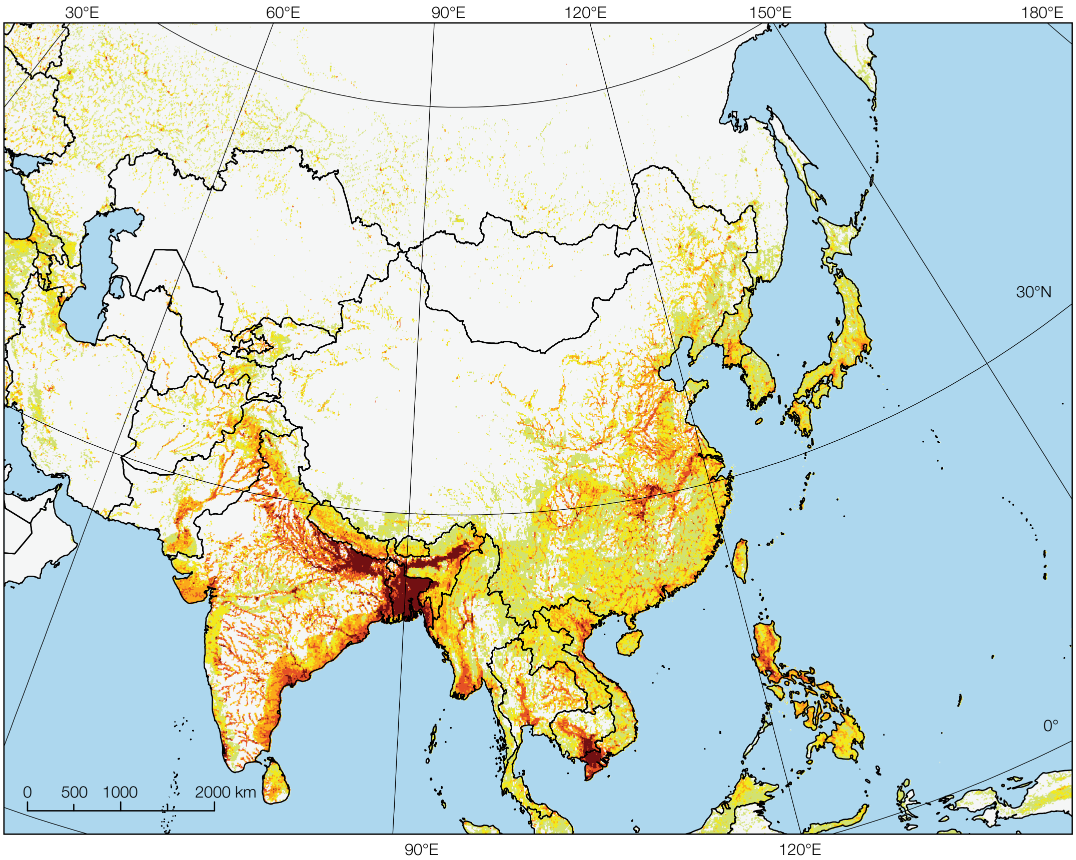


Figure 2.6

Mortality risk distribution from weather-related hazards (tropical cyclones, floods and rain-triggered landslides) in Asia as modelled

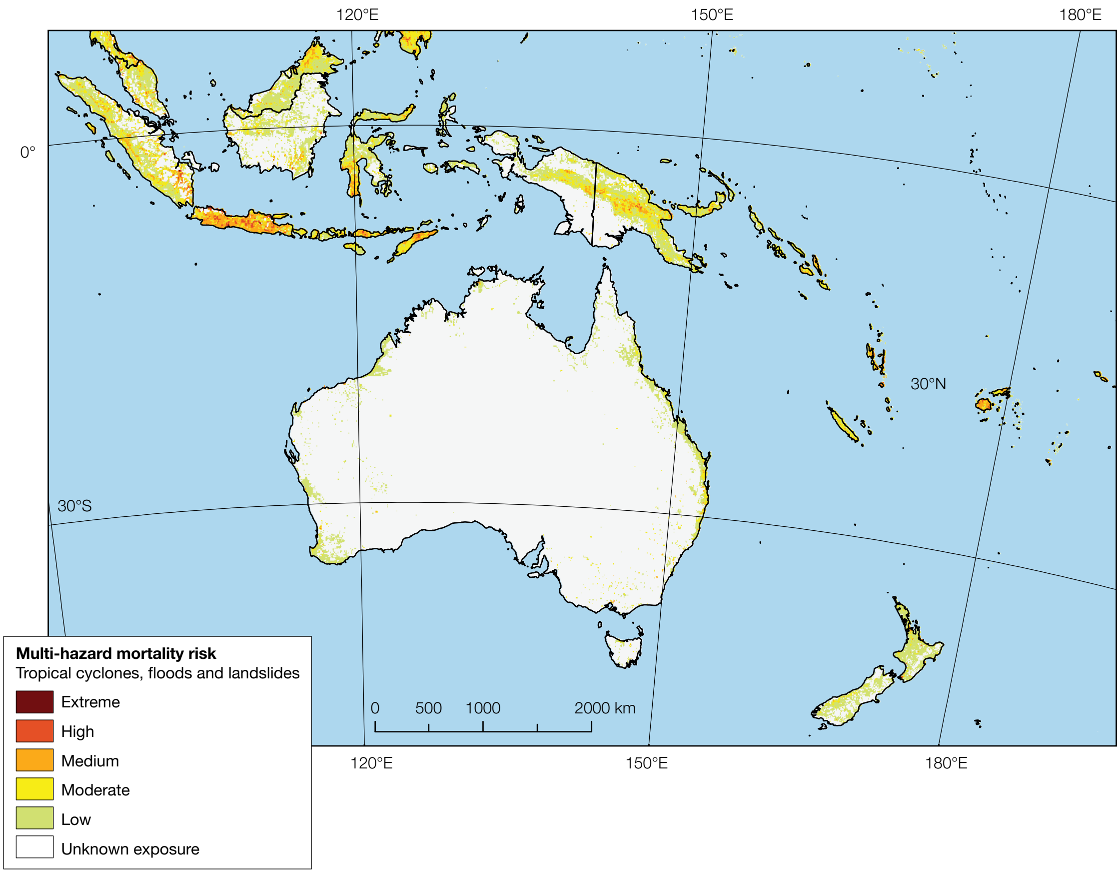


Figure 2.7

Mortality risk distribution from weather-related hazards (tropical cyclones, floods and rain-triggered landslides) in Oceania and South East Asia as modelled

Figure 2.8
Trend in flood exposure per income region as modelled

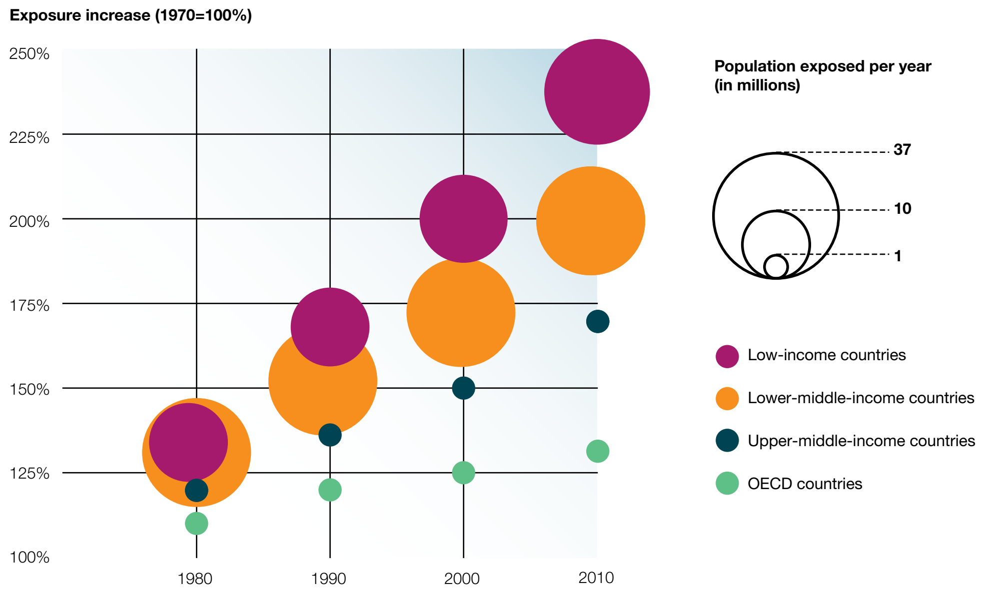


Table 2.2 Flood exposure by World Bank region as modelled[9] (million people per year)

Region	1970	1980	1990	2000	2010
East Asia and the Pacific (EAP)	9.4	11.4	13.9	16.2	18.0
Europe and Central Asia (ECA)	1.0	1.1	1.2	1.2	1.2
Latin America and the Caribbean (LAC)	0.6	0.8	1.0	1.2	1.3
Middle East and North Africa (MENA)	0.2	0.3	0.4	0.5	0.5
OECD countries (OECD)	1.4	1.5	1.6	1.8	1.9
South Asia (SAS)	19.3	24.8	31.4	38.2	44.7
Sub-Saharan Africa (SSA)	0.5	0.7	1.0	1.4	1.8
World	**32.4**	**40.6**	**50.5**	**60.5**	**69.4**

(Sources: PREVIEW flood global model; Landscan, 2008 (extrapolated from 1970 to 2010 using UN world population))

Since 1970 there has been little change in the overall number of tropical cyclones (Figure 2.9). The number of recorded Category 1 and 2 cyclones has been decreasing whereas the number of Category 4 and 5 cyclones has been increasing.[10] Over half of all tropical cyclones that made landfall affected East Asia and the Pacific and OECD countries (mainly Japan, the United States of America and Australia) (Table 2.3). Although most of the annual average exposure to tropical cyclones is concentrated in lower-middle- and high-income countries, exposure is growing most rapidly in low-income countries (Figure 2.10) where it has increased almost eight-fold since the 1970s (the dip in exposure in the 1990s reflects fewer cyclones in that decade).

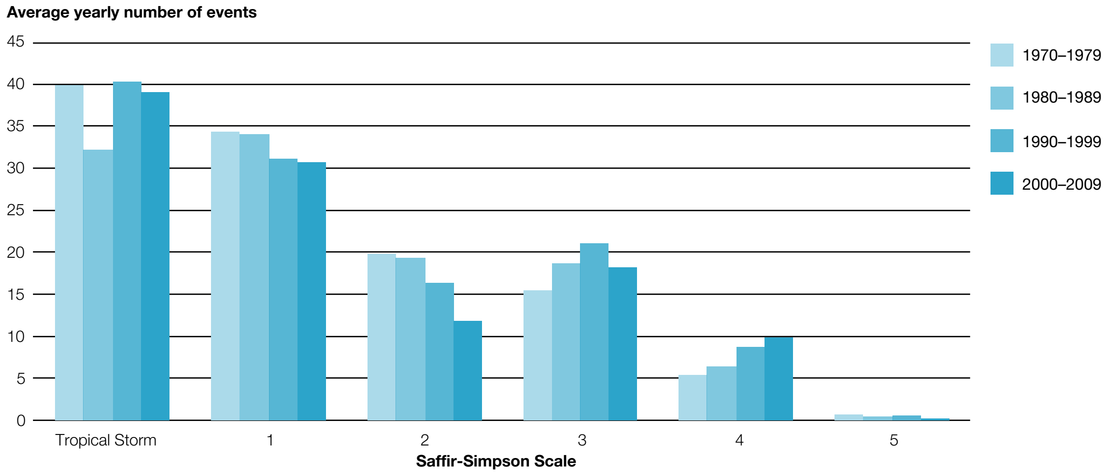


Figure 2.9

Average annual number of tropical cyclones by Saffir-Simpson Category between 1970 and 2009 as observed

Table 2.3 Exposure to tropical cyclones by World Bank region as modelled from observed events (in million people per year)

Region	1970–1979	1980–1989	1990–1999	2000–2009
East Asia and the Pacific (EAP)[11]	36.6	42.2	44.3	53.7
Latin America and the Caribbean (LAC)	1.1	1.6	1.2	5.2
Middle East and North Africa (MENA)	0.0	0.0	0.0	0.1
OECD countries (OECD)	26.2	27.2	39.7	53.2
South Asia (SAS)	1.5	7.8	11.1	7.6
Sub-Saharan Africa (SSA)	0.5	0.9	1.5	2.7
World	**65.9**	**79.8**	**97.8**	**122.5**

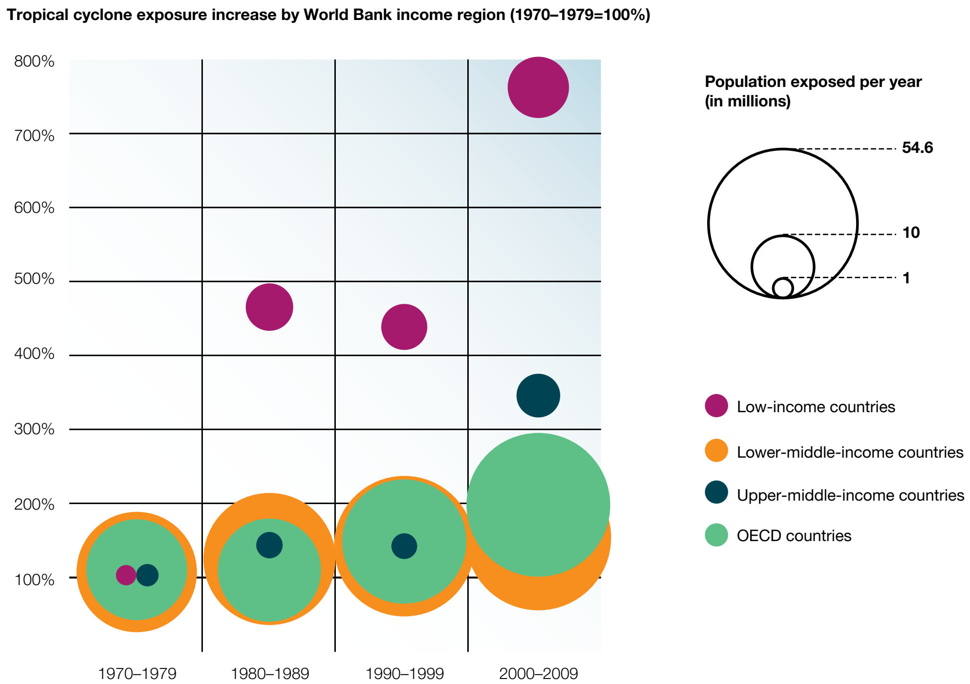


Figure 2.10

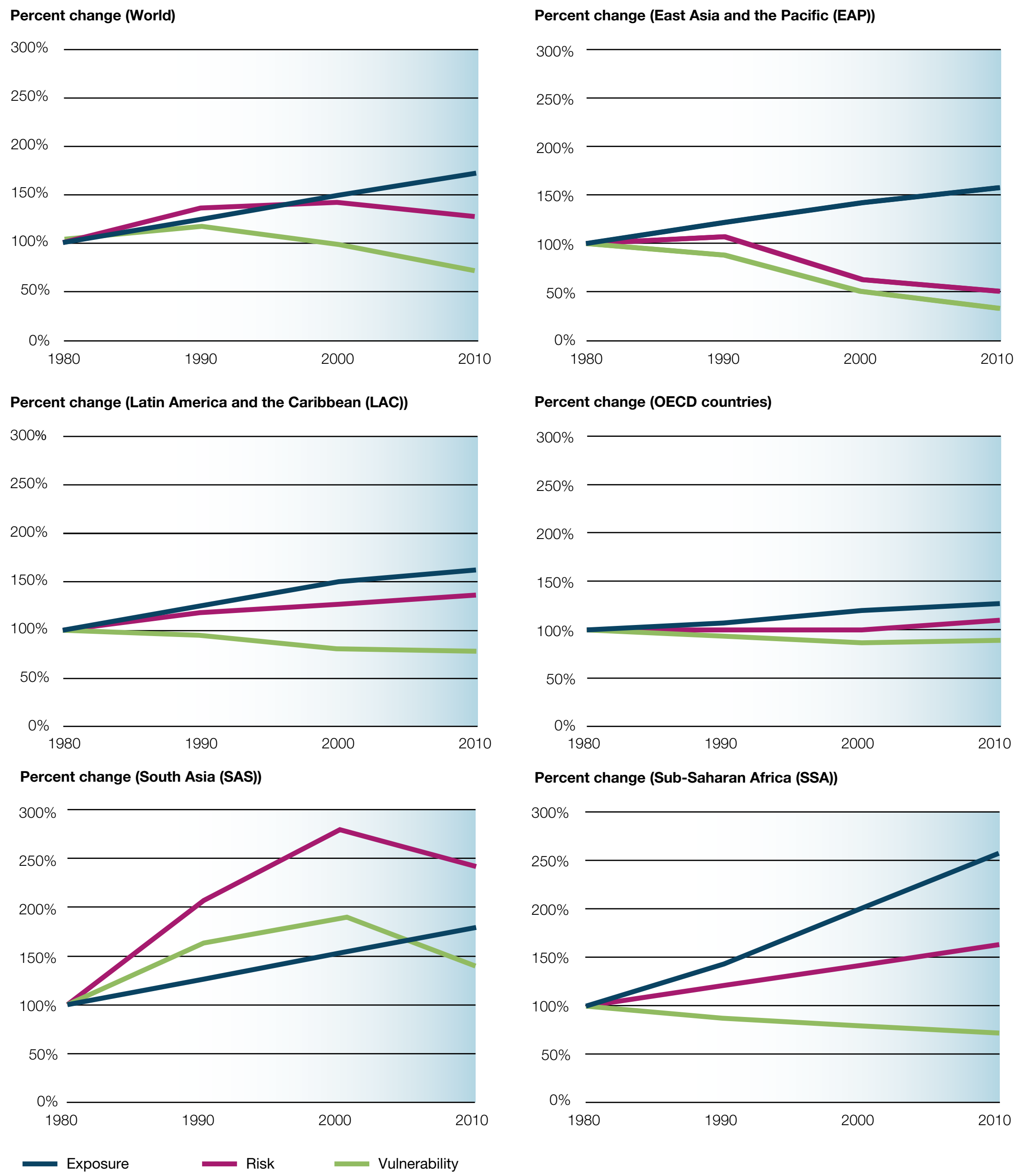
Trend in exposure to tropical cyclones per income region as observed

2.2.3 Tropical cyclone and flood mortality risk is decreasing

Global vulnerability to flood hazard has decreased since 1990, with South Asia the only region where vulnerability was still increasing during the 1990s (Figure 2.11). Since then, vulnerability has declined in all regions except Europe, Central Asia and the OECD, where it has remained stable. These figures are regional averages and may include individual countries in which vulnerability is increasing. In general, however, the statistics reflect how development has reduced vulnerability and strengthened DRM capacities.

Figure 2.11 also shows that global flood mortality risk was increasing until 2000, but it has subsequently declined and is now lower than in 1990. There are, however, important regional differences. In the Middle East and North Africa, Latin America and the Caribbean, and sub-Saharan Africa, flood mortality risk is still increasing, indicating that growing exposure continues to outpace reductions in vulnerability. The positive global trend is largely determined by Asia, where risk is falling. The major success story has been East Asia and the Pacific, where despite rapidly increasing exposure, flood mortality risk has more than halved since 1990. South Asia is reducing its vulnerability at a much slower pace,

Figure 2.11
Percentage change in flood mortality risk, exposure and vulnerability, as modelled, from 1980–2010 (compared to baseline year 1980)



(Sources: Killed as modelled (GRID-Europe), Flood exposed (UNEP/GRID-Europe))

meaning that risk in 2010 is higher than it was in 1990 (Box 2.3).

Vulnerability to tropical cyclones has decreased in all regions since 2000 (Figure 2.12). However, even though the vulnerability of low-income countries in 2010 was about 20 percent lower than in 1980, it was still 225 times higher than in OECD countries. The most significant reduction in vulnerability has been in lower-middle-income countries, where vulnerability in 2010 was less than half that in 1980.

Global tropical cyclone mortality risk is also decreasing (Figure 2.12), a trend largely controlled by a very significant reduction in risk in East Asia and the Pacific. In the OECD and sub-Saharan Africa, increased exposure is being offset by reduced vulnerability. However, in Latin America and the Caribbean, and South Asia, risk in 2010 remained higher than in 1990.

The picture is even more optimistic when looking at risk relative to population size. Flood mortality risk has fallen since 1980 in all regions apart from South Asia (Figure 2.14). In East Asia and the Pacific, in particular, it has declined by about two-thirds.

In relative terms, cyclone mortality risk has fallen in all regions since 2000 (Figure 2.15), and is now lower than in 1980. This is an important achievement considering the extent to which exposure has increased over the same

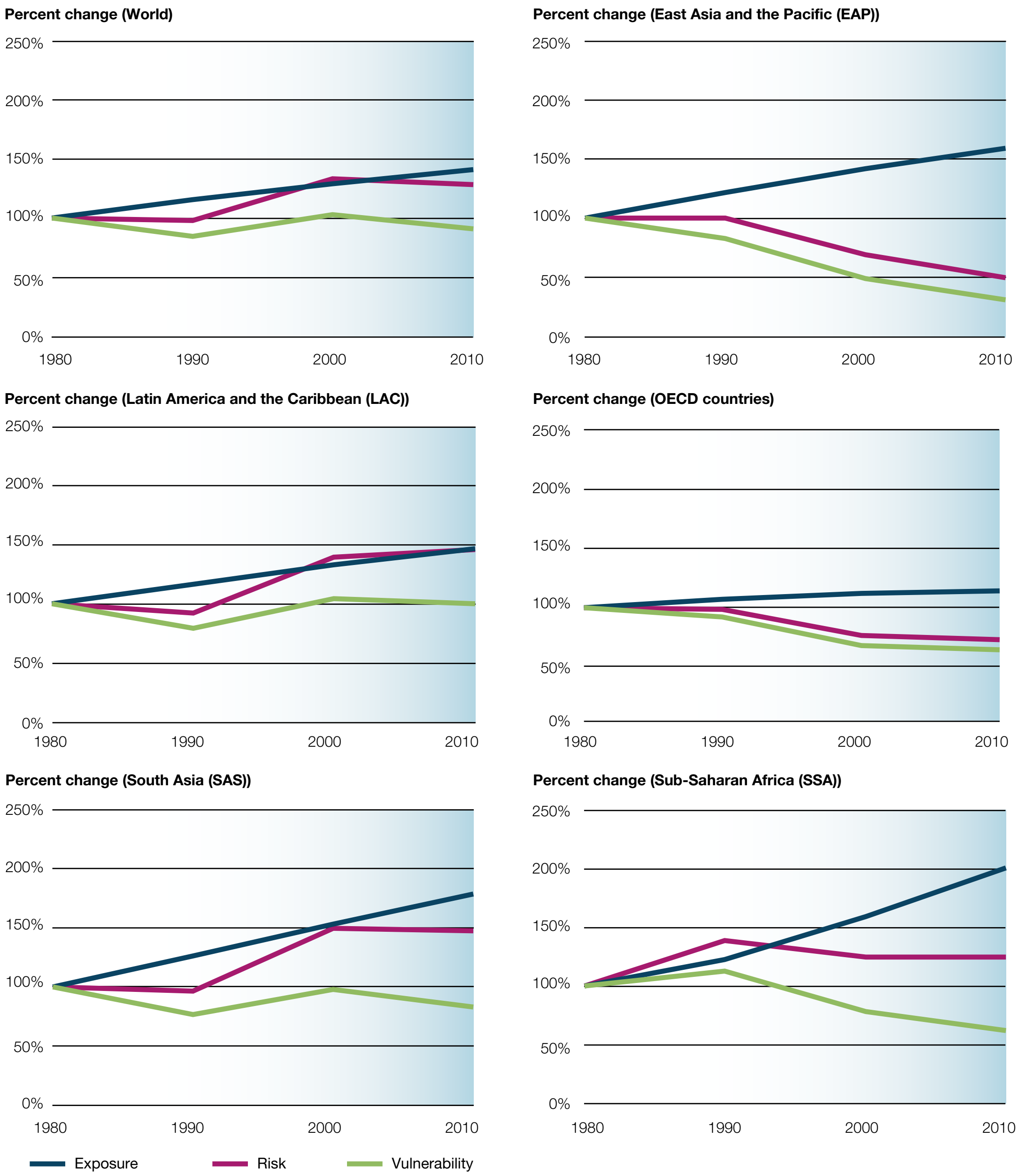
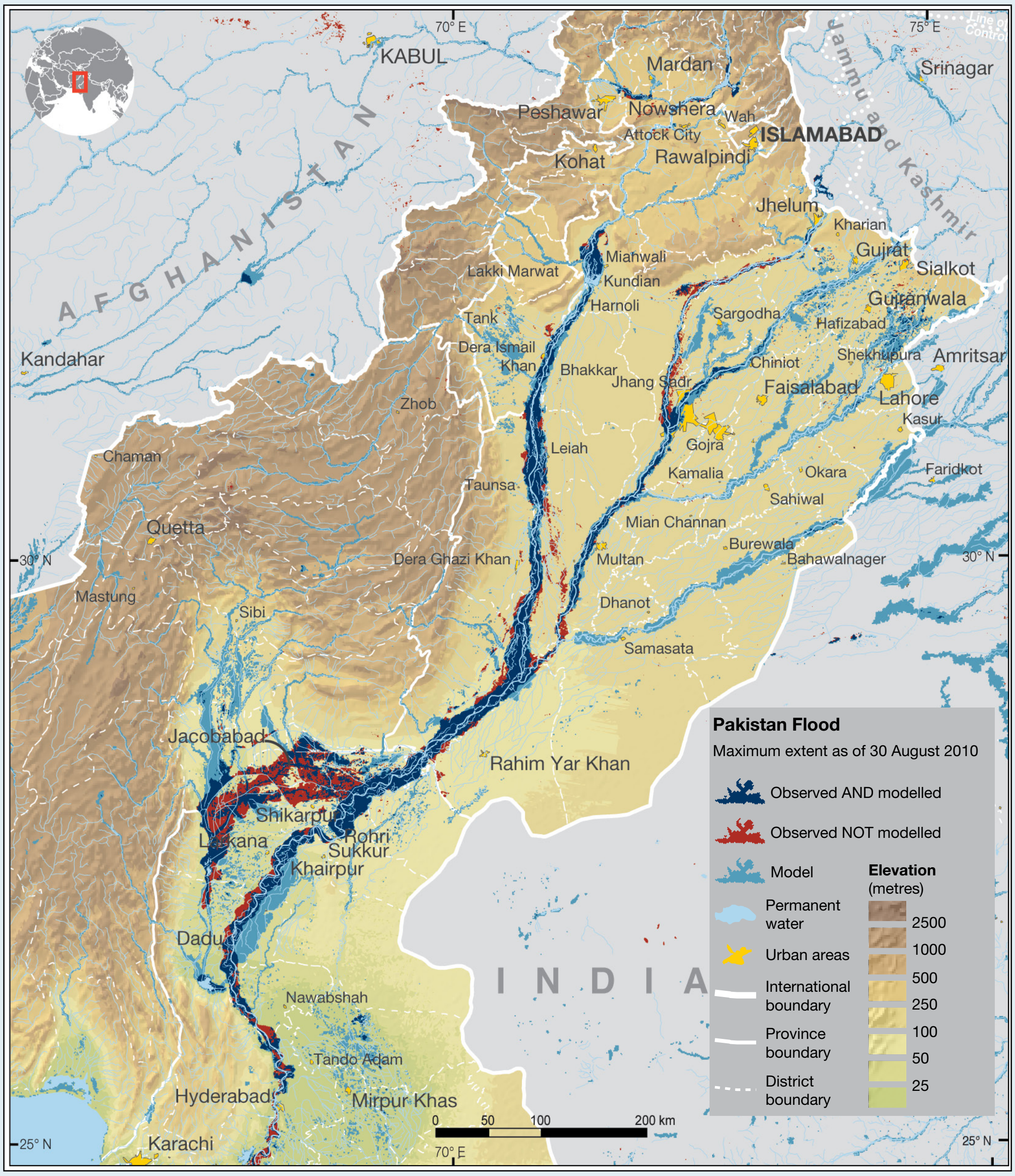


Figure 2.12
Percentage change in tropical cyclone mortality risk, exposure and vulnerability, as modelled, 1980–2010 (compared to baseline year 1980)

Box 2.3 The August 2010 floods in Pakistan

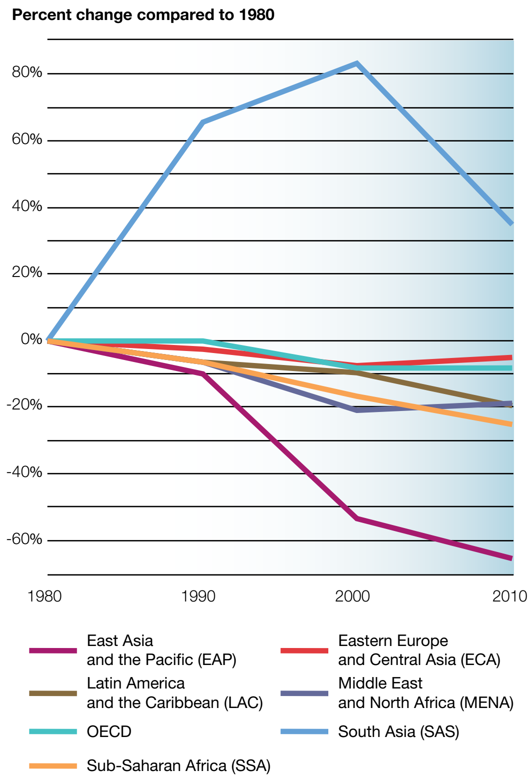
Figure 2.13
Extent of flooding in Pakistan on 30 August 2010



(Source: UNEP/GRID-Europe, 2010)

The challenges to reducing flood risk in South Asia were highlighted by the August 2010 floods in Pakistan, which killed approximately 1,700 people and caused US$9.7 billion in damage to infrastructure, farms and homes, as well as other direct and indirect losses (ADB/World Bank, 2010). The map contrasts the areas that actually flooded with those areas that the GAR09 risk model predicted would be flooded during a 1-in-100-year flood (Herold and Mouton, 2011). As with any flood, some areas the model predicted would flood were spared, and some flooded areas were not captured by the model. The flooding was concentrated in rural areas with rapidly growing populations that lacked a prominent political voice—risk factors that contributed to the high mortality.

The risk model also predicted a mortality rate approximately four times higher than that reported, suggesting the reduction in flood mortality in South Asia described earlier may be conservative. That the risk could be modelled at all highlights that this was not an *unexpected* disaster.



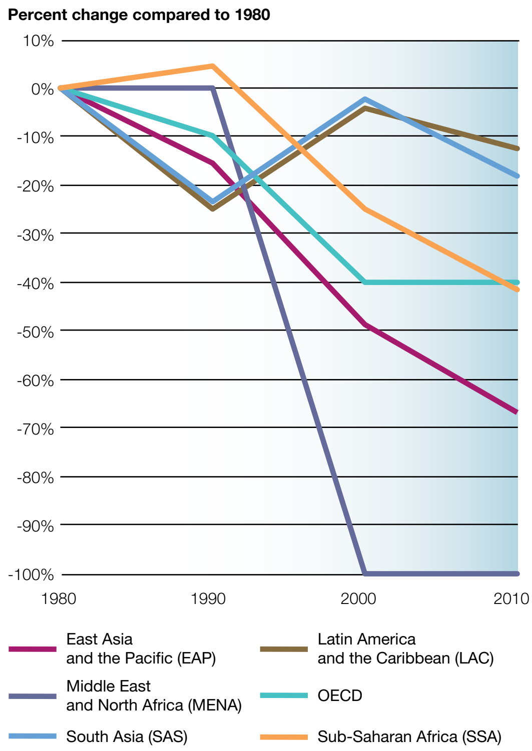


Figure 2.14 (left)

Percentage change in relative flood mortality risk by region as modelled, 1980–2010 (compared to baseline year 1980)

Figure 2.15 (right)

Percentage change in relative tropical cyclone mortality risk by region as modelled, 1980-2010 (compared to baseline year 1980)

(Source: UNEP/GRID-Europe, 2010)

period. For example, in East Asia and the Pacific, relative mortality risk has fallen by about two-thirds since 1980, and has almost halved in sub-Saharan Africa.

2.2.4 Tropical cyclone and flood economic loss risk is increasing

In contrast to mortality risk, estimated economic loss risk associated with floods and tropical cyclones is increasing in all regions. As with mortality risk, as countries develop they strengthen their risk governance capacities and reduce their vulnerabilities. However, these improvements have failed to offset the very rapid increase in exposure fuelled by rapid economic growth. Increases in such capacities do not immediately reduce the vulnerability of existing fixed assets, such as buildings and infrastructure, which are often used beyond their expected lifespan. Similarly, as will be further explored in Chapter 6, instruments such as land use planning and building regulation have struggled to reduce vulnerability, particularly in rapidly urbanizing areas.

In the case of floods, economic loss risk is increasing faster in OECD and high-income countries than in other geographic and income regions, even though exposure in these countries is increasing at a far slower rate than elsewhere, for example Latin America and the Caribbean (Figure 2.16). As the 2011 floods in Germany and Australia illustrate, even high-income countries struggle to manage increasing exposure. Although GDP exposure to floods (Table 2.4) is increasing faster than GDP per capita in all regions, the risk of economic damage is only growing faster than GDP per capita in high-income countries.

The proportion of the world's GDP exposed to tropical cyclones increased from 3.6 percent in the 1970s to 4.3 percent in the first decade of the 2000s. During that time, the absolute value of global GDP exposed to tropical cyclones tripled, from US$525.7 billion to US$1.6 trillion (Table 2.5).[12] GDP exposure increased rapidly in the OECD in the 1990s, and in East Asia and the Pacific and in Latin America and the Caribbean in 2000–2009. In East Asia and the Pacific in 2009, the GDP exposed

Figure 2.16

Percentage change in economic loss risk, exposure and vulnerability to floods in the OECD and in Latin America and the Caribbean as modelled, 1990–2010 (compared to baseline year 1990)

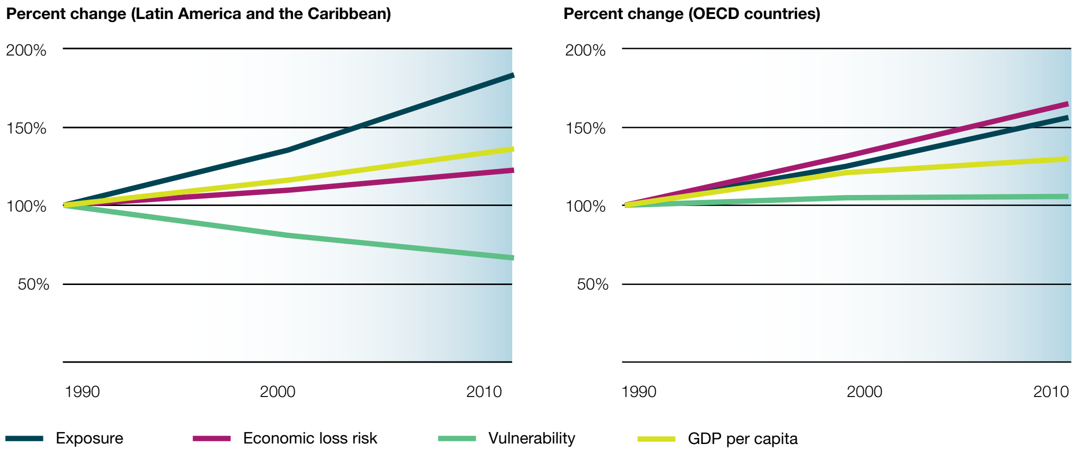


Table 2.4 Average annual global GDP exposed to floods as modelled (in billion 2000 US$)

Region	1970–1979	1980–1989	1990–1999	2000–2009
East Asia and the Pacific (EAP)	2.8	5.1	10.2	21.5
Europe and Central Asia (ECA)	2.2	2.7	2.7	3.1
Latin America and the Caribbean (LAC)	2.5	3.1	3.9	5.4
Middle East and North Africa (MENA)	0.3	0.4	0.6	0.9
OECD countries	24.1	32.8	43.5	52.9
South Asia (SAS)	3.9	5.4	8.7	15.4
Sub-Saharan Africa (SSA)	0.4	0.5	0.6	0.9
World	**36.2**	**50.0**	**70.2**	**100.1**

Table 2.5 Average annual global GDP exposed to cyclones from observed events (in billion 2000 US$)[13]

Region	1970–1979	1980–1989	1990–1999	2000–2009
East Asia and the Pacific (EAP)	16.0	25.3	39.5	90.2
Latin America and the Caribbean (LAC)	2.3	4.9	3.7	24.3
Middle East and North Africa (MENA)	0	0	0	1.0
OECD countries (OECD)	506.6	665.1	1,247.1	1,455.0
South Asia (SAS)	0.3	2.6	4.2	4.3
Sub-Saharan Africa (SSA)	0.5	1.1	1.3	1.7
World	**525.7**	**699.0**	**1,295.8**	**1,576.5**

was nearly six times greater than in 1970. In contrast, although most of the exposed global GDP is concentrated in OECD countries, it was only three times greater in 2009 than it was in 1970.

Economic loss risk for cyclones is increasing in all regions. It has almost quadrupled (increasing by 265 percent) since 1980 in the OECD, almost tripled in sub-Saharan Africa (181 percent), and is more than two-and-a-half times greater in other regions (over 150 percent higher). In East Asia and the Pacific, and South Asia, risk is increasing because reductions in vulnerability are not offsetting rapidly increasing exposure (Figure 2.17). In terms of income regions economic loss risk has almost quadrupled (increasing by 262 percent) in high-income countries, and is more than two-and-a-half times greater in upper-middle-income countries (165 percent), lower-middle-income countries (152 percent) and low-income countries (155 percent). Thus economic strength has failed to reduce economic loss risk, even in the OECD.

GDP per capita has grown by more than eight times (703 percent) in East Asia and the Pacific and has almost quadrupled (increasing by 293 percent) in South Asia, outpacing the growth in exposure in both regions. As such, estimated risk has fallen relative to GDP per capita. In all other regions, however, both exposure and the estimated risk of economic loss are growing faster than GDP per capita. Thus the risk of losing wealth in disasters associated with tropical cyclones is increasing faster than wealth itself is increasing.

2.2.5 Countries that are falling behind in their development achievements have less resilience to disaster loss

Disaster losses must be put into perspective. Economic losses due to floods in South Asia are in absolute terms far smaller than those in the OECD. Relative to the size of South Asia's GDP, however, flood losses there are approximately 15 times greater than losses in the OECD. Thus, although economic loss risk in the OECD may be increasing faster, such losses threaten OECD countries' economies far less than they do those of most low- and middle-income countries.

Low-income countries have less capacity to absorb and recover from flood-inflicted economic losses. Similarly, larger economies are more able to absorb losses than smaller ones (including many Small Island Developing States). Larger economies tend to be more diverse geographically and economically, and are thus better able to compensate for losses in any one region or sector (Corrales, 2010). Furthermore, they can better absorb migration

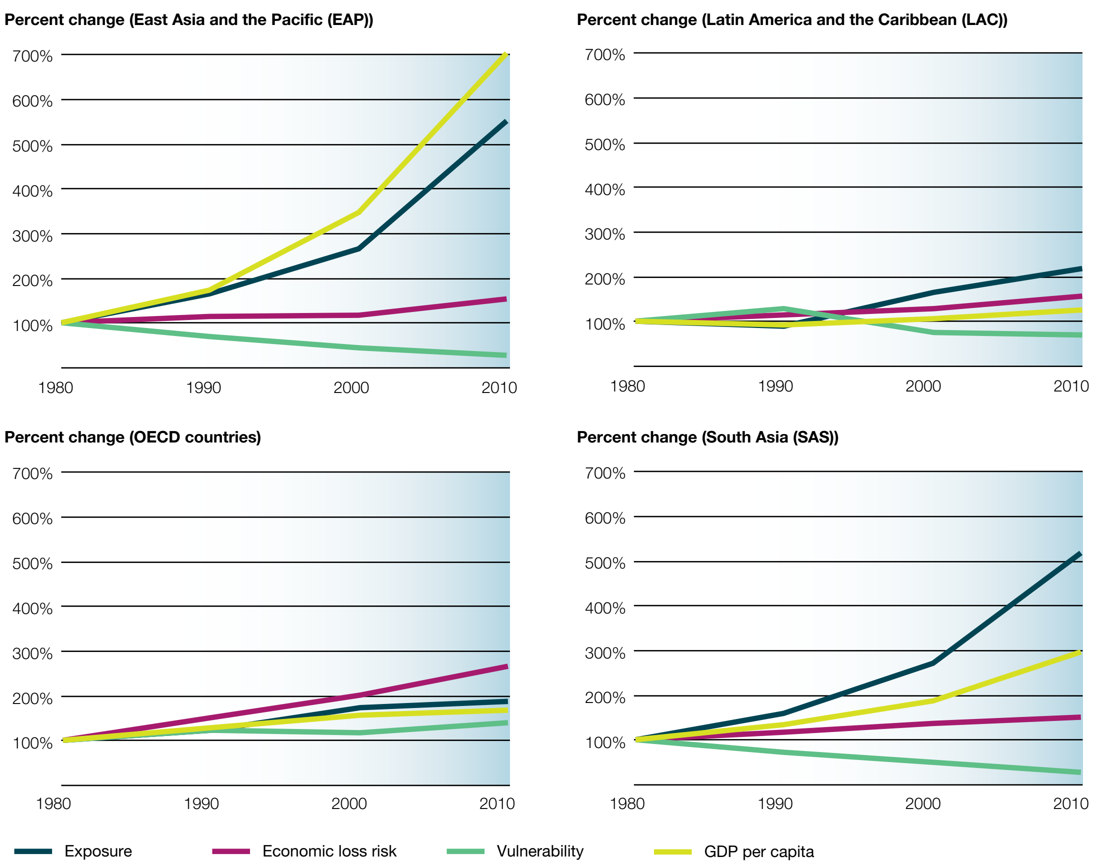


Figure 2.17

Percentage change in economic loss risk, exposure and vulnerability to tropical cyclones in East Asia and the Pacific, South Asia, Latin America and the Caribbean, and OECD countries as modelled, 1980–2010 (compared to baseline year 1980) and are more likely to be able to counter the longer-term economic effects of severe loss of productive assets, interrupted supply chains or distorted markets after a disaster. The ability to withstand losses is not solely dependent on a country's share in world trade or on trade volumes, but also on the diversity of its products and trade partners. Limitations in both make a country more vulnerable to disaster-induced trade shocks and disruptions.

As Figure 2.18 shows, over the last 30 years, the gap in development achievements between many lower-income countries and the OECD has grown and is likely to widen further as a result of climate change.[14] Although GDP per capita, human development, capital formation and competitiveness of some low- and middle-income countries has approached those of the OECD, others have fallen further behind both their low- and middle-income counterparts and the OECD. Some of these divergent economies may be experiencing 'resilience traps', where disaster losses and impacts cause negative feedback into slow development and structural poverty. Climate change may further test the resilience of many of these countries.

2.3 Extensive disaster risk trends

The past 20 years have seen an exponential increase in the number of local areas reporting losses, the number of houses damaged, the number of people affected, and the damage to health and educational facilities associated with extensive disasters. Increasing extensive risk is closely related to the challenges low- and middle-income countries face in addressing underlying risk drivers and reducing vulnerability.

Figure 2.18
Development achievements 1980–2010

(Source: Corrales, 2010)

Extremely heavy and persistent rains fell across a broad area of the Central Valley and Pacific coast of Costa Rica on 2–3 November 2010. Just south of San José, a mudslide destroyed the small community of Calle Lajas in San Antonio de Escazú, killing 23 people and destroying 25 houses. The losses in Calle Lajas, however, were only the most intensive of those associated with a large number of floods and landslides that affected 50 municipalities and 681 communities in Costa Rica. The disaster damaged or destroyed 2,540 houses (Figure 2.19), four schools and 85 bridges (CNE, 2010).

Whereas these disasters were characterized as a consequence of unexpectedly heavy rains, in reality they were the outcome of an unseen but continuous accumulation of risk. Costa Rica is ranked 59th out of 184 countries on risk governance capacities (Lavell et al., 2010), ahead of most low- and middle-income countries. However, many municipalities do not have land use plans informed by risk assessments, and over the years building and urban development have been authorized in many hazard-prone locations. Although Costa Rica has good levels of environmental protection, it is having difficulty managing rapidly increasing hazard exposure from urban development, and ensuring the security of public infrastructure such as roads and bridges.

It was anticipated that the 2010 rainy season would be more intense than usual given the presence of La Niña[15] in the region. Although a scientific study had already identified the risk of landside in Calle Lajas, local authorities were unable to address this because of a combination of ineffective planning and enforcement mechanisms, responsibilities spread over many different public bodies with unclear accountability, and a resistance to relocation from many of the households at risk.[16]

These extensive disasters in Costa Rica are representative of the way in which risk is unfolding in low- and middle-income countries. Analysing trends in extensive risk is important for three reasons.

First, although extensive disasters are responsible for only a small proportion of global disaster mortality (Figure 2.20), they account for a very significant proportion of damage to public assets, such as health and educational facilities and infrastructure, as well as to the livelihoods, houses and assets of low-income groups. Many countries are making progress in systematically

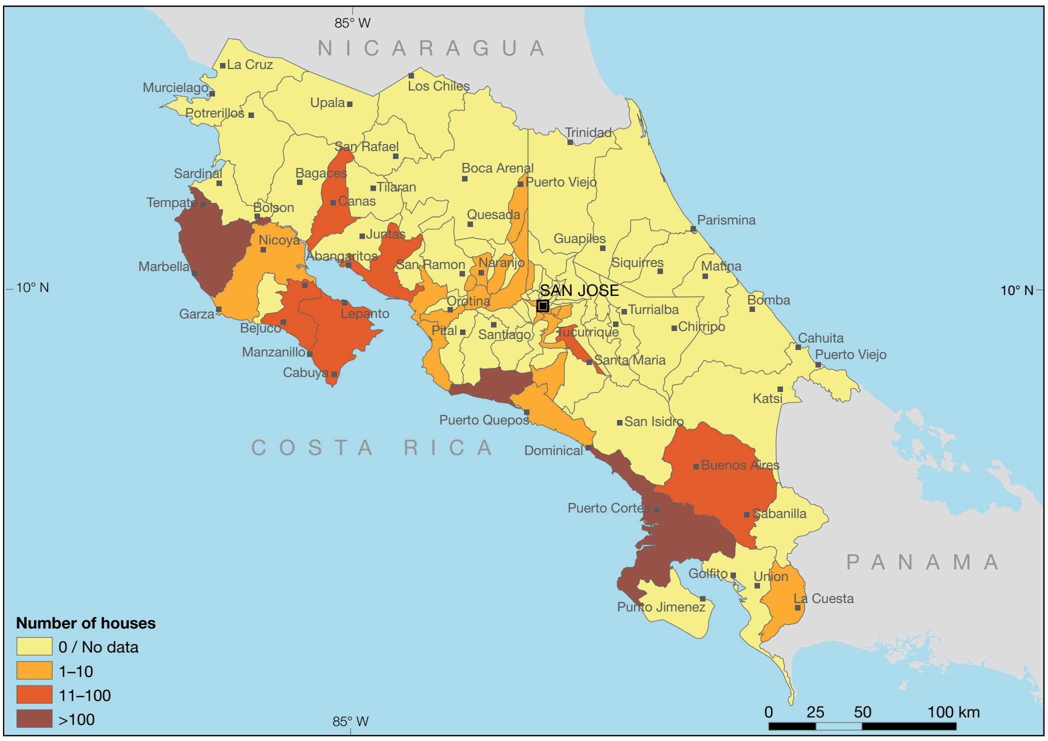
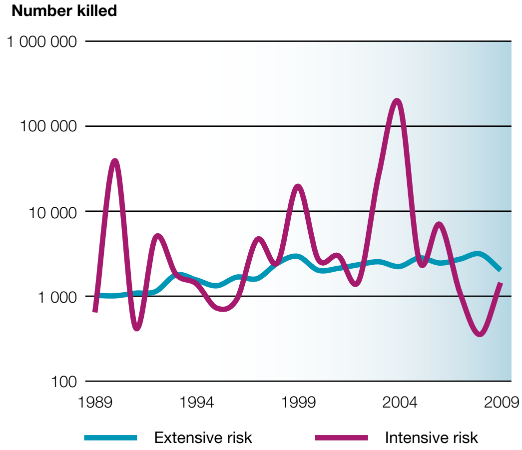


Figure 2.19
Number of houses damaged in different municipalities as a result of the November 2010 rains in Costa Rica

Figure 2.20

Mortality from extensive and intensive disasters, 1989–2009 in 21 countries[17] in Africa, Asia, Latin America and the Middle East



recording disaster loss, but most extensive disaster losses go unaccounted for (see Box 2.4). The invisibility of such a high proportion of disaster loss is one reason why so many countries find it politically and economically difficult to prioritize investments in DRM.

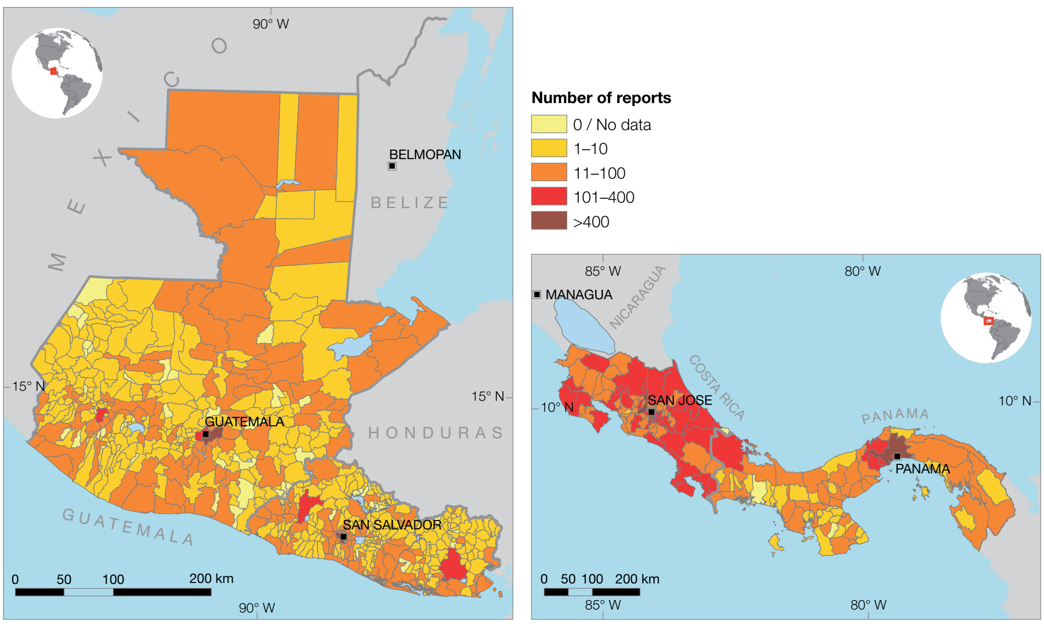
Second, as highlighted in Section 2.2, economic loss risk is increasing because countries have been unable to strengthen their risk governance capacities fast enough to address the rapidly increasing exposure that accompanies economic growth. Analysing extensive risk provides a unique real-time view of this challenge. Extensive risk, along with many of the localized weather-related hazards with which it is associated, is directly constructed by risk drivers such as badly planned and managed urbanization, environmental degradation, and poverty. Given that almost all (97 percent) of extensive disaster loss reports are weather-related, extensive risk analysis also provides an opportunity to view the impact of climate variability. Extensive risk, unlike intensive risk, is not dependent on the location of earthquake fault lines or cyclone-prone coastlines. The Central American countries of Costa Rica, El Salvador, Guatemala and Panama illustrate this issue, where extensive risk exists wherever development occurs (Figure 2.21). All Panama's municipal areas report extensive disaster losses even though the country lies south of the Caribbean hurricane belt and earthquakes are infrequent.

Third, and precisely because it reflects risk construction processes in operation, extensive risk is also an indicator of new intensive risk hotspots. As illustrated in the case of Dhaka, increased seasonal flooding is also an indicator of growing intensive earthquake risk.

Globally, the analysis of new and updated local disaster loss data from a wider geographical sample of countries in Africa, Asia, Latin America and the Middle East (see Box 2.5) confirms the trends first identified in 2009 (UNISDR, 2009).

Figure 2.21

Number of reports of extensive disaster loss in Costa Rica, El Salvador, Guatemala and Panama



Box 2.4 Updating the extensive risk analysis

To improve the analysis of extensive risk, GAR11 has incorporated substantial new data. All the databases of GAR09 have been updated to include disaster loss data for 2008 and 2009, and nine new countries have contributed data for the analysis (Chile, El Salvador, Guatemala, Indonesia, Jordan, Mozambique, Panama, Syrian Arab Republic and Yemen). The dataset (see Table 2.6) now includes almost 200,000 local level disaster reports covering a 40-year period from 21 countries: Argentina, Bolivia, Colombia, Costa Rica, Ecuador, India (Orissa and Tamil Nadu), Iran (Islamic Republic of), Mexico, Nepal, Peru, Sri Lanka and Venezuela in addition to the nine new countries. Combined, these countries and states comprised a population of more than 850 million people in 2009.

'Extensive' and 'intensive' risks are relative terms. As such, any quantitative threshold between extensive and intensive manifestations of risk is arbitrary no matter the scale. Given that each country or locality has a unique risk footprint, hybrid loss exceedance curves would be most appropriate to define what is extensive or intensive in any given country (see Box 5.3 for more information). At present, such curves have only been constructed for three of the countries in the data universe (Colombia, Mexico and Nepal). For the purpose of this analysis of 21 countries and states, a statistically robust quantitative threshold was calculated for the data universe as a whole, rather than for individual countries or regions, and was used to filter the most intensive manifestations of risk. The threshold for intensive risk used in GAR11 was established at 25 deaths or 600 houses destroyed in any one local level loss report (Freire, 2010; OSSO, 2011a).

The analysis showed that extensive risk accounts for only 9.6 percent of the deaths and 20 percent of the houses destroyed (a proxy for direct economic loss). Damage is much more extensively spread, with extensive risk accounting for 53.9 percent of houses damaged, 80 percent of people affected, 83.1 percent of people injured, 45.2 percent of damage to schools, and 55.2 percent of damage to health facilities.

Table 2.6 Summary of the GAR11 loss data universe

Risk type	Hazard type	Reports	%	Deaths	%	Houses destroyed	%	Houses damaged	%
Extensive	Weather-related	188,236	96.3	59,911	9.2	1,096,891	18.3	5,674,114	50.1
Extensive	Geological	5,565	2.8	2,861	0.4	104,451	1.7	431,613	3.8
Intensive	Weather-related	1,293	0.7	182,723	27.9	3,079,749	51.4	3,806,413	33.6
Intensive	Geological	464	0.2	408,303	62.5	1,717,405	28.6	1,410,417	12.5
TOTAL		**195,558**	**100.0**	**653,798**	**100.0**	**5,998,496**	**100.0**	**11,322,557**	**100.0**

2.3.1 Weather-related disaster damage is increasing exponentially

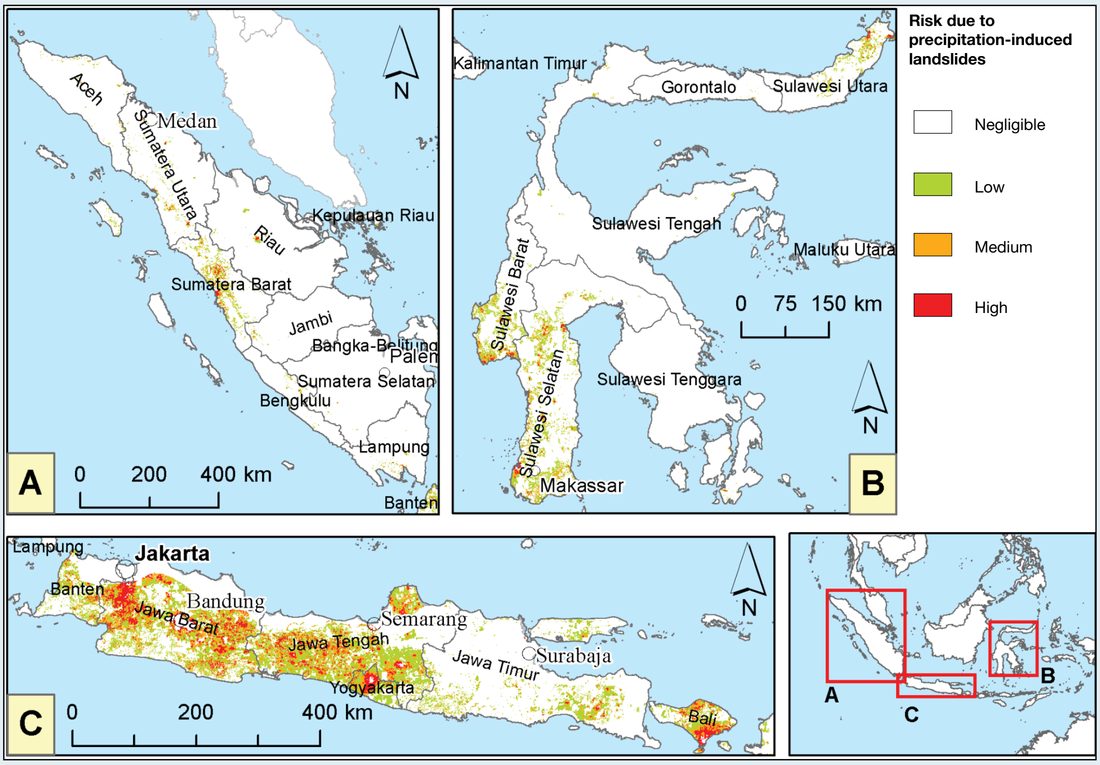
Across the 21 countries and states (see Box 2.4), disaster occurrence and loss was down significantly in 2009. Given that most extensive risk is weather-related, its manifestations are closely related to climate variability, associated for example with the El Niño Southern Oscillation. As such it can be expected that both the number of events and losses increased again in 2010. Looking at the longer-term picture, the past 20 years have seen a significant increase in the number of local areas reporting losses, the number of houses damaged, the number of people affected and the damage to health and educational facilities associated with extensive

Box 2.5 Progress in recording local level disaster impacts and losses

In the past two years, a number of countries have made significant progress in developing information systems to systematically record and document disaster loss.

The Indonesian Disaster Data and Information Management Database (DIBI) is based on official government data from 1815 to 2009. DIBI is already being used as the basis for national policy, planning and budgeting in disaster risk reduction and is informing development planning decisions. For example, Indonesia's National Disaster Management Agency (BNPB) has used DIBI to identify hazard-prone areas across Indonesia in order to prioritize the creation of district level disaster reduction structures. Within Indonesia's National Development Planning Agency (BAPPENAS), the Directorate for Poverty Eradication is using DIBI to establish priorities for its own and donor-funded programmes. Ongoing work to improve DIBI includes incorporating additional attributes such as school-age children, health status, infrastructure, public facilities, income levels, types of livelihoods and spatial planning data. DIBI has also been used for pioneering applications in risk assessment, applying the methodology used in the GAR global risk model at the sub-national level (Figure 2.22).

Figure 2.22
Landslide risk in Indonesia



(Source: Cepeda et al., 2010)

The Mozambique National Disaster Database, built and hosted by the government's National Institute for Disaster Management (INGC) has the best documented set of reports of agricultural losses in the entire data universe. About 30 percent of its records (1,394) contain detailed information on the area and type of crops destroyed and affected. These records provide unique insight into how extensive risk manifests in the agricultural sector and affects rural livelihoods.

In 2010, Egypt, Jordan, Morocco, the Syrian Arab Republic and Yemen also began a pioneering initiative to collect local level disaster loss data in the Arab states, where until then, the absence of systematic information on disaster impacts had been a major obstacle to strengthening capacities for disaster risk reduction. Jordan, the Syrian Arab Republic and Yemen (Figure 2.23) have recently

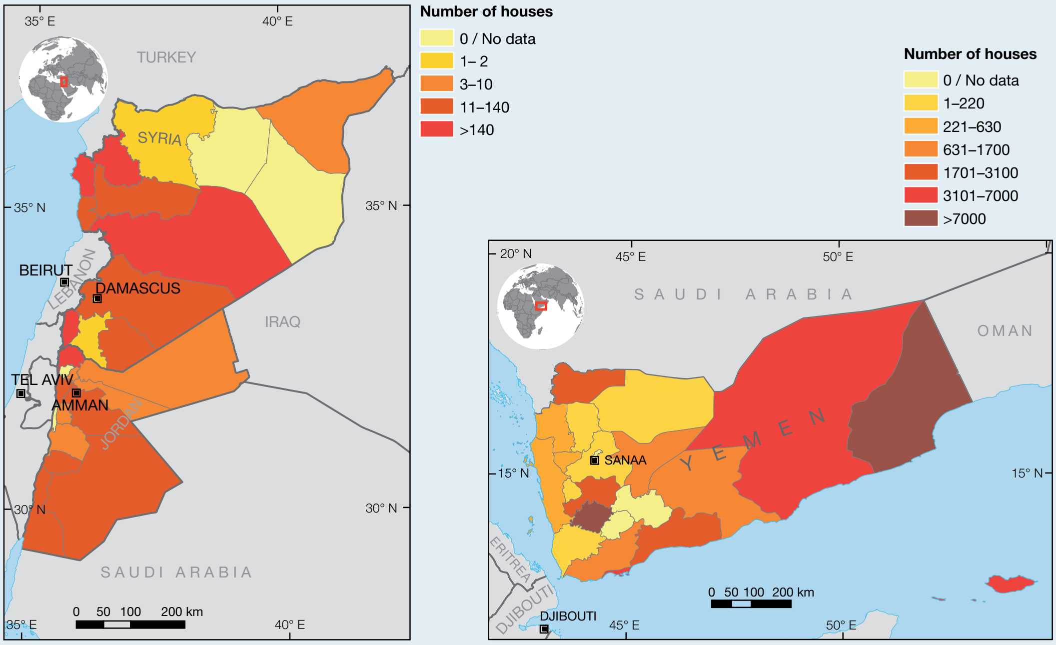


Figure 2.23
Housing damage by governorate in Jordan and the Syrian Arab Republic (left), and by province in Yemen (right), 1989–2009

published national disaster inventories, included in GAR11, and it is expected that the other two countries will soon follow. Mozambique and the Arab states also plan to include age- and gender-enabled indicators when such information is available.

Viet Nam has been collecting comprehensive disaster loss data as part of the DANA initiative of the Central Committee of Flood and Storm Control. The database contains historical data at the provincial level dating back to 1989, and was used to assess disaster impacts on children in Chapter 2 (Tarazona and Gallegos, 2010).

Latin America has been recording local level disaster loss data since the mid-1990s. Until recently, countries in this region (with the exception of Panama) struggled to institutionalize these loss databases. In the past two years, however, regional organizations as well as governments in Bolivia, Ecuador, El Salvador and Guatemala have made progress on institutionalizing systematic disaster reporting and analysis.

disasters (Figure 2.24). This reinforces the view that the rapid increases in both population and GDP exposure described in Section 2.2 have not been addressed by commensurate reductions in vulnerability.

Extensive risk is also rising in relative terms. The number of houses damaged relative to population growth in all 21 countries and states has increased by approximately 600 percent since the early 1990s (Figure 2.25). The enormous difference between this increase and the increasing economic loss to major hazards, described in Section 2.2, reflects how extensive disaster loss is largely unaccounted for, disguising a transfer of risk within countries to low-income households and communities.

2.3.2 Extensive risk is expanding geographically

Spatially, the expansion of extensive risk mirrors urban and regional development and hence increasing population and asset exposure. Across all 21 countries and states, the number of local administrative areas reporting disaster losses has increased more or less continuously over the past 20 years (Figure 2.26). In Mozambique, for example, more local administrative areas reported losses more often between 1999

Figure 2.24

Extensive risk trends by indicator (for the 21 countries and states included in the GAR11 analysis)

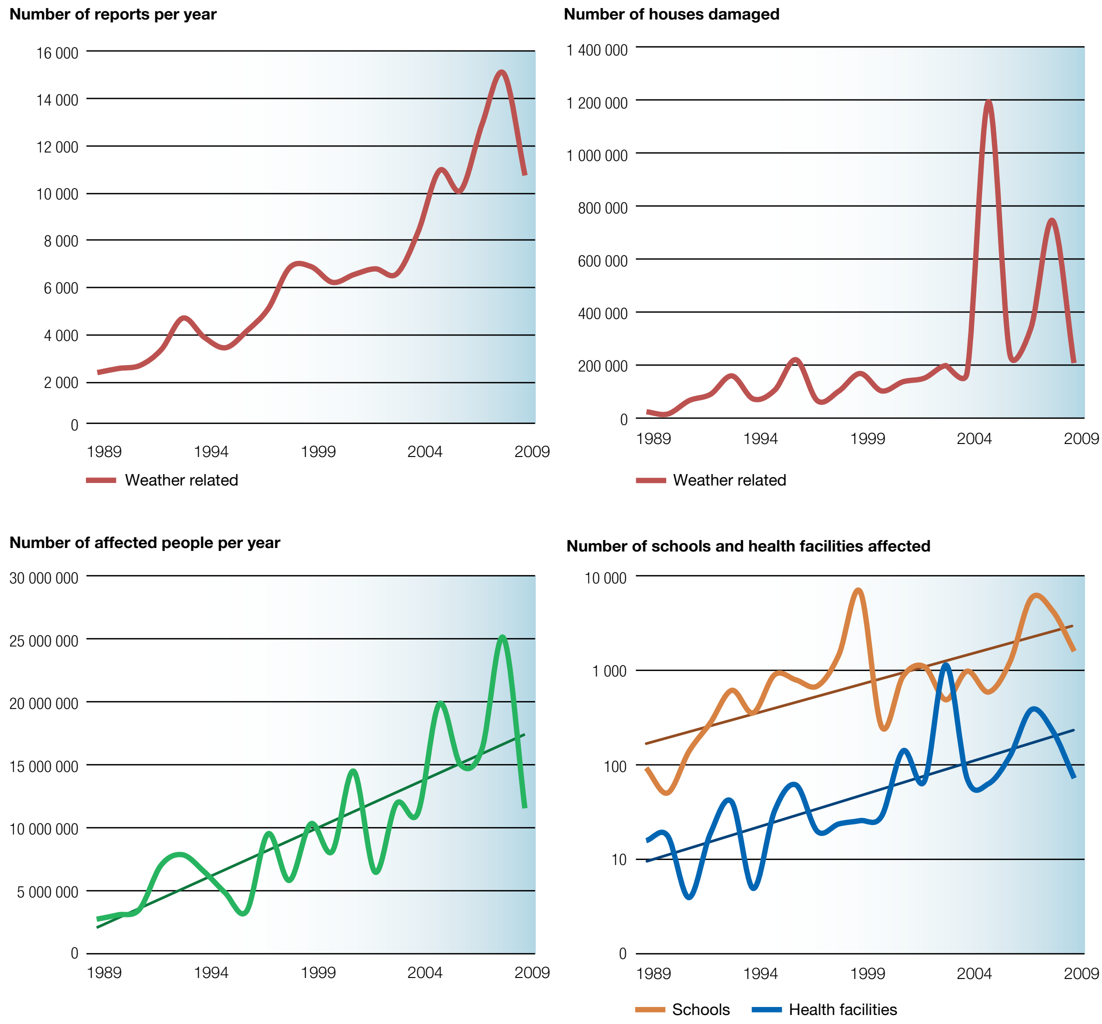
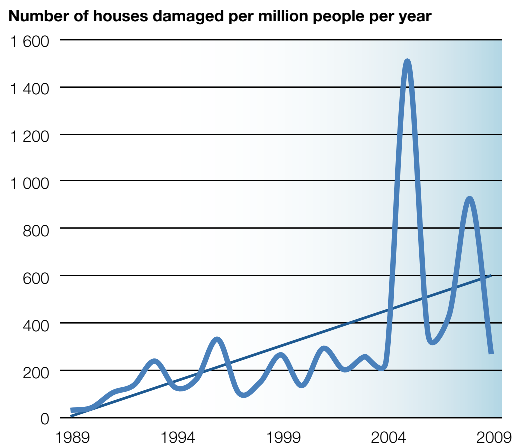


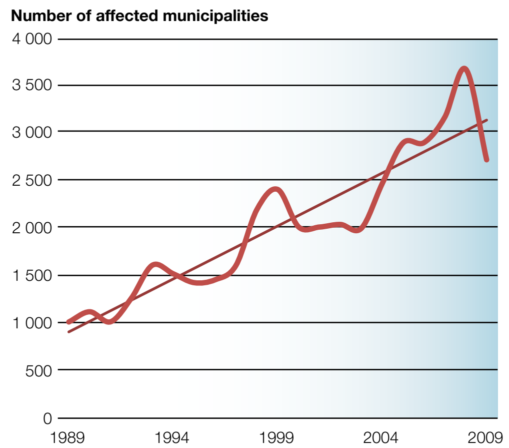
Figure 2.25 (left)

Number of houses damaged per million people per year (using all 22 datasets)

Figure 2.26 (right)

Number of local administrative areas annually reporting extensive disaster losses





and 2009, than between 1989 and 1999 (Figure 2.27).

2.3.3 Mortality is still rising in the countries with the weakest risk governance capacities

These global trends in risk vary widely from country to country, indicating that risk accumulation processes that mirror development are as heterogeneous as development itself. However, confirming again the findings of Section 2.2, countries with stronger risk governance capacities appear better able to reduce mortality than to reduce the numbers of houses damaged and people affected (Table 2.7). The increase in extensive mortality risk reported in countries

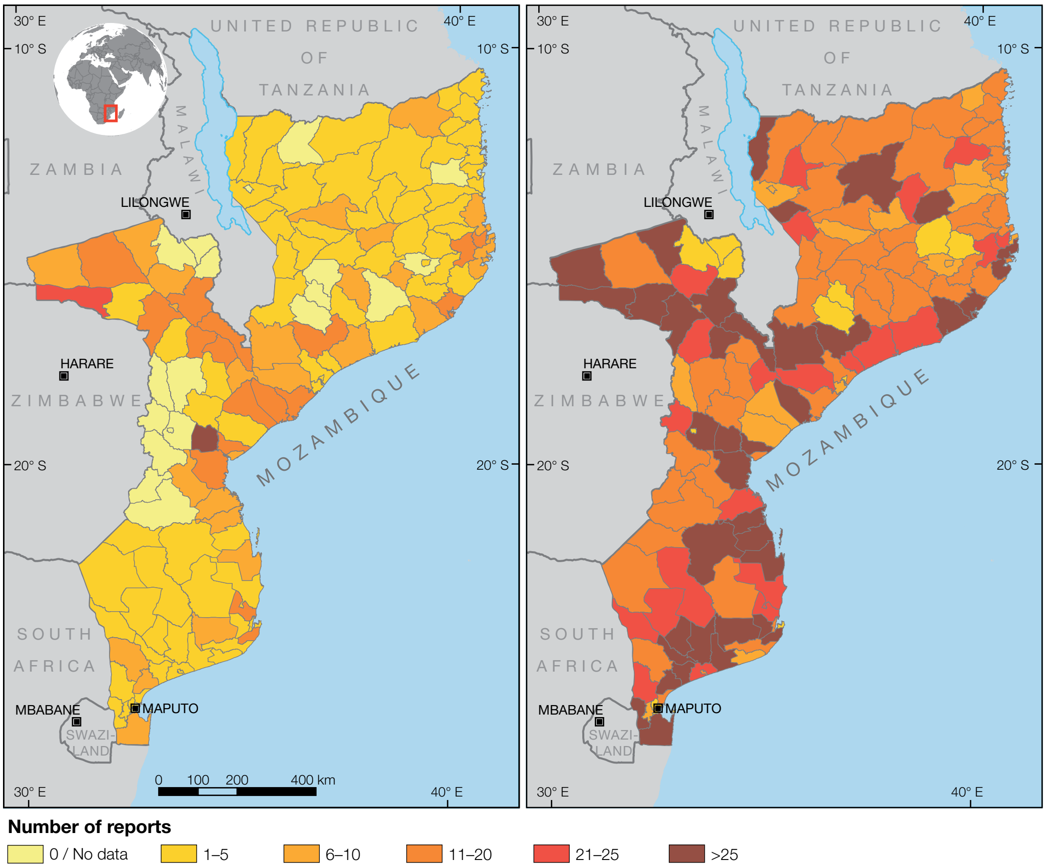


Figure 2.27

Spatial extent of extensive risk in Mozambique: number of reports per district, 1989–1999 and 1999–2009

(Source: INGC, 2010)

like Bolivia, Mozambique, Nepal and Yemen reflect low levels of development. In contrast, mortality risk in Chile and Costa Rica is falling while the rate of housing damage is rising. The heterogeneous nature of risk is further illustrated in Box 2.6, which explains that even in the world's largest economy, the United States of America, there are major differences in risk governance capacities among wealthier and poorer states and counties.

2.3.4 Revisiting the underlying risk drivers

Improved reporting of disaster impacts and losses makes it difficult to determine with precision the cause of any increase in reports of disaster impacts and losses over time, even in the last 20 years. In the case of national disaster databases, there is certainly evidence of improved reporting in some countries such as Costa Rica and Sri Lanka, where new official data sources began to contribute to the datasets during the GAR11 analysis period. Nevertheless, improved reporting alone does not appear to explain the increase in damaged housing, for example, across the 21 countries and states used in the GAR11 analysis.

New case study evidence supports GAR09's finding that increasing extensive risk is closely related to the challenges low- and middle-income countries face in addressing underlying risk drivers and reducing vulnerability. Risk is increasing most rapidly in small- and medium-sized urban centres with relatively weak capacities for managing urban growth (Table 2.8). Compounding this, landslide and flood risk at the local level is closely associated with poverty, and overall risk is magnified by deforestation and the destruction of coastal ecosystems.

Table 2.7 Extensive risk trends: houses damaged, people affected and mortality

Country (or state)	Average annual change in housing damage rate, 1989–2009		Average annual change in number of people affected, 1989–2009		Average annual change in mortality rate, 1989–2009		Risk governance capacity
	Annual change	Trend	Annual change	Trend	Annual change	Trend	Ranking
Chile	33.3	↑	2154.7	↑	-0.0846	↘	39
Costa Rica	40.1	↑	40.6	→	-0.1054	↓	51
Argentina	1.9	→	-111.0	↘	0.1123	↗	56
Jordan	-0.6	→	34.3	→	-0.1093	↘	62
Panama	56.2	↑	414.5	↗	-0.0569	↘	74
Colombia	79.9	↑	734.8	↗	-0.0372	→	75
Mexico	99.1	↑	1262.3	↑	0.0697	↗	80
Sri Lanka	30.4	↑	2428.3	↑	0.1375	↗	98
Ecuador	12.3	↗	-318.3	↘	-0.2104	↓	105
Peru	-3.8	↘	163.9	↗	-0.0529	↘	107
Indonesia	9.9	↗	744.5	↗	0.0771	↗	109
El Salvador	50.4	↑	332.6	↗	0.4370	↑	110
Iran (Islamic Republic of)	-0.3	→	-74.0	→	-0.0257	→	111
Syria	0.3	→	326.6	↗	0.3042	↑	112
India (Orissa)	117.19	↑	6892.1	↗	0.6544	↑	114
India (Tamil Nadu)	25.6	↑	671.5	↗	0.0864	↑	114
Venezuela	9.7	↗	485.9	↗	-0.0033	→	117
Guatemala	23.6	↗	857.6	↗	0.1144	↗	118
Bolivia	3.9	↗	-16.3	→	0.1912	↑	126
Nepal	-0.3	→	-145.7	↘	0.2804	↑	146
Mozambique	10.7	↗	4977.6	↑	0.2914	↑	153
Yemen	-0.3	→	3.4	↗	0.2190	↑	169

↑ High increase ↗ Moderate increase → Stable ↘ Moderate decrease ↓ High decrease

(Source: GAR11's 22 disaster loss databases; Lavell et al., 2010)

2.4 Impacts on children and internal displacement

Children make up a large proportion of those who are most vulnerable to disasters, and they are affected particularly severely when they occur. Disasters can also contribute heavily to internal displacement, even when mortality is relatively low.

The mechanisms through which disaster losses contribute to poverty were explored in depth in GAR09 (UNISDR, 2009). This year's report expands on the different and specific disaster impacts that affect child welfare and development.

Children are affected particularly severely by disasters and constitute an extremely large percentage of those who are most vulnerable (Bartlett, 2008). This is supported by a number of studies on how disasters affect children's medium-term development (Baez and Santos,

Box 2.6 Extensive risk in the United States of America

Anyone looking for a safe place to live in the United States of America should consider moving to Prince of Wales – Outer Ketchikan County in Alaska, the only county that does not report disaster losses in the SHELDUS database.[18] SHELDUS contains more than 640,000 local level disaster loss reports in the United States of America for the period 1960–2009 (Borden and Cutter, 2008) and provides a unique look at extensive risk in a high-income country.

Unlike low- and middle-income-countries, mortality due to disasters in the United States of America is extensively distributed. Most (89 percent) of the mortality since 1960 corresponds to extensive disasters (Figure 2.28). SHELDUS records 26,936 deaths between 1960 and 2008 compared with 18,273 in the Emergency Events Database (EM-DAT). In contrast, two-thirds of the economic loss is intensively concentrated in only 0.4 percent of the reports.

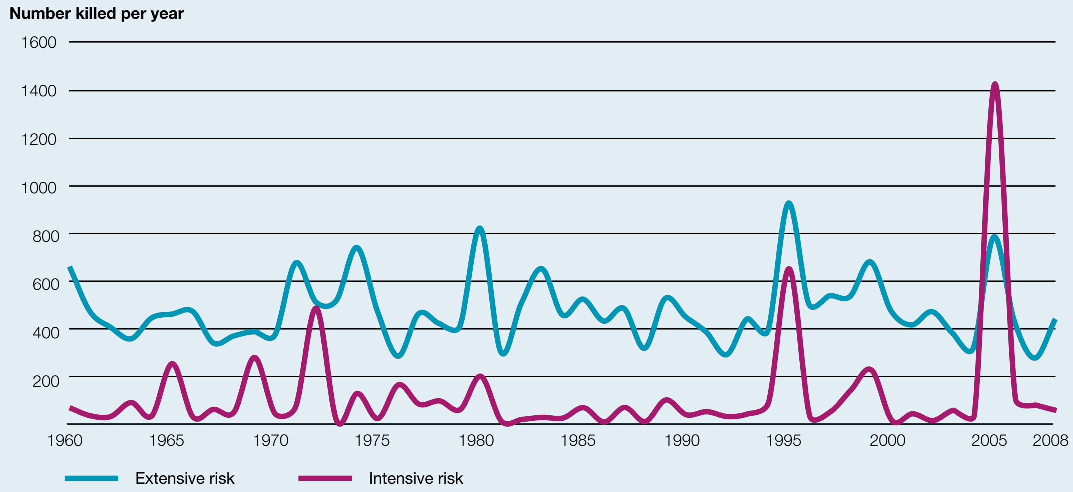
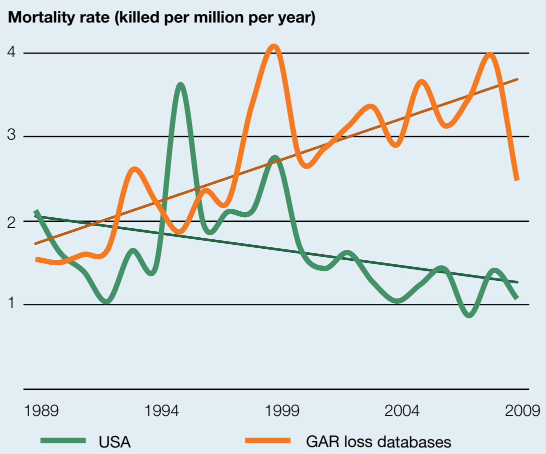


Figure 2.28
Extensive and intensive mortality in the USA

Figure 2.29 shows that, compared with the other countries in the data universe, mortality in extensive disasters in the United States of America is falling. Figure 2.30, however, shows that even when normalized by GDP per capita, economic loss is rising.



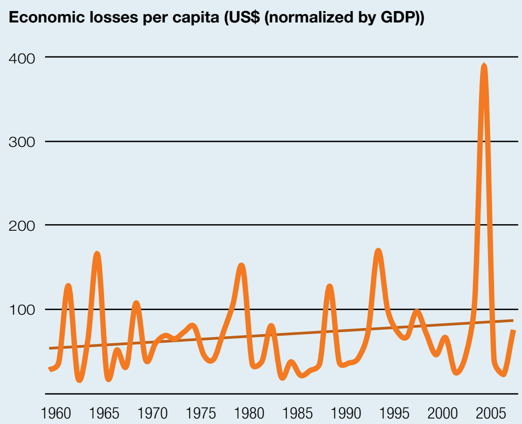
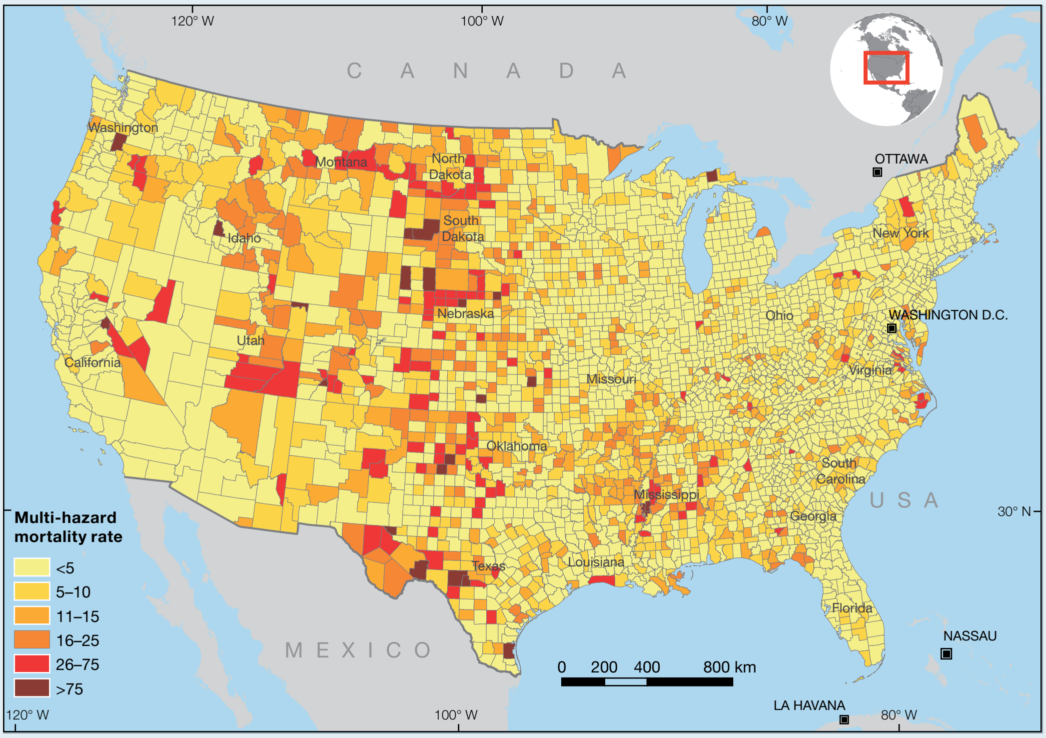


Figure 2.29 (left)
Mortality per capita per year in extensive disasters: United States of America compared with Africa, Asia, Latin America and the Middle East

Figure 2.30 (right)
Economic loss per capita, normalized by GDP

The highest extensive risk mortality rates are strongly associated with a wide geographical corridor that stretches from the north to the southwest of the United States of America, through the states of North and South Dakota, Nebraska, Kansas, Oklahoma and Arkansas (Figure 2.31).

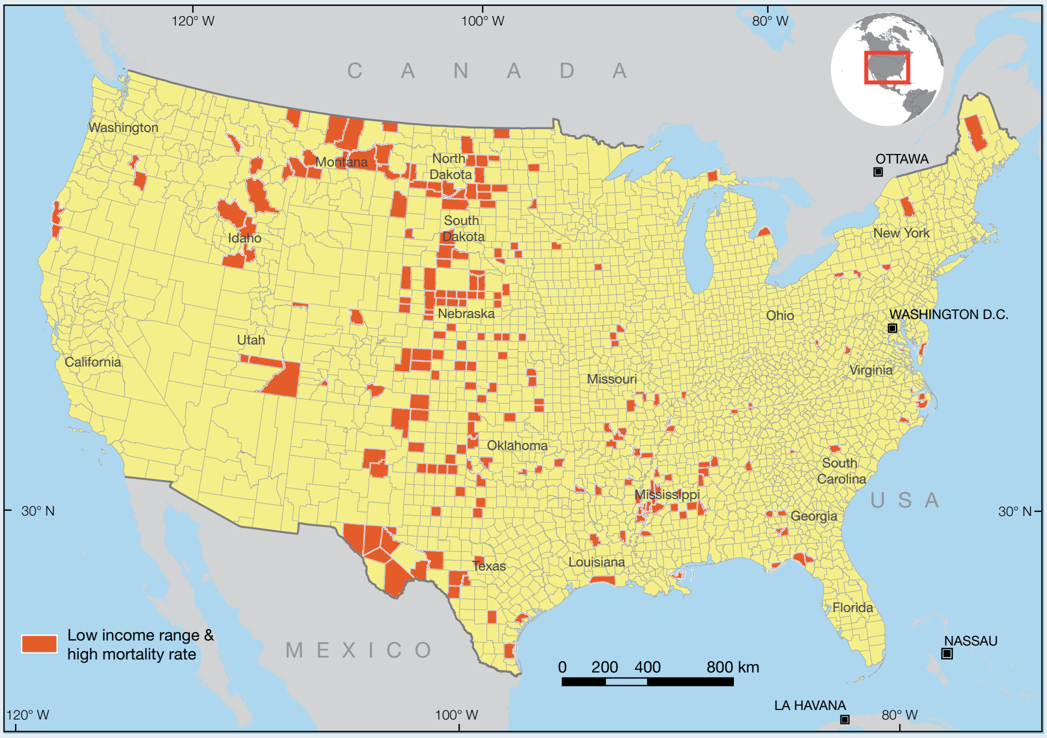
Figure 2.31
Multi-hazard crude mortality rate (accumulated mortality per million per year) per county, United States of America, 1960–2009



(Sources: mortality rates from SHELDUS (without Hurricane Katrina); population year (2006) from the US Census Bureau)

As Figure 2.32 shows, 220 out of the 302 counties (73 percent) with annual mortality rates greater than 15 per million had average annual household incomes of less than US$40,000. Many are sparsely populated counties in the north-to-southwest corridor mentioned above.

Figure 2.32
Counties with low average annual income and high mortality rates, United States of America, 1960–2009



(Sources: income and population (2006) from the US Census Bureau; loss data from SHELDUS. Mortality due to Hurricane Katrina not included)

(Source: Serje, 2010a)

Table 2.8 Risk drivers and disaster outcomes

Risk driver	Outcome
Badly planned and managed urban development Disaster risk may be increasing faster in rapidly growing small- and medium-sized urban centres than in either rural areas or larger cities. Compared with small and medium urban centres, large urban centres and megacities generally have stronger risk governance and investment capacities along with slower growth, both of which facilitate planning and urban management.	**Latin America** In most Latin American countries, the number of disasters reported in small and medium urban areas is increasing at a faster rate than in large urban centres and megacities (Mansilla, 2010).[19] More than 80 percent of all reports of disaster loss in Latin America occur in urban areas. Although each country has a different urban structure, 40–70 percent of all nationally reported disasters occur in urban centres of less than 100,000 inhabitants, and 14–36 percent in small urban centres. This proportion is growing. In Mexico for example, small and medium urban centres accounted for 45.5 percent of total municipal disaster loss reports in the 1980s, and 54 percent since 2000. **Colombia** In Colombia, municipalities with the most rapidly growing urban population between 1995 and 2005 were also more likely to experience more disasters and have higher numbers of houses damaged (Serje, 2010b).
Ecosystem decline Deforestation in tropical areas is a critical global driver of climate change. It also has important and often negative local feedbacks, leading to increases in mean temperatures and decreases in mean precipitation. Coastal ecosystems, including coral reefs, sea grasses, mangroves and other beach vegetation, play a key role in mitigating impacts of storm surges and coastal flooding. Unfortunately, coastal ecosystems in many areas are in decline, simultaneously increasing disaster risk while threatening the sustainability of local economies.	**Peru** In the Peruvian Amazon, deforestation at least partly explains why some watersheds experience greater disaster loss and damage as a result of floods and landslides than others. To establish this link, satellite images in selected watersheds of the upper Amazon were analysed to determine the rate of conversion of forest into agricultural land and other uses between 1986 and 1998. Statistical correlations suggest that those watersheds with the highest rates of deforestation are likely to experience greater disaster mortality and housing damage (Serje, 2010b; Tonini et al., 2010). Note, however, that the clear link between deforestation and disaster loss does not mean that deforestation causes the loss directly. Deforestation usually occurs in areas with an expanding agricultural frontier and growing small urban centres, and other factors including increasing hazard severity, exposure and vulnerability, also shape risk. **Jamaica** In Negril, Jamaica, up to 55 metres of beach depth has been lost in some areas as a consequence of the degradation of coral reefs, the removal of sea grass meadows, the loss of mangroves, and increasing urban and agricultural pollution. Coral reefs, for example, provide ecosystem services that include shoreline protection, supply of beach material, tourism revenue and local fishing. In Negril, coral reefs have been degraded in numerous ways: damage inflicted by major storms (such as Hurricane Ivan in 2004); coral bleaching through increased sea temperatures; pollution from sewage and agricultural run-off causing algal growth that suffocates coral; invasive predators such as lion fish; and destructive fishing practices. Mangroves protect beaches and shorelines by dissipating near-shore waves and play a vital role as a breeding habitat for fish and shellfish, but they have been harvested for firewood and building materials. Sea grass meadows are also a significant natural source of beach material but are in decline mainly because of removal by the tourism industry. Other coastal ecosystems suffering degradation include wetlands and forests. This degradation of coastal ecosystems has increased storm surge risk in Negril. A 1-in-50-year hurricane has the potential to produce storm waves of almost 7 metres, affecting around 2,500 local residents, more than 60 hotels and their guests, and water and sanitation infrastructure (UNEP, 2010).

Poverty	Indonesia
Within countries, poorer areas tend to have higher disaster risk, illustrating the complex interactions between poverty and disaster risk analysed in detail in GAR09 (UNISDR, 2009).	In Indonesia, mortality risk from landslides is higher in areas with low levels of human development and higher levels of poverty. Detailed information on hazard factors, population exposure and a range of socioeconomic indicators was used to build a landslide risk model with a sub-national level of resolution, calibrated with disaster loss data from the recently developed DIBI information system (see Box 2.5). Landslide mortality risk correlated positively with physical exposure and the Human Poverty Index, and negatively with the Human Development Index. Poverty explained a significant proportion of the variance in landslide risk between provinces (Cepeda et al., 2010). The poorer the province the greater the risk, and vice versa.
	Colombia
	A similar modelling exercise in Colombia showed that those municipalities with a greater proportion of unsatisfied basic needs and lower GDP per capita were more likely to see more people affected and more houses damaged during floods (OSSO, 2011b).

2007; López-Calva and Ortiz-Juárez, 2009; Rodriguez-Oreggia et al., 2010). For example, destroyed or damaged schools together with the loss of household assets and livelihoods can force children out of school, and infant malnutrition caused by loss of food supplies may cause stunting and lead to poor educational achievement and greater propensity to disease.

Recent studies conducted in Bolivia, Indonesia, Mexico, Mozambique, Nepal, the Philippines and Viet Nam provide evidence of how extensive disasters negatively affect children's education, health and access to services such as water and sanitation, though it was difficult to establish significant relationships between intensive disasters and child welfare (Tarazona and Gallegos, 2010; Seballos and Tanner, 2011). Given the importance of primary education for human and long-term economic development, these findings should serve as a warning to governments.

In areas in Bolivia that experienced the greatest incidence of extensive disasters, the gender gap in primary education achievement widened, pre-school enrolment rates decreased and dropout rates increased. Equivalent areas in Nepal and Viet Nam saw, respectively, reduced primary enrolment rates and a drop in the total number of children in primary education. Extensive disasters also led to an increased incidence of diarrhoea in children under five years of age in Bolivia, an increased proportion of malnourished children under three in Nepal, an increased infant mortality rate in Viet Nam, and an increase in the incidence of babies born with low birth weight in Mozambique. This study also found evidence of negative impacts in terms of access to water and sanitation in Mexico and Viet Nam. These impacts indicate a need for greater consideration of children's vulnerability (Box 2.7).

Disasters also contribute to internal displacement (Box 2.8). Hazards such as floods, although causing relatively low mortality, destroy many houses and hence cause considerable displacement. Between 1970 and 2009 in Colombia, for example, 24 of the country's 35 disaster loss reports detailed floods that killed fewer than 10 people but destroyed more than 500 houses (IDMC, 2010). In total, around 26,500 houses were destroyed, potentially displacing more than 130,000 people. In the Indian state of Orissa, 265 floods with similar low mortality rates destroyed more than half a million houses.

Intensive disasters also lead to large-scale internal displacement. Pakistan's 2010 floods have to date left an estimated 6 million people in need of shelter; India's 2008 floods uprooted roughly 6 million people; Hurricane Katrina displaced more than half a million people in the United States of America; and Cyclone Nargis uprooted eight hundred thousand people in Myanmar and South Asia (IDMC, 2010).

Box 2.7 Child-centred approaches to dealing with climate stresses and extreme events

A number of estimates suggest that at least 66.5 million children are affected by disasters annually (Penrose and Takaki, 2006; Bartlett, 2008; Costello, 2009; Sanchez et al., 2009). Addressing high child mortality rates as well as the significant psychological impacts of disasters on children requires new approaches that recognize the role of children as agents of change. On the one hand, these approaches should include child-sensitive policy and programming, where existing social protection, school feeding programmes and structural strengthening of school buildings all contribute to child welfare. On the other hand, they extend to participatory DRM policy and programming in which children and young people are actively engaged in decision-making and accountability processes. These usually have the benefit of improving communication and integrated planning within communities, and increasingly serve to promote effective preparation and prevention.

Engaging children in DRM remains constrained by lack of finance, skills and knowledge. This hampers both the processes and delivery of risk management and the engagement of children in planning and decision-making. Also, perceptions of children as passive, subordinate and unable to participate hinder them from actively voicing their risk perceptions, needs and potential.

There are examples of how an enabling policy environment can help change this. In the Philippines, the Strategic National Action Plan and the Local Government Code provide a policy environment in which decentralization of disaster risk management responsibilities opens up opportunities for child-centred initiatives. Sangguniang Kabataan are youth councils that are directly involved in decision-making at village level and are represented at municipal, provincial and national levels. However, it is political will and local capacities above and beyond these supporting policies that facilitate child-centred participatory DRM. With external support and guidance, youth groups have made good progress in changing attitudes and providing opportunities for participatory DRM.

(Source: Seballos and Tanner, 2011)

Box 2.8 Floods and internal displacement in Tumaco, Colombia

On 16 February 2009, the Mira and Telembí rivers in Nariño, Colombia, flooded four municipalities on the Pacific Coast: Tumaco, Barbacoas, Roberto Payán and Magüí Payán. Two people were killed, with a further 20 reported missing, but 1,125 houses as well as schools, health centres, and roads were destroyed. The government declared a municipal emergency on 23 February in Tumaco, but there was no international appeal for relief.

Based on the number of houses destroyed, there were an estimated 5,625 displaced people. However, the actual number recorded by the authorities was more than 25,000, of whom 14,000 were forced into shelters, with the remainder staying with friends and families.

One reason for the discrepancy may be that people whose houses were damaged (but not destroyed) were nevertheless displaced during the peak of the flood. Around 1,400 houses were damaged by the floods, likely generating another 8,000 displaced people. In addition, the number of displaced may include those who evacuated during the floods as a preventive measure, and who most likely returned after a few days or weeks. The number of destroyed houses is therefore more likely to be a better indicator for long-term displacement than for short-term displacement during emergencies.

(Source: IDMC, 2010)

Assuming a family size of five in the 21 countries and states included in the GAR11 analysis, the destruction of 5.9 million houses in intensive disasters between 1970 and 2009 would have displaced almost 30 million people. Although extensive disasters account for less than one-fifth (19 percent) of destroyed housing, this implies an additional 7.5 million displaced people, who are typically less visible than those displaced in intensive disasters subject to large-scale international humanitarian assistance.

2.5 Emerging risks

Countries are faced with a range of emerging risks associated with extremely low-probability hazards such as volcanic eruptions or extreme space weather, and new patterns of vulnerability associated with the growing complexity and interdependency of the technological systems on which modern societies depend, including: energy, telecommunications, finance and banking, transport, water and sanitation. These new vulnerabilities multiply disaster risks and can trigger cascading and concatenated system breakdowns at different scales which are difficult to model, but which can exponentially magnify impacts.

2.5.1 Volcanic eruptions affecting the global weather system

The eruption of Huaytaputina in 1600 showed that the mid-latitudes of the northern hemisphere can experience slight winter warming and marked summer cooling due to the spread of volcanic ash and gas from the tropics by global air circulation patterns (Pyle, 1998). Of the more than 550 active volcanoes in the world, 154 erupted between 1990 and 1999 (Siebert and Simkin, 2011), and the direct risks associated with these can be estimated. In Europe, for example, there is US$87 billion of exposed value at risk to the 10 volcanoes that potentially affect population centres of at least 10,000 inhabitants (Spence et al., 2009). Despite a 30 percent probability of an eruption occurring in the 21st century the size of that of Tambora (Indonesia) in 1815 (Sparks, 2010), it remains a challenge to calculate or quantify the human or economic risks arising from volcanic eruptions affecting the global weather system.

2.5.2 Extreme space weather

Geomagnetic storms represent another low-probability, sequential risk whose impacts are difficult to measure. These storms are characterized by severe disturbances of the upper atmosphere and near-Earth space environment, caused by the magnetic activity of the sun. Such disturbances have always occurred but are a growing hazard for modern societies and the global economy, which are increasingly dependent on interconnected electric power grids and telecommunications and other systems affected by these disturbances. For example, Canada's Hydro-Quebec power grid collapsed during a geomagnetic storm in March 1989, leaving millions of people without electricity for up to nine hours (National Research Council, 2008).

Although the probability of such blackouts is low, the potential for cascading impacts in vulnerable systems that depend on power grids is increasingly high, such as banking and finance, government services, transport and communications, and drinking water. The evolving connectedness and interdependency of these systems increases the probability of joint failures and means that the real risk is difficult to calculate and quantify, and is often underestimated. The 1859 Carrington super storm was the most spectacular geomagnetic storm in recent history but occurred in a world without interdependent networks and systems. If a similar storm were to occur today, the increased vulnerability could lead to unprecedented impacts.

2.5.3 Unexpected climate extremes

Two recent cyclones, a Category 2 storm that struck Santa Catarina province in Brazil in 2004 and Cyclone Gonu, which made landfall in Oman and the Persian Gulf in 2007, occurred in locations that had never in recorded history experienced storms of such magnitude (Figure 2.33). Contemporary populations have been unprepared for such extremes as the 2003 European heat wave or the 2010 Russian forest fires, which expose emerging or hidden vulnerabilities.

Global climate change may generate climate extremes for which there may be no historic precedent. Although it is still not possible to attribute the cause of individual events such as these to climate change, stochastic modelling can provide governments with insights into possible scenarios (ECA, 2009).

2.5.4 Interactions between physical and technological hazards

On 11 March 2011, Japan declared an 'atomic power emergency' when a devastating earthquake and tsunami damaged the Fukushima Daiichi Nuclear Power Station and caused a radioactive leak (Wald, 2011). This synchronous failure is posing major challenges to Japan, but its impacts are already being felt globally, in capital markets and in the nuclear energy industry.

Other such difficult-to-quantify risks are associated with major fires at industrial and petrochemical facilities. In addition to the effects of explosion and fire, such disasters may include the release of toxic gases. The red sludge from a burst bauxite storage reservoir in October 2010 near the Hungarian town of Ajka is one example of the consequences of poorly managed storage of highly toxic industrial and mining waste. Nine people were killed and more than 7,000 affected by the million cubic metres of spilled toxic sludge, and the full environmental and economic damage are not yet known (EM-DAT, 2011c).

Many similar chemical storage sites are also located in areas prone to other physical hazards. The remnants of the Soviet nuclear arms industry in Central Asia, for example, are located in an area prone to earthquakes, floods and landslides (Figure 2.34) (Sevcik, 2003;

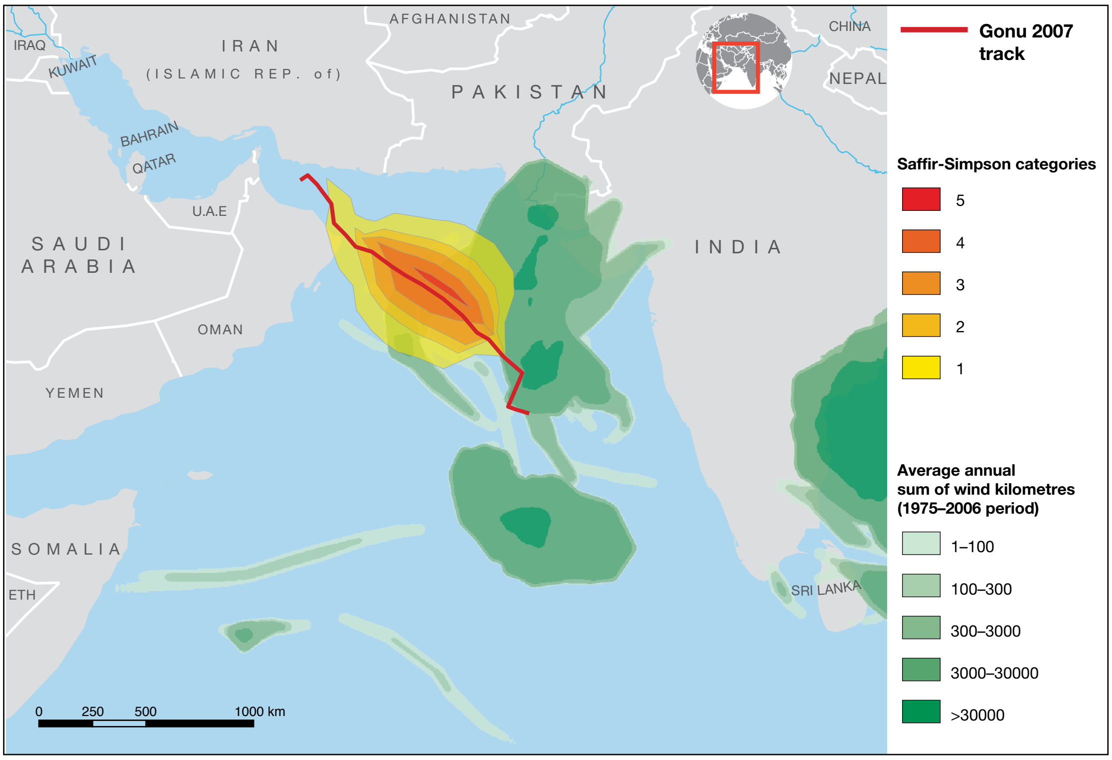
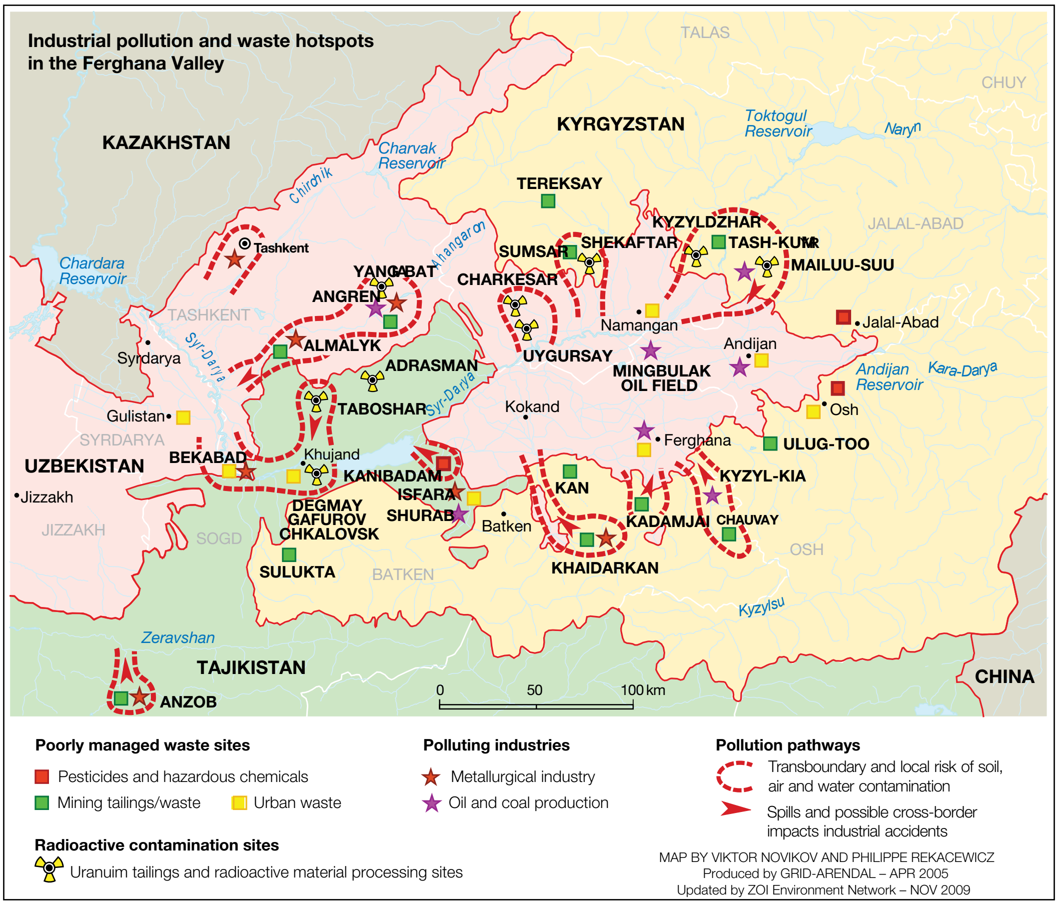


Figure 2.33
The track of Cyclone Gonu (2007)

Hobbs, 2010). Kyrgyzstan and Tajikistan are both subject to earthquakes, landslides and flooding that could magnify an already high risk of contamination (Sevcik, 2003; Hobbs, 2010). The compound risks posed by the proximity of nuclear tailings to natural hazards in Central Asia are particularly severe, but they are not unique. Mining and toxic-waste storage occurs in hazard-prone areas in many other countries, often without adequate risk identification or risk management. If such activities are initiated in countries with weak risk governance capacities, these compound risks will only increase.

Figure 2.34

Industrial pollution and waste hotspots in the Ferghana Valley, an area prone to earthquakes, landslides and flooding



(Source: UNEP-GRID, 2011)

Notes

1 The low mortality in Sidr does not imply that the next severe cyclone to hit Bangladesh will have similar impacts. Although encouraging, one success story is not sufficient to prove that mortality risk has been definitively reduced.

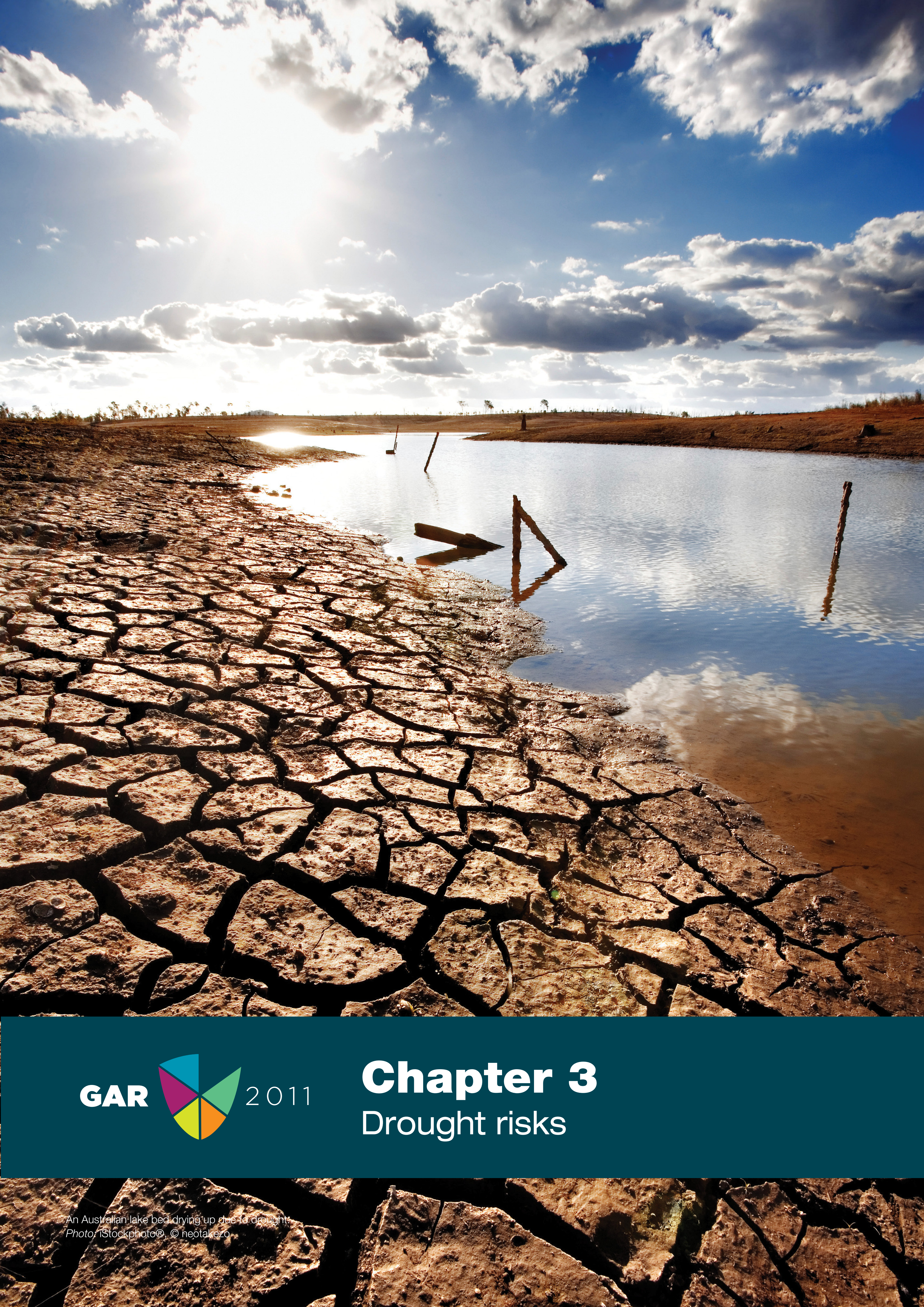
2 Since the launch of GAR09, the number of tropical cyclones analysed has increased from 2,510 to more than 4,100, and an additional seven years of data have been included (1970–2009). For GAR09, cyclone risk was analysed only up to 300 km inland. Following expert review this limit has been removed. The algorithm for calculating average cyclone frequencies has also been improved and a new method for country level aggregation introduced. As a consequence tropical cyclone exposure has been calcualted differently in GAR11 compared with GAR09. The GAR11 flood analysis has also been improved and includes data from the hydroshed model for Canada, Mexico and the United States of America, which was not available for GAR09.

3 Norwegian Geotechnical Institute, Expert group meeting Earthquake Hazard and Risk Modelling Workshop, 12–13 October 2009, Oslo, Norway.

4 It is important to note that geographic regions may disguise strong inter-regional differences. For example, the fact that China and Pacific Islands such as Nauru and Vanuatu are part of East Asia and the Pacific does not mean that they are experiencing similar processes of risk construction. For World Bank income and geographic regions, see www.data.worldbank.org/country.

5 This is the number of countries affected by cyclones that make landfall. One cyclone can affect several countries, but many tropical cyclones never make landfall and are thus not included.

6 Small islands by definition often do not have ‘remote rural areas’ but still can have high mortality risk.
7 This analysis focuses on major river basin flooding (in watersheds with an area greater than 1,000 km^2). It does not include urban flooding, coastal flooding, flash floods or glacial lake outburst floods (GLOFs), or flooding on small islands. Nor does it take into account the damages caused by winds during floods, which can be substantial in some cases.
8 A completely new tropical cyclone dataset based on newly available data (from IBTrACS, NOAA) was used for this analysis (Peduzzi et al., 2011), improving upon on the analysis from GAR09.
9 The other high-income economies (OHIE) region is not included in this and the related tables and figures because of the limited number of countries modelled for floods and cyclones in this category.
10 Possibly due to climate change and warmer sea temperatures, but possibly also because of changes in recording instruments and methods (Landsea et al., 2006). With only short data series it is impossible to confirm if this is a longer-term trend.
11 Tropical cyclone exposure (approximately 100,000 people in 2000–2009) in the Russian Far East has been included in the EAP region.
12 In constant 2000 US$.
13 The analysis of tropical cyclone exposure does not include other high-income economy (OHIE) countries due to limited exposure, which is insufficient for robust modelling.
14 Expected impacts of climate change were studied considering three factors: expected reduction in agricultural productivity, rise in sea level, and scarcity of fresh water. Almost all countries with high or very high vulnerability, food insecurity and extreme trade limitations were expected to suffer severe reductions in agricultural productivity. All Small Island Developing States would be severely affected by sea-level rise and almost all African countries would be strongly affected by water scarcity, coastal flooding and other extreme weather-related events.
15 El Niño is a phenomenon in the equatorial Pacific Ocean characterized by a positive sea surface temperature departure from normal (for the 1971–2000 base period) greater than or equal in magnitude to 0.5 degrees Celsius, averaged over three consecutive months. La Niña is phenomenon in the same region characterized by a negative sea surface temperature departure from normal greater than or equal in magnitude to 0.5 degrees Celsius, averaged over three consecutive months (NOAA, 2003).
16 A statement released by the municipal authorities of Escazu highlights these issues (Segura et al., 2010).
17 Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, India (Orissa and Tamil Nadu), Indonesia, Iran (Islamic Republic of), Jordan, Mexico, Mozambique, Nepal, Peru, Panama, Sri Lanka, Syrian Arab Republic, Venezuela and Yemen.
18 SHELDUS uses different attributes to the other disaster loss databases analysed in GAR11, and contains data on mortality and economic losses at the county level in all 50 states in the United States of America, but does not record other attributes such as housing damage and destruction. Data for this case study were drawn from the Spatial Hazard Events and Losses Database for the United States, Version 8.0. Hazards and Vulnerability Research Institute (2010). Columbia, University of South Carolina, www.sheldus.org.
19 Small urban centres are defined as those with populations of 10,000 to 19,999; medium urban centres 20,000 to 99,999; large urban centres 100,000 to 999,999 and megacities greater than 1 million.



GAR 2011

Chapter 3
Drought risks

An Australian lake bed drying up due to drought.
Photo: iStockphoto®, © neotakezo

Chapter 3 Drought risks

Unlike the risks associated with tropical cyclones and floods, those associated with drought remain less well understood. Drought, therefore, is often a less visible risk. Losses and impacts are not systematically captured, global standards for measuring drought hazard are only slowly being introduced, and there are difficulties regarding data collection.

As a result, comprehensive assessments of drought risks are only just beginning and, as yet, there is no credible global drought risk model. Case studies indicate that the impacts of drought can only be partly attributed to deficient or erratic rainfall, as drought risk appears to be constructed over time by a range of drivers. These include: poverty and rural vulnerability; increasing water demand due to urbanization, industrialization and the growth of agribusiness; poor soil and water management; weak or ineffective governance; and climate variability and change.

Such drivers are increasing vulnerability and exposure, and translate drought hazard into risk. Impacts and drivers may be strongly interrelated but, as many relate to poor, rural households, there is currently little political or economic incentive to address the risk. Yet, strengthening drought risk management, as an integral part of risk governance, will be fundamental to sustaining the quality of life in many countries during the coming decades. This chapter is only a first step in presenting the complexities of global drought risk. Understanding and revealing the full spectrum is a challenge that must be addressed in the years to come.

3.1 Drought risk in the Navajo Nation

The dramatic case of the Navajo Nation in the south-western United States of America shows that much of what are characterized as drought impacts are only partly due to lack of rainfall. Factors including political marginalization and rural poverty have helped to translate meteorological drought into a widespread disaster for the entire people.

Between 1999 and 2009, the Navajo Nation experienced a drought of historic proportions. Many springs sampled for a 1999 water-quality study had run dry by 2002 and have remained dry ever since. Wells and aquifers became so saline that they could no longer be used for drinking, by humans or livestock. More than 30,000 cattle perished between 2001 and 2002 alone, and entire communities ran out of water (Redsteer et al., 2010). Though the drought officially began in 1999, data suggest that it may have begun in 1996 or even 1994; the uncertainty due to large portions of the reservation being poorly monitored.

Some of the causes of this disaster were not directly due to decreasing rainfall during the drought period. Annual snowfall has been decreasing during the past 80 years (Figure 3.2), and by the 1960s more than 30 major rivers and bodies of water upon which the Navajo relied for livestock and agricultural production had dried up (Figure 3.1) (Redsteer et al., 2010). Since then, the soil has become drier due to higher temperatures during the warmest months, further increasing water stress (Weiss et al., 2009).

However, it was factors like political marginalization and rural poverty that translated meteorological drought into a disaster for the Navajo people. The Navajo reservation was established in 1868 in a vast and remote region spanning four states (Arizona, Colorado, New Mexico and Utah). The majority of the

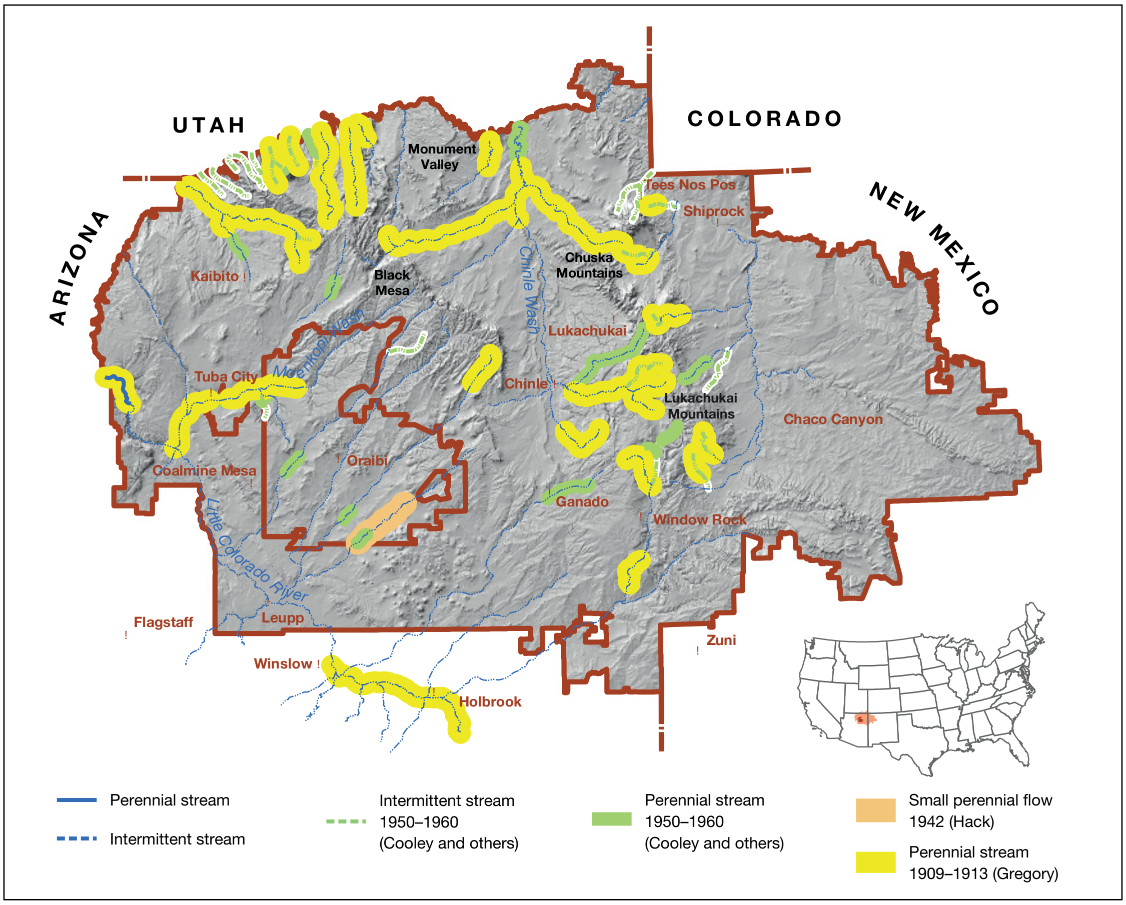
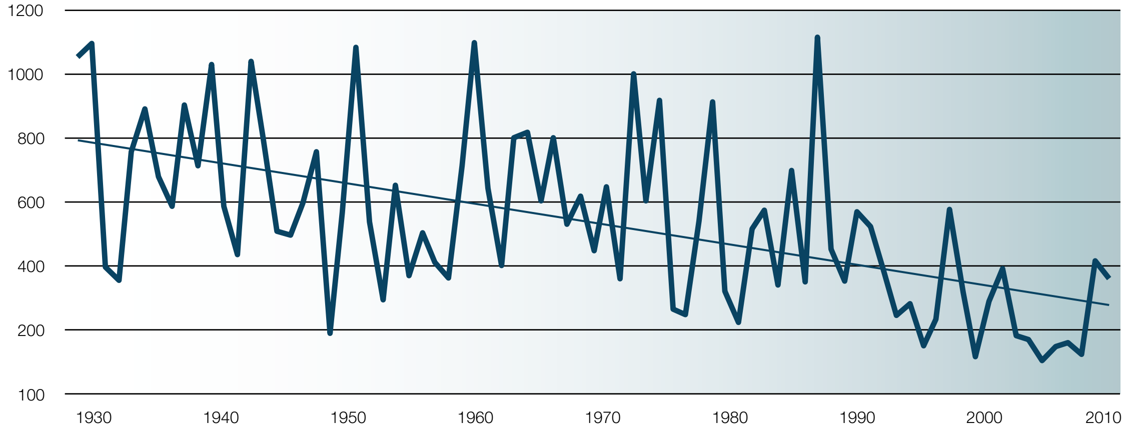


Figure 3.1
Navajo Nation and its historic stream-flow

Figure 3.2

Average annual snowfall at 25 weather stations on or near the Navajo Nation (1930–2010)



(Source: Redsteer et al., 2010)

reservation occupies the driest third of the Navajo's traditional homeland, because ranchers had claimed the best rangelands for themselves (Redsteer et al., 2010). During the 1930s, the government began requiring permits to raise livestock, limiting the numbers each family could own, and demanding that they had to remain within one of 20 newly demarcated grazing districts (Young, 1961; White, 1983; Kelley and Whiteley, 1989). This final restriction interrupted a traditional Navajo drought impact management practice of moving livestock across district boundaries to less drought affected areas (White, 1983; Kelley and Whiteley, 1989; Iverson, 2002). Some Navajo traditions and practices also increased drought risk, such as their continued preference of cattle over other species, added to by US Government and Navajo Nation policies that require families to have livestock in order to validate traditional land use rights, even if they have lived on the same land for generations (Redsteer et al., 2010). Even with grazing restrictions, herds have exceeded the carrying capacity of the land since the 1960s (Young, 1961; Redsteer et al., 2010).

Such policies in a context of decreasing water availability led to endemic poverty even before the last drought began. In 1997, average annual per capita income was less than US$6,000, and 60 percent of the Navajo lived in poverty, in houses without water and electricity. Savings mitigate drought impacts, but because the Navajo often invest their savings in livestock, this safety net is in itself vulnerable to drought (Redsteer et al., 2010). Risk drivers, such as inappropriate development, badly managed water resources, weak local governance and inequality, all played their part in translating the most recent meteorological drought into a further series of cascading losses and impacts.

3.2 Drought hazard

Meteorological drought is a climatic phenomenon rather than a hazard per se, but it is often confused with other climate conditions to which it is related, such as aridity. It only becomes hazardous when translated into agricultural or hydrological drought, and these depend on other factors, not just a lack of rainfall.

Unlike the risks associated with tropical cyclones and earthquakes, drought risk remains poorly understood. Although meteorological drought is increasingly well characterized, the measurement of agricultural and hydrological drought remains a challenge (see Box 3.1 for definitions). Far less attention has been given to identifying, let alone addressing, the underlying risk drivers. Attempts to build credible global drought risk models have proved elusive, and drought losses and impacts are not systematically recorded. Despite increasing evidence of the magnitude of drought impacts, few countries have developed drought risk management policies or frameworks, and the political and economic imperative to invest in reducing drought risk remains weakly articulated.

Box 3.1 Types of drought

There are three general types of drought: meteorological, agricultural and hydrological. Meteorological drought refers to a precipitation deficit over a period of time. Agricultural drought occurs when soil moisture is insufficient to support crops, pastures and rangeland species. Hydrological drought occurs when below-average water levels in lakes, reservoirs, rivers, streams and groundwater, impact non-agricultural activities such as tourism, recreation, urban water consumption, energy production and ecosystem conservation.

(Source: Wilhite and Buchanan-Smith, 2005; UNISDR, 2009)

Meteorological droughts are usually defined as deficiencies in rainfall, from periods ranging from a few months to several years or even decades. Long droughts often change in intensity over time and may affect different areas. For example, the 1991–1995 meteorological drought in Spain migrated from west to east and then south (Figure 3.3).

Until the recent adoption of the Standard Precipitation Index (SPI) (see Box 3.2), there was no agreed global standard to identify and measure meteorological drought. National weather services used different criteria, making it difficult to establish exactly when and where droughts occur.

The application of the SPI could strengthen the capacity of countries to monitor and assess meteorological drought. Despite its simplicity, many countries have difficulty using it due to an insufficient number of rainfall stations in some areas, due to the low priority awarded to hazard

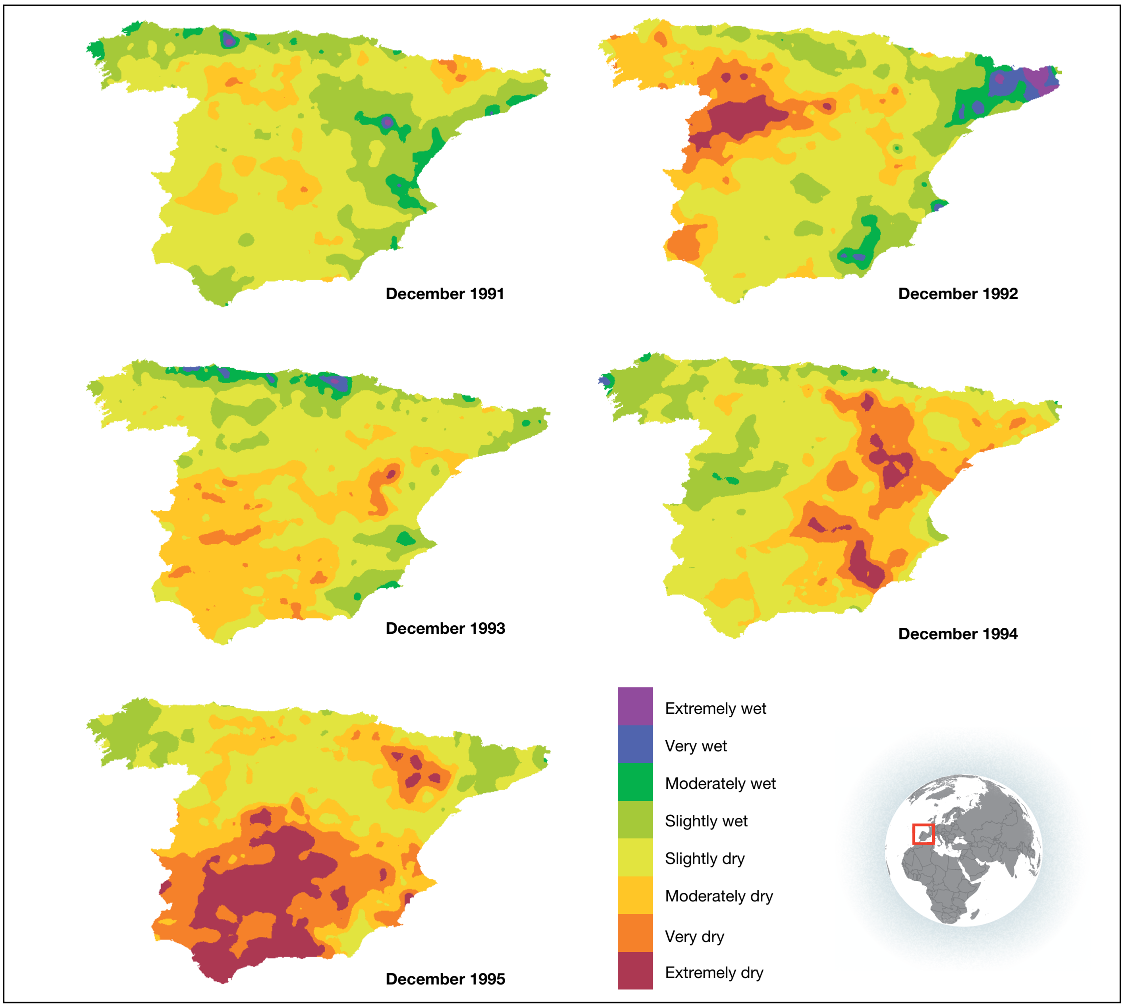


Figure 3.3
12-month Standardized Precipitation Index in Spain during the 1991–1995 drought

(Source: Mestre, 2010)

Box 3.2 Measuring meteorological drought

The World Meteorological Organization (WMO) adopted the Standardized Precipitation Index (SPI) in 2009 as a global standard to measure meteorological droughts, via the ‘Lincoln Declaration on Drought Indices’. It is encouraging use by national meteorological and hydrological services in addition to other indices used in each region, and will be considered for acceptance by the World Meteorological Congress at its Sixteenth Session in June 2011.

The Standardized Precipitation Index (McKee et al., 1993, 1995) is a powerful, flexible and simple index based on rainfall data, and it can identify wet periods/cycles as well as dry periods/cycles. The SPI compares rainfall over a period – normally 1–24 months – with long-term mean precipitation at the same location (Guttman, 1994; Edwards and McKee, 1997).

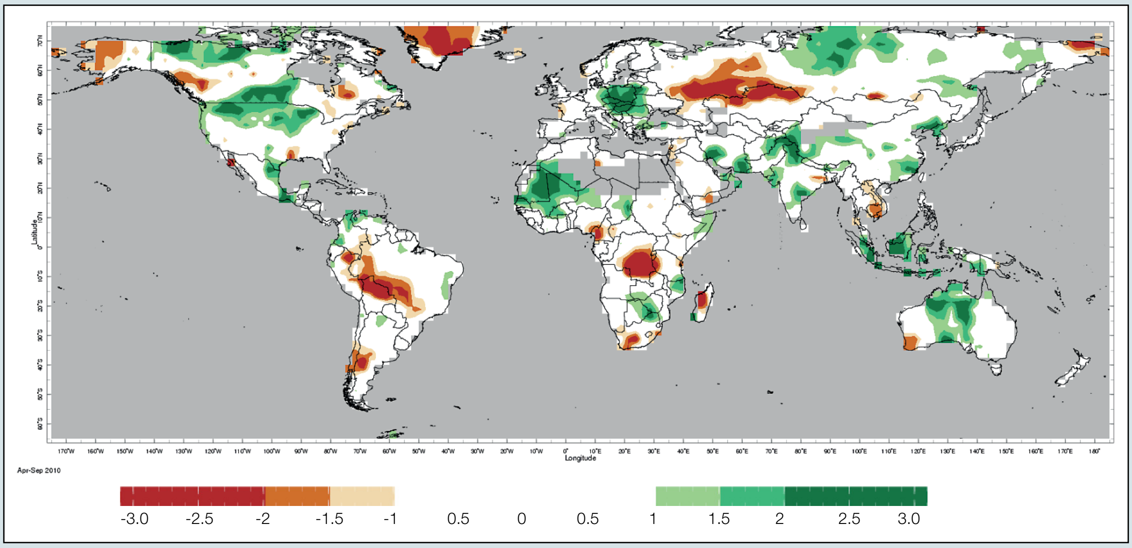
However, at least 20–30 years (optimally 50–60 years) of monthly rainfall data is needed to calculate the SPI (Guttman, 1994). Given the lack of complete data series in many locations, and that many drought-prone regions have insufficient rainfall stations, interpolation techniques may need to be applied to temporal and geographic gaps. Table 3.1 shows how an SPI of 3 months can be used to calculate the probability of different levels of droughts severity.

Table 3.1 Drought probability using a 3-month Standardized Precipitation Index

SPI	Category	Number of occurrences per 100 years
0 to -0.99	Mild dryness	33
-1.00 to -1.49	Moderate dryness	10
-1.5 to -1.99	Severe dryness	5
< -2.0	Extreme dryness	2.5

Figure 3.4 shows the global distribution of meteorological dryness/wetness at the end of September 2010, using a 6-month SPI. This map highlights in red the droughts in Russia associated with wildfires (discussed in Chapter 1) and western Brazil, a normally humid climate.

Figure 3.4
Interpolated global map using a 6-month Standardized Precipitation Index (April–September 2010)



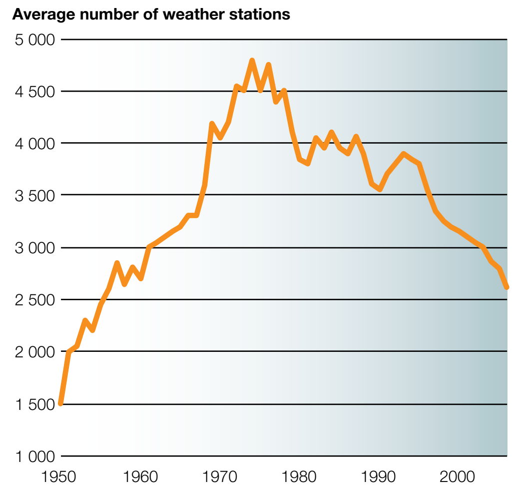
(Source: IRI, 2010)

(Source: Sivakumar et al., 2010)

monitoring in government budgets. The number of rainfall stations maintained by Spain's national meteorological agency, AEMET, for example, has declined to almost half of the peak of the mid-1970s (Figure 3.5) (Mestre, 2010).

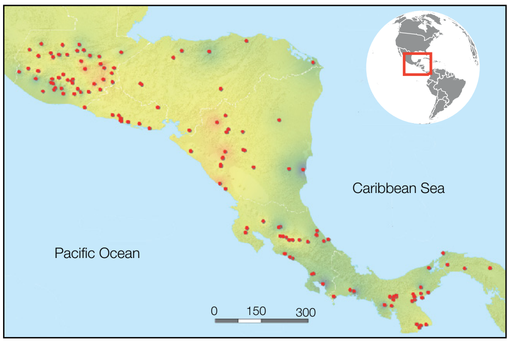
In Central America, more weather stations are located nearer to the Pacific coast (Figure 3.6), presenting an obstacle to making accurate SPI calculations on the Caribbean side required for regional drought monitoring and planning (Brenes Torres, 2010). Remote sensing can partly fill this gap, but SPI models still need to be calibrated using physical rainfall data (Dai, 2010). Because meteorological drought is a climatic phenomenon, rather than a hazard per se, additional data is required to identify and measure drought hazard.

Experts have now reached a consensus that agricultural drought should be measured using composite indices that consider rainfall, soil moisture, temperature, soil and crop type, stream-flow, groundwater, snow pack, etc., as well as historical records of drought impacts (WMO, 2010).[1] However, such indices require data that is available only in a handful of countries at present, mostly in North America and parts of Africa. Work is also ongoing to identify indicators of hydrological drought, but this is also challenged by data constraints and modelling complexities.[2]



(*Source: Mestre, 2010*)

Figure 3.5
Average number of rainfall stations maintained by AEMET by year in Spain



(*Source: Brenes Torres, 2010*)

Figure 3.6
Distribution of weather stations in Central America

3.3 Drought impacts

Drought losses and impacts are systematically reported in only a few countries, even though there are clear and significant impacts on agricultural production, rural livelihoods, and urban and economic sectors. Droughts also contribute to migration, conflict and ecosystem decline.

In internationally reported droughts since 1900, more than 11 million people have died with over 2 billion affected (EM-DAT, 2010b), more than by any other single physical hazard.

Most of the drought-related mortality recorded in EM-DAT, however, occurred in countries also experiencing political and civil conflicts. Also, since the 1990s, internationally recorded drought mortality has been negligible, with only 4,472 fatalities from 1990 to 2009 (EM-DAT, 2010b). Drought impacts are poorly recorded internationally. Reasons include the lack of visible damage outside of the agriculture sector, the high proportion of indirect losses compared to direct losses, and the highly complex nature of drought mortality, which is highly livelihood-dependent (Below et al., 2007).

Due to the absence of systematic data, it is impossible to provide a global assessment of patterns and trends in drought impacts and loss. Available evidence, however, provides a good indication of the magnitude and inter-relatedness of impact on mortality, rural livelihoods, food security, agricultural production, economic and urban development, migration, conflict, the environment and public spending (Table 3.2).

Table 3.2 Evidence of agricultural and hydrological drought impacts across the world

Mortality and well-being	Internationally, drought mortality risk is currently severely under-recorded, and drought mortality may be significantly higher than reported, with many fatalities going unrecorded or attributed to other causes. For example, in Mozambique only 18 deaths were reported internationally between 1990 and 2009. In contrast, Mozambique's disaster loss database recorded 1,040 deaths for the same period (EM-DAT, 2010b; INGC, 2010). Poor rural households with livelihoods that depend on rain-fed agriculture are more vulnerable to drought and less able to absorb and buffer the losses. Consequences include increased poverty, reduced human development and negative impacts on health, nutrition and productivity (de la Fuente and Dercon, 2008; UNISDR, 2009), declining purchasing power and increasing income inequality (Rathore, 2005). As with the Navajo, poor rural households can rarely mobilize sufficient assets to buffer crop and livestock losses, while droughts tend to undermine household and community coping mechanisms because large numbers of households are affected simultaneously and for long periods.[3]
Rural livelihoods, food security and agricultural production	In the Caribbean, the 2009–2010 drought saw the banana harvest on Dominica reduced by 43 percent, agricultural production in Saint Vincent and the Grenadines 20 percent below historic averages, and onion and tomato yields in Antigua and Barbuda decline by 25–30 percent. Australia experienced losses of US$2.34 billion during the 2002–2003 drought, reducing national GDP by 1.6 percent. Two thirds of the losses were agricultural, the remainder attributed to knock-on impacts in other economic sectors (Horridge et al., 2005). During the 2002 drought, food grain production in India dropped to 183 million tonnes, compared to 212 million tonnes the previous year (Shaw et al., 2010). In the 2007–2008 drought in the Syrian Arab Republic, 75 percent of the country's farmers suffered total crop failure, and the livestock population was 50 percent below the pre-drought level more than a year after the drought ended (Erian et al., 2010). Mozambique is one of the few countries with a disaster database that systematically records drought losses (INGC, 2010), so the real scale of drought risk becomes visible. Since 1990, drought events damaged 8 million hectares of crops (half of which were destroyed) and affected 11.5 million people (Figure 3.7). Thus, international under-reporting of drought losses undermines the visibility of drought risk and the political and economic imperative for its reduction, and also hides the significant implications for livelihoods of small-scale farmers, especially elderly and women farmers and female-headed households.
Urban and economic development	Droughts reduce water supplies for domestic and industrial use, and for power generation, affecting cities and non-agricultural sectors of the economy. During the 1991–1992 drought in Zimbabwe for example, water and electricity shortages and a decline in manufacturing productivity of 9.5 percent resulted in a 2 percent reduction in export receipts (Robinson, 1993; Benson and Clay, 1998). The overall cost to the economy of the drought-driven decline in energy production was more than US$100 million and 3,000 jobs (Benson and Clay, 1998). In 2008, a severe drought in the south-eastern United States of America threatened the water supplies for cooling more than 24 of the nation's 104 nuclear power reactors. The 2003 European drought and heat wave reduced France's nuclear power generation capacity by 15 percent for five weeks and also led to a 20 percent reduction in the country's hydroelectric production (Hightower and Pierce, 2008). In the middle of Spain's 1991–1995 drought, hydroelectric production was reduced by 30 percent and 12 million urban residents experienced severely restricted water availability (Mestre, 2010).
Migration	Droughts are associated with migration. In the Syrian Arab Republic, a million people left rural areas for cities after successive crop failures from 2007–2009 (Erian et al., 2010). In response to both recurring droughts and marginal rural livelihoods, half of all rural Mexicans migrated to urban centres during the twentieth century (Neri and Briones, 2010). In Rajasthan, India, droughts regularly lead to forced migration, increased debt and borrowing, reduced food consumption, unemployment and poorer health (Rathore, 2005). Given that drought occurred in 47 years in the past century, this implies a profound impact on rural livelihoods. Migration leads to changing household decision-making patterns, often resulting in an increase in female-headed households. Case studies from Jordan and Lebanon show that family dynamics and women's public roles may also change significantly as a result of drought-associated migration (Erian et al., 2010).

Conflict	Droughts contribute to the likelihood of conflict by causing displacement and migration, increasing competition for scarce resources and exacerbating ethnic tensions, and by encouraging poor rural farmers to join armed resistance groups (Barnett and Adger, 2007; Reuveny, 2007). Since the 1950s, droughts precipitated waves of migration and contributed to intense conflicts in India and Bangladesh, and droughts during the 1980s and 1990s were a factor that precipitated ethnic conflict and border skirmishes between Mauritania and Senegal (Reuveny, 2007). A 1,100-year analysis of drought in equatorial East Africa found evidence of drought-induced famine, political unrest and large-scale migration during the six centuries before 1895 (Verschuren et al., 2000). They may have also helped precipitate the 1910 Mexican Revolution (Neri and Briones, 2010). More recently, droughts were associated with riots in Morocco during the 1980s (Swearingen, 1992) and contributed to Eritrea's secession from Ethiopia in 1991 (Reuveny, 2007).
Environment	Droughts affect habitats, bodies of water, rivers and streams, and can have major ecological impacts, increasing species vulnerability and migration, and loss of biodiversity (Lake, 2003; NDMC, 2006; Shaw et al., 2010). Between 1999 and 2005, droughts contributed to the loss of at least 100,000 hectares of salt marshes along Florida's coastline (Silliman et al., 2005). In Spain, the 1991–1995 drought indirectly resulted in the draining of wetlands, causing saltwater intrusion of coastal aquifers; and the area affected by forest fires in southern Spain increased by 63 percent compared to the previous decade (Mestre, 2010).
Public spending	Downstream impacts indicate increased competition and conflict between different sectors of water users and a need for increased government spending on relief and compensation. In Andhra Pradesh, India for example, rice irrigation increasingly relies on pumped groundwater. As energy for pumping is subsidized by the government, this results in even lower groundwater levels, and rice cultivation also drains state funds and contributes to periodic blackouts (Lvovsky et al., 2006). The cost of food and non-food assistance provided in response to the 1991–1992 drought in ten southern African countries exceeded US$950 million, and during the 2007–2009 drought in Kenya, 70 percent of the population of one region depended upon food aid (Holloway, 1995; Galu et al., 2010).

3.4 Drought risk drivers

The impacts of drought point to a multitude of drivers that turn lower than average precipitation, limited soil moisture and low water levels into disaster events for vulnerable populations and economies. In the absence of a credible global drought risk model, case studies from around the world were commissioned for this report to identify factors that increase vulnerability and exposure, and that could translate drought hazard into risk in different situations.

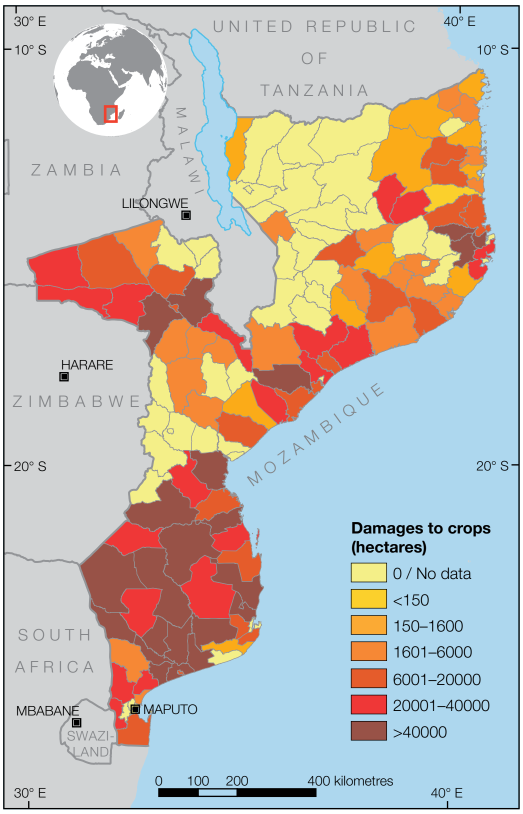


Figure 3.7

Drought-related crop damage in Mozambique, 1990–2009

(Source: INGC (Instituto Nacional de Gestão de Catastrofes), 2010)

3.4.1 Decreasing rainfall, climate variability and climate change

Rainfall has been decreasing in many regions in the past century. In areas with increasing water stress, even less intense drought episodes are now manifesting as agricultural or hydrological droughts. Areas that are most stressed in normal times will be the first to suffer drought impacts when deficiencies in rainfall occur (Table 3.3).

3.4.2 Poverty and rural vulnerability

Case studies from all regions confirm the findings from the *2009 Global Assessment Report*, that drought risk is intimately linked to poverty and rural vulnerability (Table 3.4) (UNISDR, 2009). From Brazil and Mexico to India and South Africa, they highlight that poor rural households whose livelihoods depend on rain-fed subsistence agriculture are very exposed and vulnerable to drought and least able to buffer and absorb its impacts. Rural poverty is thus both a cause and a consequence of drought risk. In many places, as the example of the Navajo Nation highlighted, people may have been forced to occupy marginal drought-exposed land, and may be unable to access irrigation technology or drought-resistant seeds that could reduce their vulnerability. Limited access to affordable credit and insurance further constrains their resilience.

For example, sub-Saharan Africa's water storage facilities are severely under-developed, with an average per capita storage capacity of 200 cubic metres per year, compared to 1,277 cubic metres for Thailand and 5,961 for North America (Grey and Sadoff, 2006; Foster and Briceno-Garmendia, 2010). Averages hide significant variations, however, with Ethiopia and South Africa having storage capacities of 38 and 687 cubic metres, respectively. The total capital needs for the development of adequate water infrastructure in sub-Saharan Africa for 2006–2015 was estimated to be approximately US$15 billion (Foster and Briceno-Garmendia, 2010).

For vulnerable rural households, even minor drought episodes can lead to yield losses and can have devastating impacts on already precarious and non-diversified livelihoods. Barely subsisting even in good years, many are unable to mobilize the necessary assets to

Table 3.3 Evidence and estimates of climate variability and change as a driver of drought risk

Climate scenarios in India	Maharashtra, India, is home to nearly 100 million people, with most working in the agriculture sector, mostly in small-scale and marginal farming (ECA, 2009). Agriculture here depends on rainfall for much of its water supply, so even a small decline in precipitation can threaten the food security of millions of people. An analysis of 22 climate models indicates that droughts that occur once every 25 years may return as often as once every 8 years in the coming decades (ECA, 2009).
Small-scale farmers affected by changing climates in sub-Saharan Africa	The IPCC Fourth Assessment Report reports that in South Africa, net crop revenues may fall by 90 percent by 2100, particularly affecting small-scale farmers (Boko et al., 2007). Parts of Mali already receive 200 mm less annual rainfall than 50 years ago, and a range of climate scenarios suggests increased drought frequency during the coming decades could reduce agricultural and livestock production by as much as US$300 million per year (ECA, 2009).
China's crop losses due to climate variability and change	Between 2004 and 2007, Chinese farmers lost nearly US$8 billion of crops to drought (McKinsey Climate Change, 2009). In the drought-prone north and north-east, annual crop losses to drought could be 6–7 percent of the total yield by 2030 due to expected decreases in precipitation during critical months of the growing season. In such a scenario, annual drought losses could be as high as US$9 billion in north-eastern China alone (McKinsey Climate Change, 2009).

Table 3.4 Evidence of poverty and vulnerability as drivers of drought risk

Lack of irrigation and water storage in Kenya and Brazil	In Kenya's Mwingi district, 70–80 percent of the population depend on rain-fed agriculture and livestock production for both food and income, and 60 percent subsist on US$1 per day or less (Galu et al., 2010). Therefore, when drought occurs it can wipe out income and investments, leaving communities with limited means to buffer losses. During the 2008–2009 drought, for example, 70 percent of the population depended on food aid, and although this relief successfully averted a food security crisis, it reveals the extreme vulnerability of rural agricultural and agro-pastoral livelihoods (Galu et al., 2010). In Ceará, Brazil, agricultural drought risk is concentrated amongst smallholder farmers whose livelihoods depend entirely on rain-fed agriculture, and who do not hold water rights or have access to irrigation and water-storage infrastructure. As a result, per capita GDP in such rural communities is only one third of those in urban settlements along the coast, and Human Development Index values of rural districts are less than 0.65, compared to 0.70 for Brazil as a whole (Sávio Martins, 2010; UNDP, 2010).
Expansion of intensive cash crop production and urbanization in Mexico	Mexico's water management and land tenure policies date back to the 1910 revolution and are based on communal ownership of land and water by smallholder farmers, known as ejido, 25 percent of whom live in abject poverty. The expansion of intensive market agriculture and urbanization has led to the forced sale of water rights, pushing the rural poor to farm marginal lands more intensively, increasing their drought risk further still (Fitzhugh and Richter, 2004). Today, the ejido cannot compete with large farmers and agribusinesses, and in Sonora their agricultural drought risk is increasing as nearly 75 percent of irrigation water is now allocated to this sector (Neri and Briones, 2010).
Limited access to credit in Honduras	In Honduras, 67 percent of the rural population are subsistence farmers, but only 2 percent have access to formal credit, which could facilitate investment in better equipment and provide protection from drought impacts (Brenes Torres, 2010). Drought losses in Honduras and other Central American countries cause increased school drop-out rates, rural debt, rural-to-urban migration, forced sale of lands, and increased unemployment (Brenes Torres, 2010).

buffer losses, and their welfare declines further still. Such impacts are self-reinforcing. They are most pronounced in poor communities, and each drought erodes livelihoods further, leaving households and communities more vulnerable to future droughts and other hazards (Wilhite and Buchanan-Smith, 2005). At the macro level, institutions may have little capacity to provide drought relief or compensation, or may have little accountability with ethnically and politically discriminated communities (Wilhite and Buchanan-Smith, 2005), with the result that agricultural drought impacts can turn into food security crises (Devereux, 2007).

3.4.3 Increasing water demand due to urbanization, industrialization and the growth of agribusiness

Urban and economic development per se is not a driver of drought risk. However, much development is planned and authorized without taking water availability into account, or without taking adequate measures for water management and conservation (Table 3.5). Case studies highlight that in already water-stressed areas and countries, the growth of intensive agriculture, urban development, tourism and other economic sectors leads to increased and conflicting demands for often declining water resources. This is a key driver of both hydrological and agricultural drought risk, but is seldom taken into account in development planning (Wilhite and Pulwarty, 2005).[4]

Competition for freshwater already exists and it is expected to increase as water demand continues to grow, alongside population growth and economic development. These two processes determine the relationship between water supply and water demand to a much greater degree than climate change (Vörösmarty et al., 2000). Total global annual water demand has tripled since 1960, and is currently increasing by 64 billion cubic metres every year (WWAP, 2009a). This growth has not happened evenly. Developed countries consume

Table 3.5 Evidence of accelerating water demand as a driver of drought risk

Accelerated water demand in the United States of America	Phoenix, Arizona, is running dry. Already by the 1940s, demand for water driven by population growth and economic development was outstripping supply (Fitzhugh and Richter, 2004). The Salt and Verde Rivers were dammed to increase availability but soon both rivers had run dry except after rains. While continuing to draw excessively from the region's aquifers, Phoenix began to transfer water from the Colorado River in 1980. By 2025, the city's population is expected to grow by another 50 percent (Fitzhugh and Richter, 2004), meanwhile, the IPCC Fourth Assessment Report indicates that this region will experience even more frequent and severe droughts (IPCC, 2007).
Impact of economic growth in China	China's economic growth has coincided with water shortages in the northern part of the country (WWAP, 2009a). Between 1949 and 2006, annual water demand in the Yellow River Basin increased from 10 to 37.5 billion cubic metres. This was driven by the expansion of irrigated agriculture which grew in area from 8,000 to 75,000 km^2 in the 50 years to 2000, and hydropower plants that now produce 40 TWh per year to meet growing demand from China's industrial sector (WWAP, 2009b). The impacts of such growth have made the region highly vulnerable to droughts. In the 1990s, springs in Jinan, "the city of springs", ran dry and from 1995 to 1998 there was no flow at all in the lowest 700 km of the Yellow River for 120 days of the year (WWAP, 2009b).
The effects of a growing leisure and tourism industry in Spain and the Caribbean	Per capita water use in the tourism industry is often 3 to 10 times greater than local demand (Fernandez and Graham, 1999), and overall consumption by the tourism sector is increasing dramatically (Iglesias et al., 2007; Farrell et al., 2010). As competition for water increases, it is often agriculture that loses out. In Spain, second homes and golf courses, alone, have increased water demand by 30 million cubic metres per year (Iglesias et al., 2007). Additionally, tourism leads to large seasonal variations in water use that can lead to hydrological droughts in peak seasons, often coinciding with drier, sunnier periods (Farrell et al., 2010). In the Mediterranean, the seasonal tourism industry increases overall annual water demand by at least 5–20 percent in affected communities (Iglesias et al., 2007; WWAP, 2009a). In Mallorca, the annual number of tourists almost doubled from 1989 to 2000 to 8 million, outnumbering the local population by more than 10 to 1. This meant that during the drought in the mid-1990s, the Government of Spain was forced to ship freshwater from the mainland at a cost of €42 million (Garcia and Servera, 2003; Iglesias, 2007). In the eastern Caribbean, many islands are already water scarce, with less than 1,000 cubic metres of water per capita per year. However, the 2009–2010 agricultural drought was due less to lack of rainfall than to restrictions imposed on agriculture as water was allocated to other sectors (Farrell et al., 2010).

more water per capita than most developing countries (Figure 3.9), and global trade has allowed some countries to externalize their water consumption. For example, Europe is a large importer of cotton, a water-intensive crop grown in many water scarce regions, defined as those with less than 1,700 cubic metres of water per person per year (WWAP, 2009a). By 2025, 1.8 billion people will live in countries or regions with water scarcity, and by 2030 nearly half of the world's population will live in areas with high water stress (UN-WATER, 2007; OECD, 2008).

Demand for industrial water use tends to increase with relative wealth. It can rise from less than 10 percent of total national demand in low- and middle-income countries to nearly 60 percent in high-income countries (WWAP, 2009a). Economic development, and tourism in particular, increases competition for water resources often in already water-stressed areas such as southern Spain or the eastern Caribbean.

3.4.4 Inappropriate soil and water management

Agricultural droughts have been recorded in parts of Bangladesh where mean annual rainfall is 2,300 mm, in Lao People's Democratic Republic where rainfall is 3,200 mm, and in Cambodia where an SPI of +2.7 corresponds to an excess of water and potential flooding (Shaw et al., 2010). However, Table 3.6 shows that precipitation and SPI values do not reflect water availability in reservoirs, rivers and

Box 3.3 Trends in aridity since 1900

Evidence indicates that the world has become increasingly dry during the past century. Certainly since the 1970s, aridity has increased in parts of Africa, southern Europe, East and South Asia and eastern Australia, shifting baseline precipitation data and further complicating the ability to monitor droughts (Trenberth et al., 2007; Dai, 2010). For example, from the 1950s to the 1980s, the percentage of the land surface classified as 'dry' was 10–14 percent, rising to 25–30 percent during the past decade (Dai, 2010). One reason is that warmer air and surface temperatures have increased evaporation.

Century-long global precipitation trends measured using the monthly Palmer Drought Severity Index (Figure 3.8) reveal a general drying trend in Sahelian and southern Africa, central Brazil, southern Europe, Iran (Islamic Republic of), Indonesia, north-east China, and north-east Australia (Trenberth et al., 2007).

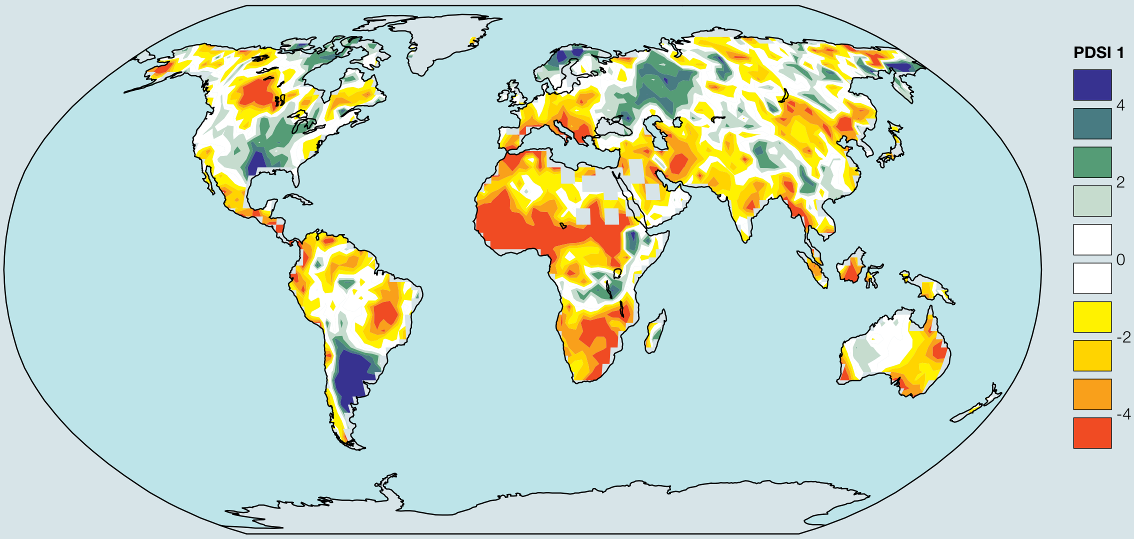


Figure 3.8
Global precipitation trends since 1900 measured using the Palmer Drought Severity Index (PDSI)

(Source: Adapted by UNISDR from Dai et al., 2004)

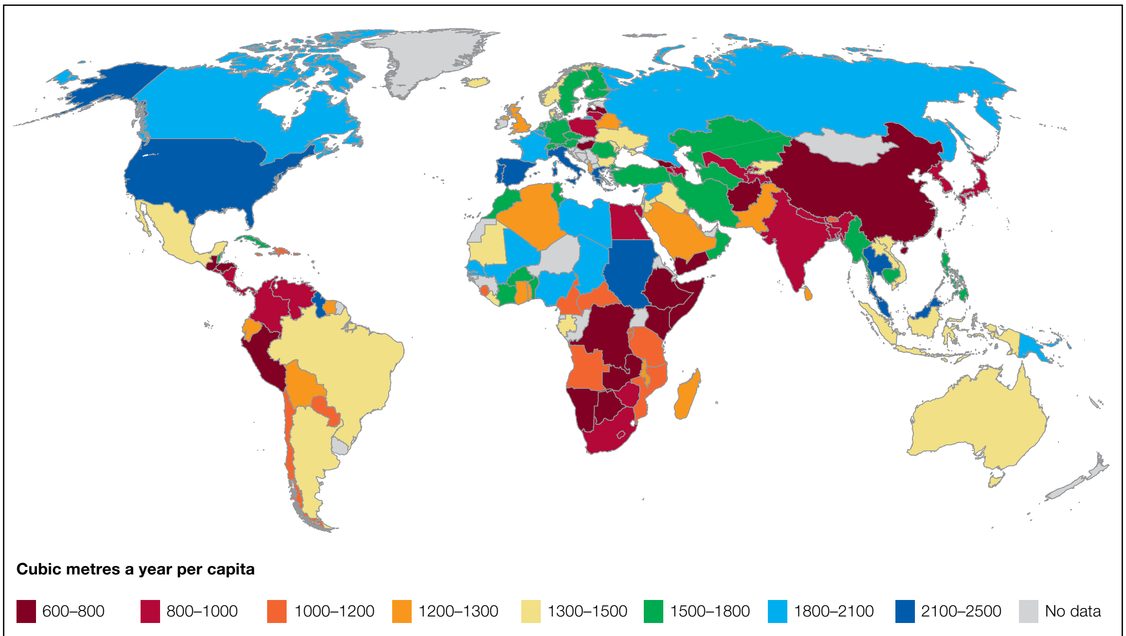


Figure 3.9
Average national water consumption per capita (1997–2001)

(Source: Hoekstra and Chapagain, 2008 (modified and cited in WWAP, 2009a))

Table 3.6 Evidence of inappropriate water and soil management as drivers of drought risk

Introduction of water-intensive crops in Saudi Arabia	In the 1970s, the Government of Saudi Arabia instituted a policy of self-sufficiency in wheat production and subsidized production accordingly. From 1972 to 1991, land used for agricultural production grew from 0.4 million to 1.6 million hectares (Saudi Arabia, 1992), and by the early 1990s it had become the world's sixth-largest wheat producer. In 1992, domestic wheat production of 4.25 million tonnes easily surpassed national demand of 1.22 million tonnes (Abderrahman, 2001; Karam, 2008). This depended upon irrigation and extraction of ground water that from 1980 to 1992 grew from 1,850 to 29,826 million cubic metres per year (Saudi Arabia, 1990; Dabbagh and Abderrahman 1997), threatening the country with unprecedented drought. The wheat self-sufficiency policy became so expensive and drained aquifers so dramatically that it was eventually abandoned. Saudi Arabia now intends to depend completely on imported wheat by 2016 (Karam, 2008).
Shifting production patterns and deforestation in Viet Nam	Rainfall in the Ninh Thuan province of Viet Nam has been increasing over time. Droughts have become more common, however, because rainfall is becoming more variable and demand for water is increasing, and is expected to increase, in every sector of the economy (Shaw et al., 2010). Agricultural demand is the largest contributor to water withdrawals, and is predicted to grow by 150 percent between 2015 and 2020, while demand for aquaculture, industry and environment needs will double. Deforestation and shifting production patterns (e.g., more shrimp farming) have further reduced supply and increased demand. In the past 40 years, per capita annual water availability in Ninh Thuan has fallen from 17,000 to 4,600 cubic metres (Tinh, 2006), leading to a 'water war' between agriculture, aquaculture, industry and tourism.
Overgrazing and rangeland management in Mexico	The management of rangeland is equally challenging for effective drought risk management. Many ranchers overgraze, and in Sonora, Mexico, herd sizes may be double to triple the carrying capacity of the land (Neri and Briones, 2010). This problem was observed in the Navajo Nation despite restrictions on herd size, which has as much to do with choice of livestock as the environmental conditions (Redsteer et al., 2010).

canal systems, highlighting once again why meteorological drought is not always an accurate indicator of drought hazard.

3.4.5 Weak or ineffective risk governance

Case studies highlighted weak or ineffective risk governance capacities to address drought risks, and few countries besides Australia and India have developed national drought risk policies or frameworks (Table 3.7). Progress is nonetheless being made in drought risk management, especially in forecasting, early warning, preparedness, response and the development of compensatory mechanisms such as insurance and temporary employment programmes. Early warning is a crucial component of drought risk management, and seasonal forecasts and climate models inform decisions about what and when to plant. However, insurance and risk transfer mechanisms may not always be available to poor rural households who most need them to offset their risks. Also, compensatory measures like drought relief may actually reward poor resource management and punish planners who employ proactive drought mitigation policies that leave them ineligible for assistance (Wilhite and Pulwarty, 2005).

3.5 From drought hazard to drought risk

Given that drought impacts are not systematically recorded and the data constraints for modelling drought hazard, it is still not possible to develop global drought risk models. Building such models at all scales is important to increasing the visibility of the risk and for building political and economic imperatives for drought risk management.

Table 3.7 Evidence of low risk governance capacity as a driver of drought risk

Low priority given to drought by governments in Mexico	Of the 16 million hectares of agricultural land in Sonora, Mexico, 87 percent are rain-fed and highly vulnerable to agricultural drought and account for 70 percent of agricultural production (Neri, 2004; Neri and Briones, 2010). Nevertheless, there is no drought early warning system or any systematic recording of drought impacts. A stakeholder survey revealed that this was not due to a lack of meteorological data or an inability to create seasonal drought forecasts, but reflected the low priority given by the authorities to drought risk management and poor rural communities (Neri and Briones, 2010). In Sonora, there is no drought risk management policy framework, and issues such as water resources and rangeland management fall through the cracks between the civil protection authorities who focus on emergency response, and other government departments.
Fragmented responsibilities for drought risk management in Viet Nam	In Viet Nam, government institutions address the risks associated with annual floods and tropical cyclones, but they are less well equipped to reduce and manage drought risks. Responsibility for drought risk is centralized within the national government, but the management of drought risk drivers falls between different institutions responsible for managing forests, agriculture, water and land use (Shaw et al., 2010).
Weak local drought risk governance capacities in Bangladesh	North-western Bangladesh receives 1,329 mm of rainfall per year, half the national average, and is prone to frequent droughts which local governments are mostly ill-equipped to manage. Drought risk relates to household resilience, but also to the institutional capacity of local governments. The local governments of Tanore and Shibganj have very low institutional resilience. They have not incorporated drought risk into disaster management plans, not developed effective drought risk management policies, training or demonstration programmes, and have weak coordination with other government institutions and NGOs (Shaw et al., 2010; Habiba et al., 2011). Even during droughts, local disaster management committees in these sub-districts have not engaged in public awareness programmes or run household level disaster drills.
Conflict and excess water use in Morocco	The lack of effective drought risk management is often aggravated by inadequate institutional and financial capacities, particularly in local government (Shaw et al., 2010). To manage scarce groundwater more efficiently during droughts, Morocco enacted a series of reforms, which included the privatization of water rights during the 1990s. The new policies conflicted with tribal customs and religious views and, due to the government's inability to ensure compliance, overexploitation of groundwater continued (Doukkali, 2005).

In the same way that meteorological drought is not synonymous with drought hazard, agricultural and hydrological drought hazard are not synonymous with risk. As with other hazards, the translation of drought into risk depends on factors related to vulnerability and exposure.

Developing models for drought similar to those already used to analyse risk trends for tropical cyclones and floods (see Chapter 2) is still not possible due to lack of sufficient and suitable data, and previous attempts to model global drought risk (see Box 3.4) produced unsatisfactory results.

Initiatives such as the National Drought Monitor in the United States of America, FEWS Net, AGRHYMET, and the Sahara and Sahel Observatory (OSS) in Africa, the International Water Management Institute's (IWMI) PODIUM and FAO's AquaCrop models, and studies by the World Bank in India (Box 3.5), show how drought risk can be modelled in specific contexts when data is available. Systematically accounting for drought losses and impacts and building credible drought risk models at all scales, from local to global, is important to increasing the visibility of drought risk and building political and economic imperatives for its reduction.

As this chapter has shown, drought risk is at least in part socially constructed, and characterized by numerous feedback loops between the different drivers. For example, the lack of systematic recording of drought losses and impacts, particularly those affecting poor and vulnerable rural households, contributes to its reduced political and economic visibility, reflected in only weak imperatives to address underlying risk drivers and strengthen risk governance. Policies to promote economic and urban development in water-scarce areas may

Box 3.4 Modelling global drought risk

The mortality drought risk index proposed by UNDP (UNDP, 2004) was unsuccessful because most droughts do not produce fatalities, and most internationally recorded drought mortality is concentrated in countries experiencing conflict or political crisis. Only weak correlations were found between the population exposed to meteorological drought and the mortality attributed to drought (UNDP, 2004). Drought impacts on human development could provide more suitable criteria than mortality for calculating human risk. However, while such impacts are sometimes recorded in certain locations (de la Fuente and Dercon, 2008), systematic national data is not available to calibrate a global risk model.

A World Bank study (Dilley et al., 2005) was more successful in that it produced global risk maps for both mortality and economic loss risk. Risk was calculated as a function of the exposure to meteorological drought of population density and national agricultural GDP, with a proxy indicator of vulnerability calibrated using recorded mortality and economic losses for each geographic and income region. The accuracy of the results is questionable, however, given that meteorological drought is not a good representation of hazard and, as described above, mortality is not an adequate metric to model impacts on humans.

Box 3.5 Modelling agricultural drought risk

A study by the World Bank (Lvovsky et al., 2006) quantified long-term agricultural and macro-economic impacts of droughts in Andhra Pradesh, India, using catastrophe modelling techniques with a range of drought risk management strategies. By analysing meteorological and agricultural data over 30 years, the effect of mild, moderate and severe droughts was measured on five different crops (rice, groundnut, sunflower, maize and sorghum) in the eight most drought-prone districts of Andhra Pradesh, including average annual and probable maximum losses.

First, the frequency and severity of meteorological drought at different locations was modelled using historic data and a stochastic weather generator (WXGEN) simulating 500 years of weather. Modelled droughts were classified using a seasonal (June–December) SPI computation and validated against historical data. Vulnerability and exposure were analysed using crop-yield and planting-area models to quantify damages to each crop based on the intensity and duration of droughts. Drought impacts on livestock production were also tested but results were inconclusive. The crop-yield model incorporated 47 parameters calibrated to the crops and environmental conditions in each district. The planting-area model was used to capture rainfall variability, including both irrigated and rain-fed cultivation.

Average yield and average annual losses for each crop for the 500-year time series were then computed, and the effect of drought intensity and duration on each crop converted to monetary losses based on market prices. Compared to simulated 'normal' years, analysis revealed that production losses exceeded 5 percent every 3 years, 10 percent every 5 years, 15 percent every 10 years and 25 percent every 25 years. Individual farmers and especially small farmers may experience much greater losses depending on their crop mix and the severity of drought in their particular location.

(Source: Lvovsky et al., 2006)

transfer drought risk to smallholder farmers. Drought-relief programmes that compensate for short-term impacts may increase dependence on relief and increase vulnerability in areas that may become more drought-prone with climate change.

International efforts to develop and apply standards for drought identification and monitoring are an important starting point to address drought risk. They need, however, to go alongside the development of mechanisms to systematically account for drought losses and impacts, and that comprehensively assess and estimate drought risks as a crucial next step to raising the profile of drought risk.

Forecasting, early warning and compensatory measures such as insurance are critical elements of drought risk management. However, to address the underlying drivers of drought risk, countries will have to strengthen and reorient other risk governance capacities, particularly those related to development planning and land and water management. There are often powerful political disincentives against addressing issues such as water rights and land use, but with ever-increasing drought impacts and losses, the imperative to seriously manage drought risk may soon outweigh these disincentives.

Notes

1 At a meeting in June 2010 convened by the World Meteorological Organization and the United Nations secretariat of the International Strategy for Disaster Reduction hosted by the Hydrographic Confederation of Segura.

2 Work is underway to develop a composite hydrological drought index that takes into account factors including stream-flow, precipitation, reservoir levels, snow pack, and groundwater levels.

3 The multiple impacts of hazards on vulnerable livelihoods were addressed in detail in the *2009 Global Assessment Report* (Chapters 3 and 4) and its background papers (de la Fuente and Dercon, 2008; Sabates-Wheeler et al., 2008; UNISDR, 2009), with a specific emphasis on how drought and rural poverty interact with each other in a way that locks in the vulnerability of these communities.

4 Some exceptions to this are more strict building standards to reduce water use. For example, approximately 40 percent of the benefits generated through New York City's Green Infrastructure Plan (2010) to improve water quality and reduce water consumption and runoff, will be achieved through new development (New York City, 2010).

GAR 2011

Chapter 4

Progress against the Hyogo Framework for Action

The Oosterschelde Storm Surge Barrier, built in response to the North Sea Flood of 1953, is the largest of a series of dams designed to protect the Netherlands from flooding. *Photo:* iStockphoto®, © GAPS

Chapter 4 Progress against the Hyogo Framework for Action

National governments report major progress against the objectives and goals of the Hyogo Framework for Action (HFA), particularly in strengthening disaster management and the institutional and legislative arrangements and mechanisms that underpin it. Significant momentum in the implementation of the HFA is also being generated through the development of regional and sub-regional strategies, frameworks, plans and programmes. Although early warning systems can be further improved, investments in enhancing preparedness and response are paying off. As highlighted in Chapter 2, weather-related disaster mortality is now declining.

In contrast, many governments and regional organizations find it difficult to address the underlying risk drivers. Despite a manifest commitment to disaster risk management (DRM), few countries systematically account for disaster losses and impacts or comprehensively assess their risks. The political and economic imperative to invest in DRM remains weak, with few countries reporting dedicated national budget lines or adequate financing for risk reduction.

Factoring DRM into national and sector planning and public investment is a particular challenge for many countries, as is the use of social protection to help vulnerable households and communities. Whereas many countries reported improvements in their legislative and institutional arrangements and have decentralized functions to local government, this is not necessarily leading to more effective implementation. In addition, gender considerations must be better incorporated into DRM across all geographic and income regions.

This chapter is based on reports submitted by national governments as part of the HFA Progress Review process through the HFA Monitor. It does not present any additional information or attempt to triangulate the information provided by countries, but demonstrates how governments perceive their country's progress and the challenges they face. Moreover, it is a representation of countries' inputs into the risk reduction and management process rather than a reflection of outcomes, which to a large extent will only be measured against reduced losses in the future.

4.1 The 2009–2011 HFA Progress Review

The HFA Progress Review enables countries to reflect on past efforts, future challenges and opportunities in DRM. By offering a framework for analysis, it catalyzes both strategic and action-oriented planning.

The HFA is a comprehensive set of actions that a country can take to strengthen its risk governance capacities. The HFA Progress Review allows countries to reflect on their efforts to strengthen their capacities and to identify strengths and gaps (Box 4.1). By offering a framework for analysis, it catalyzes both strategic and action-oriented planning. Where governments have made serious efforts to engage key public, civil society and academic stakeholders in the review process, communication and consensus building have improved (see Box 4.2). Most importantly, the discussion of indicators helps generate a common language and understanding, thus fostering real dialogue.

Although the HFA Monitor does not measure risk governance capacities directly, it identifies successes and highlights challenges, irrespective of a country's starting point. The national reports do not provide in-depth reasons for progress or lack thereof, though a number of countries provide information on the underlying drivers and barriers to progress. It is also important to note that countries are addressing the HFA from very different baselines. There are enormous objective differences between,

Box 4.1 The HFA Monitor

In 2005, 168 member states endorsed the Hyogo Framework for Action (HFA), which aims to achieve a substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of countries and communities by 2015.

The HFA Monitor is a multi-tier online tool for regional, national and local progress review, facilitated by UNISDR and led by country governments. Achievements in each core indicator are rated on a scale of 1 to 5, with 1 representing 'minor' achievement and 5 indicating 'comprehensive' achievement.[1] For the current review period, several questions have been added to allow more in-depth analysis. It also gives governments the opportunity to assess their achievements and challenges, and to upload relevant documents, such as legislation and reports.

More than 100 countries and territories used the HFA Monitor in 2007–2009, and 133 are participating in the 2009–2011 review. The process is led and owned by inter-governmental organizations, governments and local government institutions at regional, national and local levels, respectively. Many governments are engaged in consultation across key sectors, including agriculture, water, transport, health and education. For example, the review in Panama involved more than 43 actors from different ministries, including external relations, economic planning, education, housing and land management; the private sector; and civil society, including universities. In Cuba, the national statistics department, the ministry of information and communication, and the transport ministry are all involved in the process.

The quantitative and qualitative data in this section are derived from the HFA Monitor and are based on the 82 reports submitted up to February 2011 by the relevant authorities for the period June 2009 to May 2011.

Box 4.2 Using the HFA Monitor to reflect on the past and plan for the future in Indonesia[2]

In Indonesia, the National Platform for Disaster Risk Reduction (NPDRR) is an independent forum that was established to support and facilitate cooperation among stakeholders in the HFA Progress Review. During the 2007–2009 review period, the role of the NPDRR remained limited because of its relatively weak status as a new organization. During the 2009–2011 review period, however, the National Platform was able to lead in the process.

Using the HFA Monitor tools provided by UNISDR, the NPDRR accommodated many different actors working in disaster risk management, and began a series of activities in support of the review process. With the HFA Monitor template as a starting point, the NPDRR organized focus-group discussions and national workshops to review progress.

Coordination among local platforms, international NGOs, the International Federation of Red Cross and Red Crescent Societies (IFRC) and UN agencies allowed a final draft report to be completed and submitted to UNISDR. Many stakeholders contributed to this process by providing in-kind and financial support for meetings and facilitation. The report has led to three major outcomes:

1. A HFA Monitor report that has generated a better understanding of the HFA and its relevance to DRM and development in Indonesia.
2. A multi-stakeholder dialogue that brings together different government departments, NGOs and international organizations, the media and business sector. The NPDRR aims to involve even more government stakeholders in the next review.
3. A common language, vision and understanding of the responsibility for disaster risk reduction in Indonesia.

for example, the risk governance capacities of Switzerland or New Zealand and Afghanistan or Haiti (see Box 4.6).

Regionally, 58 percent of the countries and territories in the Americas, 72 percent in Asia, 61 percent in Africa, 53 percent in Europe, and 28 percent in Oceania participated in the HFA Progress Review (Figure 4.1).

The number and quality of the reports and associated documentation indicate continued and increased commitment to the HFA, which now constitutes the single most important source of information on DRM at the country level. It also provides a unique insight into where governments themselves see significant achievements and identify remaining gaps.

For this review period, local and regional monitoring frameworks, with attendant indicators, have also been developed. In light of the fact that local governments often have widely differing risk governance capacities, the national averages reported by the HFA Monitor hide large discrepancies in capacities among different areas within a country. For example, there are often dramatic differences between the capacities in a strong municipal administration in a capital or large city and those in weakly resourced localities in remote rural areas. The local monitoring framework factors local government contributions and community perspectives into national planning.

Municipalities and cities that have signed up to the 'Making Cities Resilient' campaign[3] have access to the Ten Essentials – a checklist that helps them monitor their progress in managing disaster risks. The Ten Essentials are aligned to the local indicators, thus allowing local progress to be highlighted (Box 4.3). The regional framework has also aided reporting by regional inter-governmental organizations.

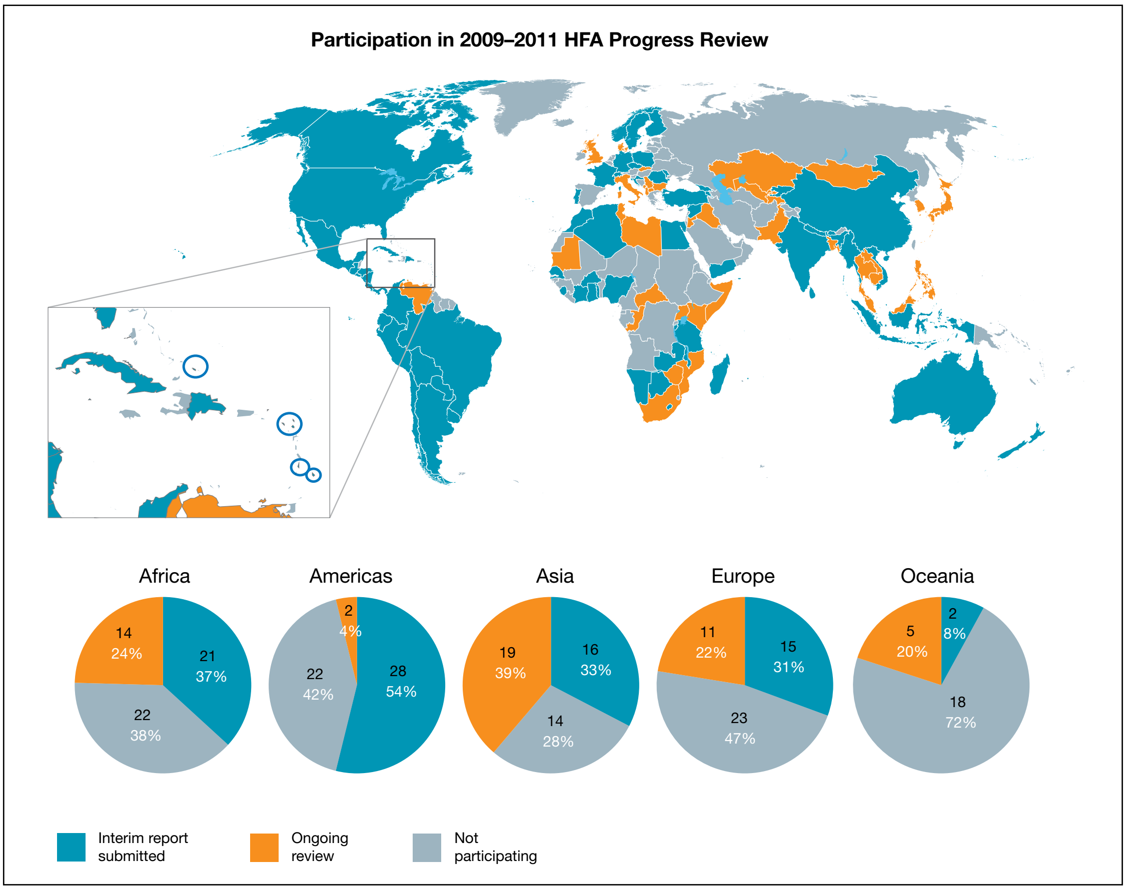


Figure 4.1
Regional distribution of participation in the 2009–2011 HFA Progress Review

Box 4.3 Using the HFA Monitor at the local level in the Philippines[4]

Albay Province in the Philippines applied the local-level HFA Monitor indicators in 2010 and assessed its progress as a province at 4.6 (with 1 representing minor achievement and 5 indicating comprehensive achievement). A good example of Albay's commitment to DRM is its allocation of more than 4.5 percent of its 2010 budget to risk reduction and climate change adaptation.

Albay was used as a model for the Philippine Disaster Risk Reduction and Management Act of 2010, which requires a Disaster Risk Reduction and Management Office in every local government unit. The province has 25 permanent emergency research and disaster specialists, and risk mapping is a common and essential tool for all existing hazards. Early warning systems are in place and communications chains are clarified and tested. Safe schools and hospitals are a major priority. Whereas Albay is exposed to multiple hazards (typhoons, volcanic eruptions, landslides and floods), its governor, Joey Salceda, pioneered the 'zero casualty policy' with pre-emptive evacuation and a clear business-continuity plan for both government and the private sector.

Governor Salceda states that "disaster risk reduction is an investment, not a cost. It increases business returns", particularly where critical infrastructure is effectively protected. Albay has seen a surge in investments in recent years, despite typhoons Reming and Milenyo, and the Mayon Volcano eruption. The Province is currently developing a Framework Plan that will emphasize reducing risks to its infrastructure.

4.2 Global overview of disaster risk reduction efforts at national and regional levels

Most countries find it difficult to comprehensively assess their disaster risks and to factor risk assessment information into national planning, investment and development decisions. At the same time, they highlight achievements and innovative practices that can drive change and provide political and economic incentives for DRM.

The global overview is based on the analysis of the interim review reports shared by the participating governments as of 7 January 2011. A total of 133 countries and territories carried out the review process, 82 of which shared their interim reports.[5]

The *2009 Global Assessment Report* (GAR09) (UNISDR, 2009) indicated that although many countries' disaster management capacities were increasing, far less progress was being made towards addressing the underlying drivers that are increasing countries' stock of risk. The evidence to support this finding is even stronger in 2011. With notable exceptions, countries find it difficult to comprehensively assess their disaster risks and to factor risk assessment information into national planning, investment and development decisions. However, they also highlight achievements and innovative practices that can drive change and provide political and economic incentives for DRM.

4.2.1 An overview of global trends

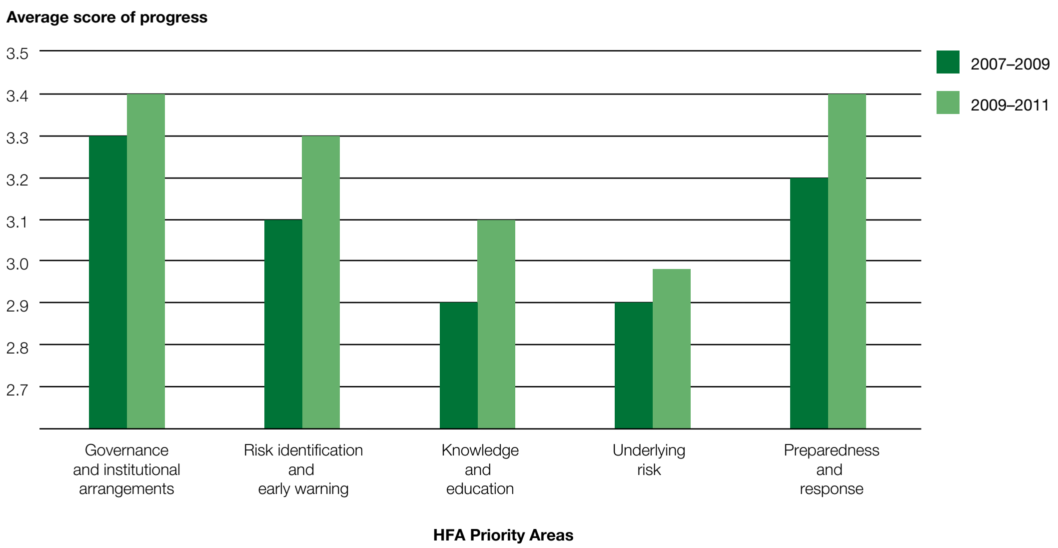
GAR09 highlighted that national efforts were mainly focused on strengthening policy, legislation and institutional frameworks, along with boosting capacities for risk assessments, early warning and disaster preparedness and response (HFA Priority Areas 1, 2 and 5). In contrast, countries reported limited progress in using knowledge, innovation and education to build a culture of resilience, as well as to address the underlying drivers of risk (HFA Priority Areas 3 and 4).

The 2009–2011 Progress Review indicates improvement across in all priority areas. However, progress in HFA Priority Area 4 (underlying risk) continues to be particularly challenging, as highlighted in Figure 4.2 (GNDRR, 2009; UNISDR, 2009, 2011).

The global overview and more detailed analysis provided in this chapter do not account for the significant linkages between the different HFA Priority Areas. The HFA itself, while outlining three strategic goals and five priority areas, highlights the need to ensure that progress in one area supports efforts in others. These

Figure 4.2

Global averages of progress against the HFA: average ratings on a score from 1 (minor achievement) to 5 (comprehensive achievement) as reported



synergies can be found in practice, but progress in some areas, such as policy development, does not automatically trigger improvements in others, such as the ability to address the underlying drivers of risk. Although global averages do not give an accurate picture of progress in any particular country, mapping global progress does highlight areas in which more effort is required (Figure 4.3).

Progress in HFA Priority Area 1 (*Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation*) has been consistent across the world. More than 42 of the 82 reporting countries and territories reported substantial or comprehensive achievement in this priority area. Specifically, 48 countries reported substantial achievement developing national policy and legal frameworks. Importantly, almost half of these are low- or lower-middle-income countries.[6] However, a number of countries also highlighted that this progress does not necessarily translate into effective DRM. This is consistent with the findings from the HFA Mid-term Review, which reported notable progress setting up institutional structures and developing plans, but limited improvements in adequate resourcing and local implementation (UNISDR, 2011).

The institutional arrangements for DRM in many countries have certainly evolved, from traditional single-agency 'civil protection of defence' structures to multi-sector systems and platforms. However, finding appropriate institutional arrangements to ease the incorporation of DRM into development planning and public investment remains a challenge.

Currently 73 national platforms for coordination of DRM exist globally (as of February 2011). These platforms vary widely in terms of their authority, membership and history. In some cases existing disaster management organizations have been nominated as national platforms; in other cases they are an advisory or consultative mechanism to foster cross-sector coordination and to involve civil society and academic organizations. Only 55 countries confirm that civil society and relevant development sectors are represented in their national platforms, and only 37 scored level 4 or 5 on the functioning of national multi-sector platforms for DRM.

For HFA Priority Area 2 (*Knowledge of risk at national and local level*), comprehensive risk assessments remain elusive, particularly at the local level. More than half (46) of the reporting countries have undertaken national multi-hazard risk assessments that could hypothetically inform planning and development decisions. However, many countries faced major challenges linking these to development processes at the national and local levels. The HFA Mid-term Review also reflects that scientific assessments, useful as they are, rarely connect with assessments of community-level vulnerability and capacity.

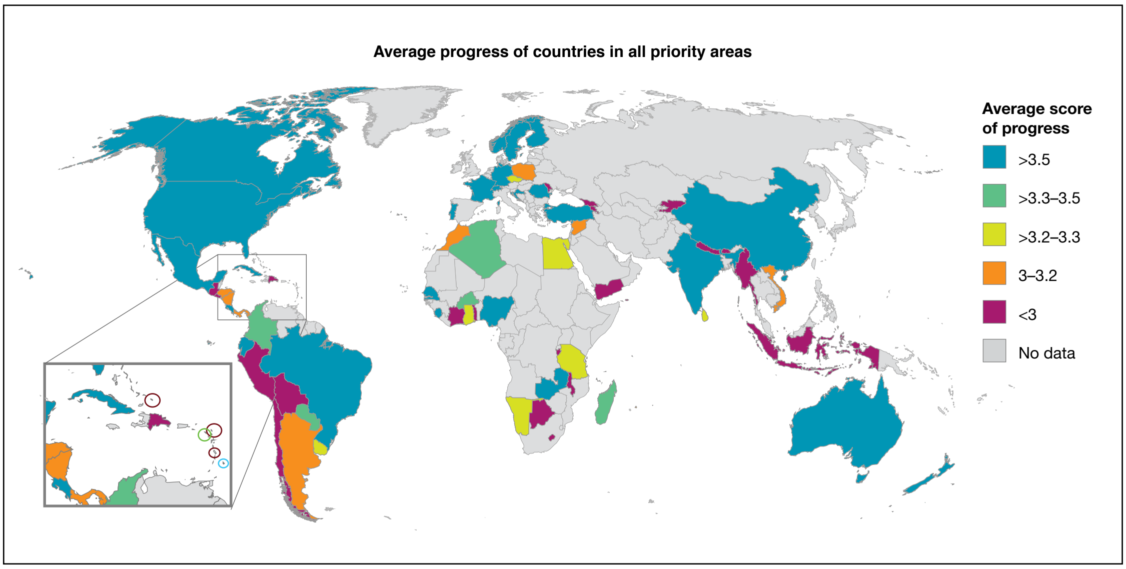


Figure 4.3
Global progress and remaining gaps as reported

Unfortunately, countries that reported substantial progress in this area also highlight an absence of national standards for assessing both disaster losses and risks. In particular, few countries carry out risk assessments of schools and health facilities. The overwhelming majority of countries (65 out of 82) do not collect gender-disaggregated vulnerability and capacity information.

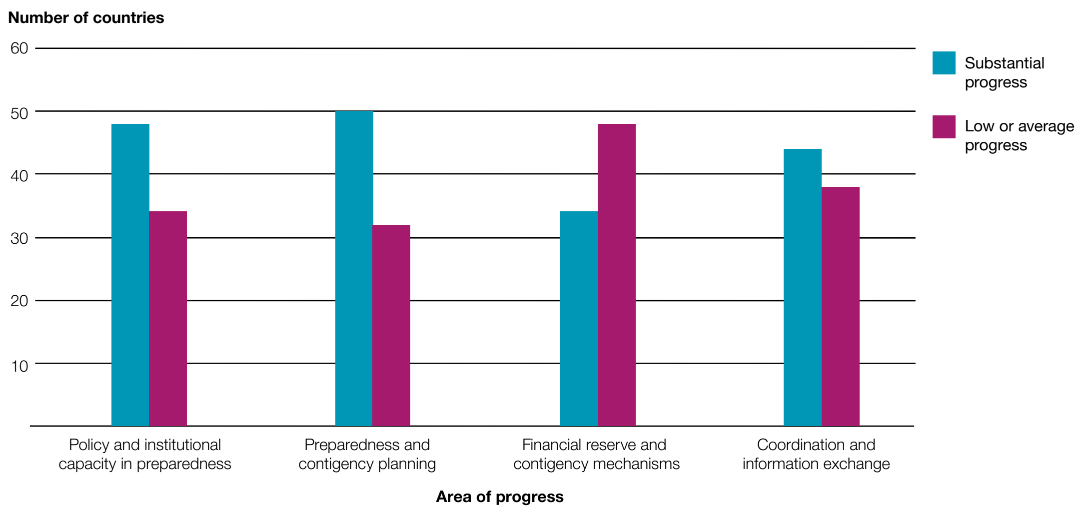
The use of new technologies has been a key driver in the substantial progress reported on early warning. However, difficulties with all components of the early warning system or chain potentially limit corresponding improvements at the local level. The HFA Mid-term Review also indicated that more progress has been made on warning for major hazards than on developing relevant local systems and communicating early warning of recurrent extensive risks through appropriate channels.

HFA Priority Area 3 (*Use knowledge, innovation and education to build a culture of safety and resilience at all levels*) continues to show limited progress. Identifying and further developing methods and tools for multi-risk assessments and cost–benefit analyses remains a particularly weak area, with only 19 of 82 countries scoring level 4 or 5. Less than a third of reporting countries rated as substantial or comprehensive their efforts to integrate risk reduction into school curricula and relevant formal training. The majority of countries reported significant gaps in developing public awareness strategies for, and communicating risk to, vulnerable urban and rural communities.

Progress in HFA Priority Area 4 (*Reduce the underlying risk factors*) is even lower. Although countries reported a greater awareness of the need to factor DRM into planning and investment, less than a third (28 percent) rated their progress towards addressing the underlying risk drivers at 4 or 5. Countries reported difficulties addressing the risks internalized in the different development sectors; as highlighted in the previous chapter, this explains why economic loss and damage continue to increase. Only 40 percent of countries, including only a quarter of low-income countries, invested in retrofitting critical public infrastructure such as schools and hospitals.

HFA Priority Area 5 (*Strengthening disaster preparedness for effective response*) has been the dominant focus of national governments for decades. This area encompasses disaster preparedness and contingency plans at all administrative levels, financial reserves and contingency mechanisms, and well-established procedures for information exchange during emergencies. More than half (46 of 82) of the countries reported substantial or comprehensive achievement developing policy, technical and institutional capacities (Figure 4.4). It is clear that effective disaster management has contributed to the decline in weather-related disaster mortality highlighted in Chapter 2.

Figure 4.4
Global progress reported in disaster preparedness



More than 80 percent of countries indicated that they have contingency plans and procedures to deal with major disasters. Around the same proportion also have operations and communication centres, search-and-rescue teams, stockpiles of relief supplies, and shelters. More than two-thirds (58 of 82) of the reporting countries possess agreed methodology and procedures for assessing damage, loss and needs when disasters occur. Almost two-thirds (53) of the countries boast national programmes and policies for making schools and health facilities safe in emergencies.

Despite this partial success, much more needs to be done. Financial mechanisms for managing disasters remain weak, fragmented and uneven. As also confirmed by the HFA Mid-term Review, few countries have contingency funding mechanisms in place, particularly at the local level. Even though 58 countries have financial mechanisms for managing disasters, and 46 have contingency funds, more than half (46) of the countries indicated only weak or average overall progress in this area.

4.3 Gaps and challenges in early warning systems

Translating warning into concrete local action is crucial, even in countries with effective capacities for forecasting, detecting and monitoring hazards and suitable technologies for disseminating advance warnings. In many countries, even accurate, timely early warnings were often not acted upon effectively.

Good overall progress in disaster management is one of the HFA's major achievements, but challenges remain in the implementation of effective early warning systems. For such systems to be effective, four elements must be in place: accurate hazard warning; an assessment of likely risks and impacts associated with the hazard; a timely and understandable communication of the warning; and the capacity to act on the warning, particularly at the local level. Countries do not report progress on early warning for specific hazards. Results predominantly reflect progress reporting on early warning for fast-onset events such as cyclones, certain types of floods and landslides.

Overall, half of the countries reported substantial achievements (Figure 4.5), but most of these included limitations in capacities and resources (level 4). A small number reported comprehensive achievement with sustained commitment and capacities at all levels (level 5). Since the last reporting period (2007–2009), progress has been made across all regions and income classes. Significantly, in 2011 only 8 percent of the countries reported minor or some progress (levels 1 and 2), compared with 18 percent in 2009.

Although 75 percent of countries reported that communities receive timely and understandable warnings of impending hazards, they also highlight a lack of communication systems and arrangements for ensuring that early warnings are acted on successfully. Forty percent of the countries indicated that two or more of the four elements of an effective early warning system are missing; 55 percent reported that at least one element is missing (Figure 4.6). These findings make it clear that most countries must strengthen their capacities in this area.

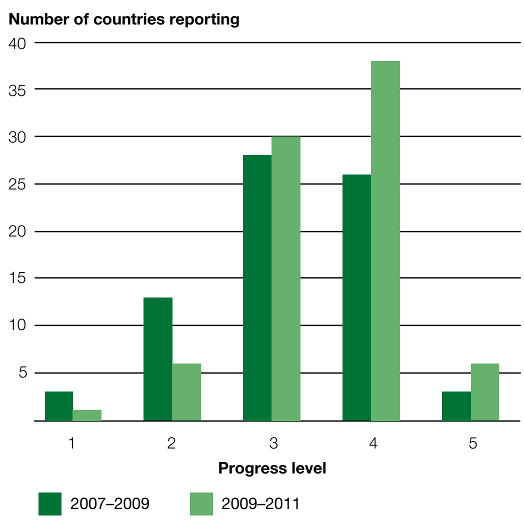
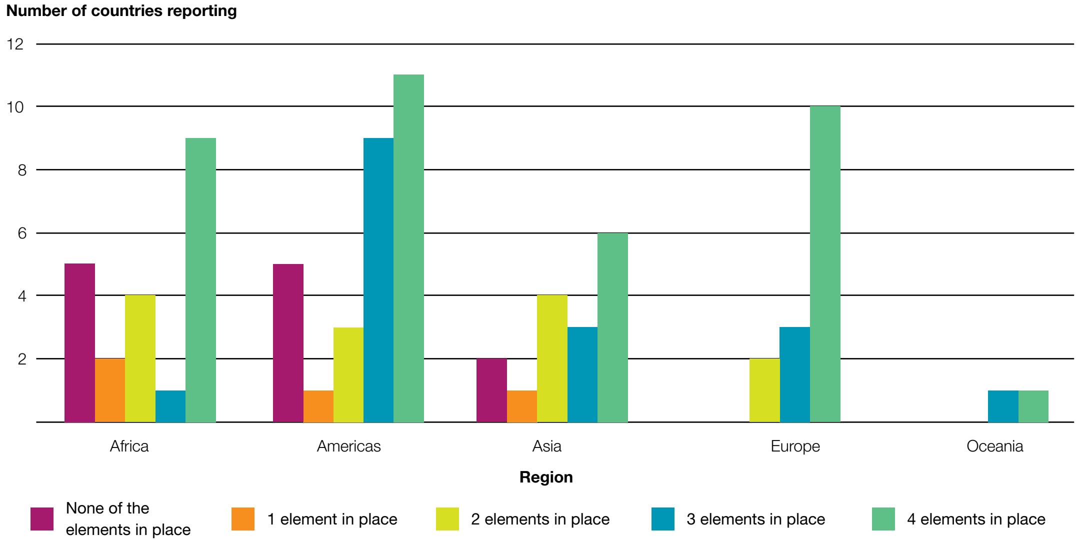


Figure 4.5
Progress level reported against core indicators for early warning for both reporting periods

Figure 4.6

Progress reported by countries on key elements of early warning



Many countries reported a need to strengthen national plans, coordination mechanisms and legislation for effective early warning systems, thus echoing the findings of earlier studies (WMO, 2009). For example, although authorities may be capable of disseminating early warnings, the warning dissemination chain is often not enforced through policy or legislation. Countries also reported difficulties in coordination, such as a lack of clarity about roles and responsibilities across institutions with responsibility for early warning for different hazards.

Perhaps the key challenge for all countries is translating warning into concrete local action, even for those with effective capacities for forecasting, detecting and monitoring hazards and suitable technologies for disseminating advance warnings. In many countries, even accurate, timely early warnings were often not acted upon effectively.

Countries reporting some progress but continued low levels of early warning capacity include Bahrain, Burkina Faso, Lesotho, the Republic of Moldova, Nepal, Sierra Leone, Togo and Yemen. Most of these countries also reported low levels of operational capacity, insufficient coverage of different hazard types, low institutional capacity, lack of resources, and difficulty issuing warnings to the very local level. Conversely, there were also several examples of countries developing innovative ways to communicate warnings to communities. Finland is developing digital radio networks for sharing information and data in emergencies, and also reaches 80 percent of its population with outdoor sirens. Australia and Madagascar are using mobile telephones to communicate warnings.

4.4 Understanding risks

Countries from all geographic and income regions reported three main obstacles to undertaking comprehensive risk assessments: limited financial resources; lack of technical capacity; and a lack of harmonization among the instruments, tools and institutions involved. Most countries also reported limited availability of data on localized losses, and difficulties connecting local disaster impact assessments with national monitoring systems and loss databases.

Disaster loss data is a prerequisite for understanding risk. Unless a country systematically records its disaster losses, measures the impacts and assesses its risks, then justifying investments in risk reduction will be difficult. The majority of countries (62 out of 82) did report having mechanisms in place to systematically report disaster loss and impacts. However, the associated challenges indicate that these mechanisms do not generate sufficient data, and suffer from fragmentation and limited accessibility. Where data-sharing protocols and mechanisms still do not exist, information remains scattered across various departments within the sector and does not provide a complete picture of national losses.

Producing reliable loss and impact information remains a challenge, especially after large disasters or in difficult environments, such as those encountered in Haiti and Myanmar. Moreover, this problem extends to localized losses, where most countries also reported limited data availability and difficulties connecting local disaster impact assessments with national monitoring systems and loss databases. For example, despite confirming that it systematically records disaster losses, Mauritius reported it had no quantitative data on the extent of damages caused by all hazards.

Also, as highlighted above, fewer than half of the countries undertook comprehensive multi-hazard risk assessments and less than a quarter did so in any sort of standardized way. Many high-risk countries, such as Armenia, Colombia, Comoros, Dominican Republic, Ecuador, Guatemala, Turkey and Viet Nam, reported little progress on multi-hazard risk assessment and identification. There are two reasons for this: in some of these countries such initiatives may have just begun; in others, such as Turkey and Colombia, it more likely reflects a growing and sophisticated understanding of the complexity of the challenge.

The European Commission has recognized this complexity and has developed and adopted guidelines for mapping and assessing risk, based on a multi-hazard and multi-risk approach. Canada is currently developing an all-hazards risk assessment framework that will become part of the country's emergency planning system. Romania has plans for an East European Multi-Risk Management Centre. A number of countries also made efforts to integrate risk assessments into a range of sectors, including health, education, agriculture, transport and water management.

Countries from all geographic and income regions reported three main obstacles to undertaking comprehensive risk assessments: limited financial resources; lack of technical capacity; and a lack of harmonization among the instruments, tools and institutions involved. These challenges were also reported by regional and sub-regional intergovernmental organizations.

In many countries a wide range of institutions are engaged in institute- and sector-specific assessments. Data on individual hazards and vulnerabilities are scattered across many organizations. This creates problems for the coordination and compatibility of data, and the harmonization of data collection and storage. Encouragingly, some countries are starting to overcome this fragmentation by finding new ways to organize (see, for example, the case of Barbados in Box 4.4).

In general, the practice of systematically incorporating risk assessments into recovery programmes has failed to take root overall, with only limited progress since the last reporting period. Most advances have occurred in low-income countries, where 42 percent report substantial progress (level 4 or 5) in 2011, compared with 29 percent in 2009.

Where responsibility for risk assessment has been decentralized, countries reported an uneven level of progress depending on technical capacities and resources. Some provinces and districts regularly update comprehensive assessments, while others had difficulty assessing even individual hazards. China provides one such example, reporting substantial progress against this indicator with successful disaster loss and hazard monitoring at national, provincial and city levels. At the same time, it had significant trouble setting up similar systems at the county level.

Box 4.4 Risk assessments in Barbados

While Barbados admits that risk assessments are not used for development planning, the country notes that comprehensive risk assessments for critical infrastructure and particularly vulnerable areas can be undertaken by coordinating different institutions that are not directly responsible for DRM. Barbados' Town and Country Planning Department and Coastal Zone Management Unit have jointly developed coastal regulations based on a 100-year storm surge inundation line. Coastal setbacks (buffer zones above a high-water mark) are measured based on distance from this benchmark. The government has committed significant resources (US$30 million) to conduct a comprehensive coastal risk assessment for the major coastal hazards identified.

Despite this progress, resources are limited for similar exercises in non-coastal areas of the country. To overcome this barrier, different government departments are acting as lead institutions on other hazards. Specific assessments and hazard maps were developed for an area of Barbados that is particularly vulnerable to landslides and soil erosion, and the existing Soil Conservation Act is used as the driving force for implementing structural and non-structural disaster-mitigation efforts in the area through the country's Soil Conservation Unit. These measures include the relocation of communities in landslide- and flood-prone areas.

4.5 From words to investment

Most countries across all geographical and income regions reported relatively little progress toward dedicating resources to strengthening their risk governance capacities. Resources allocated for DRM in individual sectors or for local governments are even more limited.

Unsurprisingly, given their difficulty in assessing risks and accounting for losses, countries have difficulty justifying investments in DRM. GAR09 showed that low- and middle-income countries require several hundred billion dollars of development investment per year to upgrade informal human settlements, to restore damaged ecosystems and to provide basic needs. Furthermore, they require specific resources to strengthen risk governance capacities and thus ensure that such investment does indeed reduce risks. The assignment of dedicated resources for this purpose provides a clear indication that countries are really following through on their stated political commitment to the HFA.

In 2009–2011, many countries recognized that development investments in poverty reduction, food security and public health reduce risks. However, they find it difficult to quantify these investments, which are provided through diverse instruments including sector budgeting, environmental protection funds, social solidarity and development funds, compensation funds, civil society and, in some countries (Algeria, for example), the private sector.

Most countries across all geographical and income regions reported relatively little progress towards assigning dedicated resources to strengthen their risk governance capacities (Figure 4.7).

Less than one country in five could describe the percentage of their national budgets assigned to DRM, indicating that allocating dedicated resources remains the exception and not the norm. The figures provided vary from 0.005 percent (Lesotho) to 2.58 percent (Sri Lanka). Even countries such as Viet Nam (Box 4.5) and India, which have both passed legislation to allocate financial resources, found it difficult to quantify their investments.

Resources allocated for DRM within sectors and for local governments are even more limited. India's 2005 DRM law requires that every national ministry integrates disaster risk reduction elements in their ongoing development programmes, and local authorities are given limited responsibility for response and reconstruction. Despite these responsibilities, dedicated budgets are lacking. Costa Rica's 2006 disaster management law similarly requires that "every public institution" dedicate a specific line item in its budget for disaster risk reduction.

Almost 60 percent of all countries (and almost 80 percent of lower-middle-income countries) reported that local governments have legal responsibility for DRM, but only 26 countries, including Canada, Egypt, Ghana, Lesotho, Poland, Seychelles and Uruguay, confirm dedicated budget allocations. With the exception of the upper-middle-income group, very few countries report dedicated budget allocations to local governments for DRM (Figure 4.8).

While global targets for DRM investment have been suggested – for example, 10 percent of response funds, 2 percent of development funds and 2 percent of recovery funds[7] – financial reporting systems still do not allow progress to be monitored against these targets. Figure 4.9

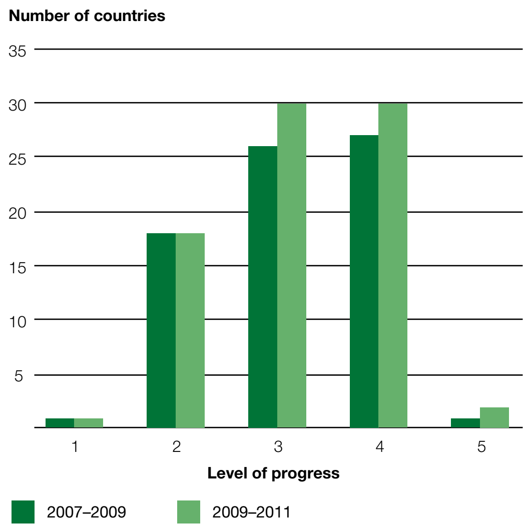


Figure 4.7
Progress in ensuring dedicated and available resources for disaster risk reduction

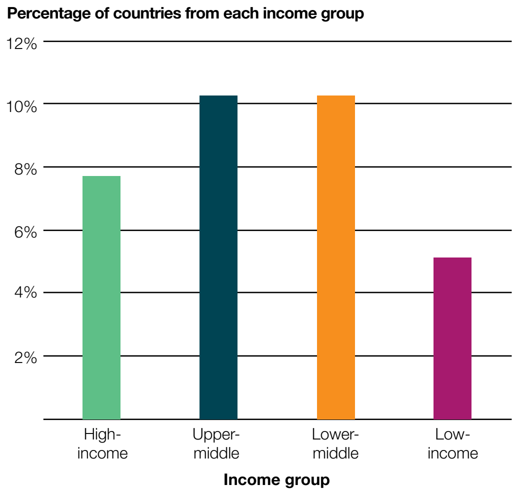


Figure 4.8
Countries reporting on budget allocations to local governments for DRM

Box 4.5 Viet Nam: legislation on resource allocation for disaster risk management

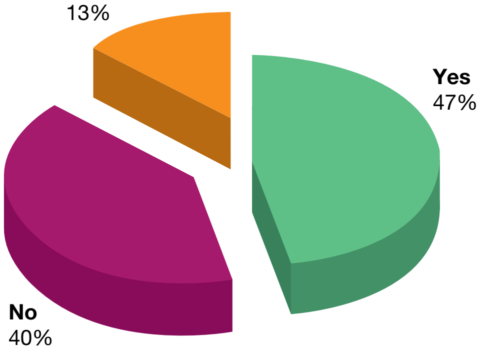
Viet Nam has passed legislation to allocate sufficient human and financial resources for implementing DRM, including structural and non-structural measures, from the national level to individual communities. With the approval of the National Disaster Risk Management Strategy, the National Target Program to respond to Climate Change (NTP on CCA) and the Community-Based Disaster Risk Management (CBDRM) Plan, significant resources have been budgeted to implement these priorities and activities.

The three main funding sources include the state (central and local), international contributors, and civil society and individual contributors. For example, to implement the CBDRM plan from now to 2020 will require 988 billion VND (US$48 million), of which the state will cover 55 percent, individuals 5 percent and official development assistance 40 percent.

The National Disaster Risk Management Strategy and the NTP on CCA identify key projects and outline funding needs. The Ministry of Finance (MoF) and Ministry of Planning and Investment (MPI) have been assigned to allocate and seek the financial resources to implement these plans. The MPI prioritized DRM needs in the Socio-economic Development Plan for 2006–2010, while the MoF sets aside annual contingency funding from 2 to 5 percent of national and provincial budgets for disaster response and recovery. However, because contingency funds must cover emergency response, significant funding gaps remain for recovery, reconstruction and DRM.

Figure 4.9

Countries reporting on budget allocations for disaster risk reduction in recovery



shows that less than half the countries (38 out of 82) budgeted explicitly for DRM within post-disaster recovery programmes and, of these, very few could report specific amounts or percentages of recovery and reconstruction funds assigned to risk reduction.

4.6 Incorporating DRM into national planning and investment

Most countries continue to have difficulty integrating risk reduction into public investment planning, urban development, environmental planning and management, and social protection.

If development planning and investments fail to incorporate risk reduction, a country's stock of risk will continue to grow. Yet, most countries and territories reported least progress in this area of the HFA. Antigua and Barbuda, Bolivia, Botswana, Georgia, Lesotho, Mauritius, Mexico, Monaco, Occupied Palestinian Territories, Paraguay, Saint Lucia and Togo are just some of the countries struggling to reduce underlying risk. But even countries that have attained some success, such as France, Germany, Portugal and the United States of America, score their efforts as low in this area.

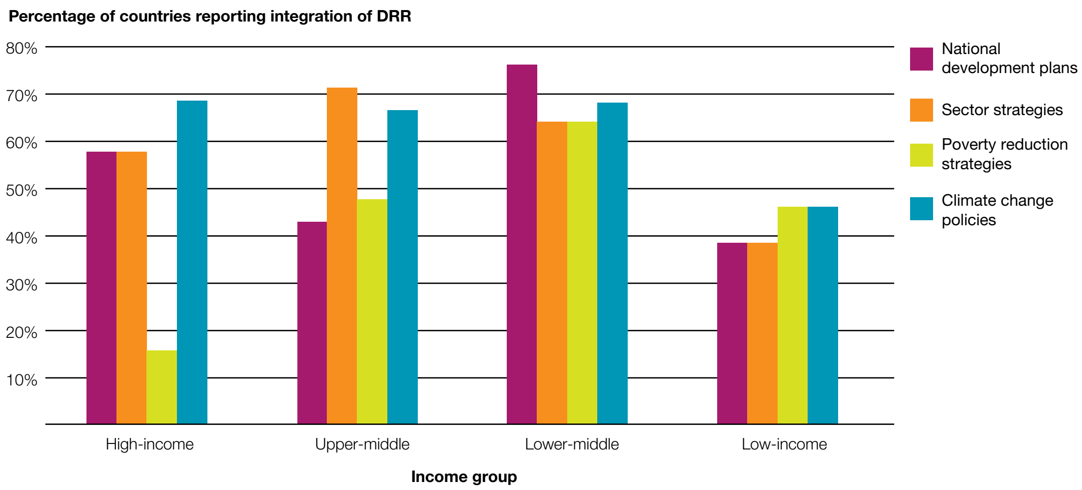
The 2009–2011 review shows little or no advance on the 2007–2009 results. Most countries continue to have difficulty integrating risk reduction into public investment planning, urban development, environmental planning and management, and social protection.

Some countries have yet to recognize climate change adaptation as an important area. A number of high-income countries or territories, such as Croatia, Czech Republic, and the Turks and Caicos Islands, reported that climate change is not yet on their policy agendas and, as a result, increasing climate risk is not taken into account in DRM. However, the majority did report the emergence or strengthening of climate change adaptation projects and programmes: 72 percent globally, with a relatively equal distribution across regions and income classes.

Compared with 2007–2009, lower-middle-income countries, such as Bhutan, reported most progress in integrating disaster risk reduction into national development plans and climate change policies (Figure 4.10). However, lower-middle-

Figure 4.10

Countries reporting on progress on HFA Priority Area 4



income countries, reported less substantial progress integrating risk reduction into poverty reduction strategies or other sector strategies that address the underlying drivers of risk.

Box 4.6 confirms that countries differ widely in their capacities to address risk drivers, such as badly planned and managed urban and regional development, the destruction of ecosystems, and

Box 4.6 The Risk Reduction Index

The DARA Risk Reduction Index (DARA, 2011) is based on 38 indicators that measure the extent to which a country is addressing the underlying risk drivers identified in GAR09, and to which it has appropriate and effective governance arrangements. In a detailed comparison of seven countries in Central America and the Caribbean, Costa Rica was found to have the strongest risk governance capacities, and Nicaragua the weakest (Figure 4.11).

The Risk Reduction Index uses data from a large range of well-established indices, including the World Bank's Governance Index. In preparatory analysis for the Index, a global risk index table for 184 countries was developed (DARA, 2011; Lavell et al., 2010). This analysis shows that the top six countries (Switzerland, Sweden, Denmark, Ireland, Norway and Finland) are all high-income countries with strong governance capacities, and have largely addressed their underlying risk drivers. In contrast, the bottom six countries (Afghanistan, Chad, Haiti, Somalia, Democratic Republic of Congo and Eritrea) are low-income countries that are experiencing or have recently experienced conflicts or political crises. These countries have very weak capacities to address the drivers.

A number of middle-income countries, such as Chile, Barbados and Malaysia, rate relatively highly on the Index, indicating that risk governance capacity is not just a reflection of GDP per capita. Low- and middle-income countries do not have to wait for their economies to develop before they address their disaster risks. Conversely, a number of relatively wealthy countries whose economies depend on energy exports rate lower on the index, including Venezuela, Saudi Arabia, Libya, Equatorial Guinea and Angola.

The in-depth comparison of Central American and Caribbean countries highlighted major differences in capacities not only among countries, but also among different areas of the same country. As well as reflecting widely varying processes of risk construction, this highlighted important differences in perception of both risk and disaster risk management among different stakeholders, and between local and national levels.

Surveys, structured around the four drivers of risk identified in GAR 2009, were conducted to inform an index on conditions and capacities for disaster risk reduction.[8] Consistent with findings from the 2009 civil society review 'Views from the Frontline', government respondents scored governance capacities considerably higher than did members of civil society.[9] Poor governance emerged as the driver that conditions all the other underlying drivers. Improving governance was thus emphasized as the single most important priority for reducing disaster risk.

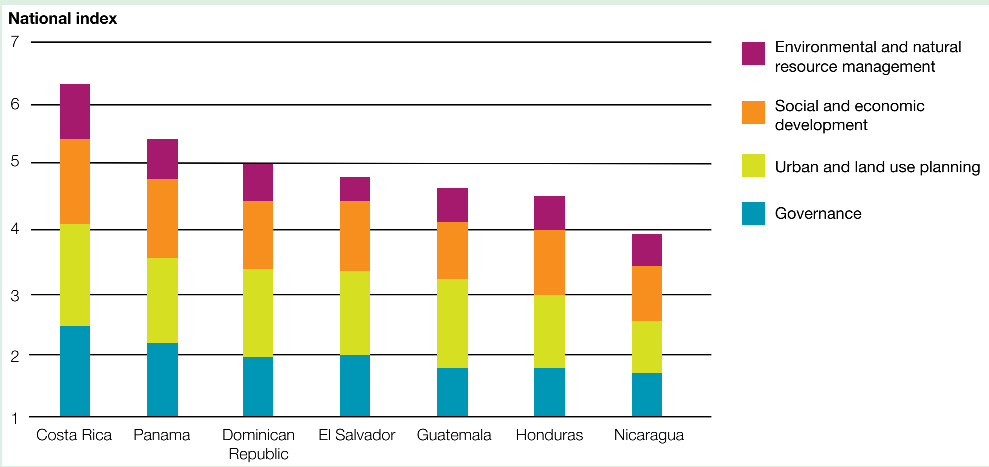


Figure 4.11
Risk governance capacities across Central America and the Caribbean

(Source: Adapted from DARA, 2011)

the pervasive poverty of risk-prone households and communities.

Given these different starting points, it is unsurprising that those countries that reported little progress did so from very different perspectives. Some national reports (from Albania and Senegal, for example) reveal a focus on preparedness and emergency management and higher progress in HFA Priority Area 5 (strengthening disaster preparedness) than in other areas. Others, such as Peru, show a sophisticated understanding of the complexities of addressing underlying vulnerabilities and drivers of risk together with a low progress score. Namibia reported that investment into DRM, rather than response and preparedness, is difficult to plan and account for. Greater understanding appears to bring greater awareness of the magnitude of the task.

Figure 4.12
Countries reporting substantial progress in assessing disaster risk impacts of infrastructure

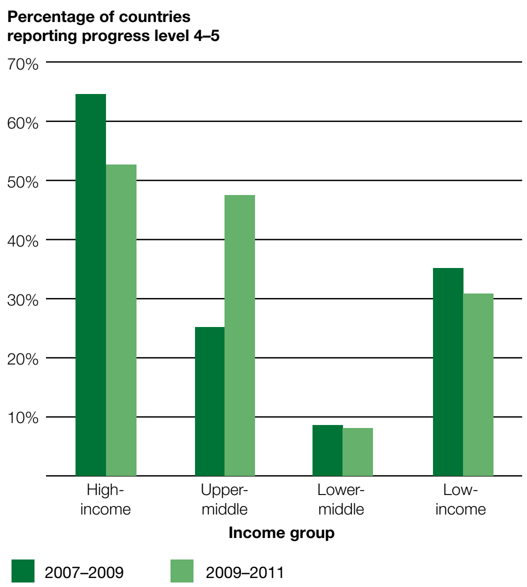
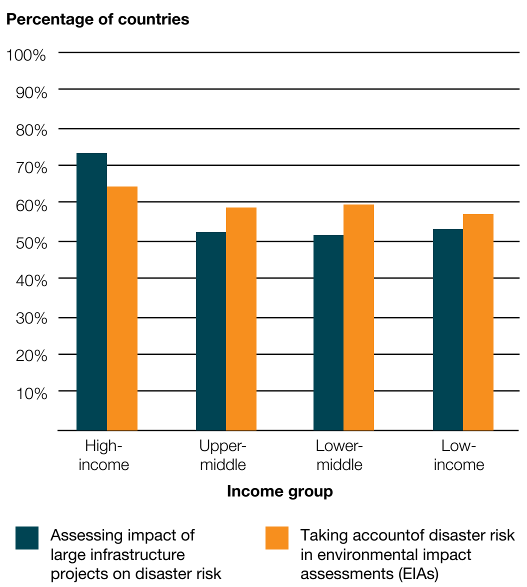


Figure 4.13
Countries reporting on means to assess disaster risk in development investments



4.6.1 Investment planning

Only 38 percent of all countries and territories, relatively equally spread across income classes and regions, systematically incorporated risk reduction into national- and sector-level public investment systems. However, it is unclear if more than a few of these are fully functioning and institutionalized systems. For example, Viet Nam reported that decisions on public investment are based on relatively limited information on hazards, climate change and underlying vulnerabilities.

As Figure 4.12 shows, countries reported less progress towards estimating the potential impacts on future disaster risk of large infrastructure projects – such as dams, highways and tourism developments – than they did in the previous reporting period. Less than 10 percent of lower-middle-income countries awarded themselves a score of 4 or 5. Again, this limited progress may reflect increased understanding of the complexities involved in conducting systematic assessments.

New supporting data for the current reporting period show that countries employ different types of mechanisms to assess disaster risk. As Figure 4.13 shows, while most OECD and other high-income countries directly assessed risks in critical infrastructure projects, low- and middle-income countries seem to rely more on pre-existing environmental impact assessments to fulfil this function.

4.6.2 Urban and land use planning

In the present reporting cycle, lower-middle-income countries reported significant progress in the area of urban development and land use planning compared with 2009. However, there remains a staggering discrepancy between high- and low-income nations, with almost 70 percent of high-income countries and only

15 percent of low-income countries scoring 4 or 5 (Figure 4.14).

As Figure 4.15 shows, while most (95 percent) high-income countries (and all OECD countries) invested to reduce risks in vulnerable settlements, only 60 percent of low-income countries reported such investments. This is particularly critical considering the large concentration of disaster risk in urban areas in low- and middle-income countries. But even some high-income countries had trouble developing appropriate land use plans. In Barbados, for example, this problem led to increased vulnerability for low-income groups. Barbados also had difficulties dealing with vulnerable settlements that were developed before current legislation on zoning and urban land use planning was passed. Although a lack of political will is rarely acknowledged, particularly with regard to relocation, it is implicit in many countries' descriptions of barriers to progress. Weak enforcement of plans is another reported challenge, reflecting the need for more participatory approaches to planning and development.

Low-income countries find it harder than higher-income countries to make the investments necessary to reduce urban risk (Figure 4.16). Urban drainage systems, for example, are recognized as an important tool for reducing urban risk but less than half (46 percent) of low-income countries invested

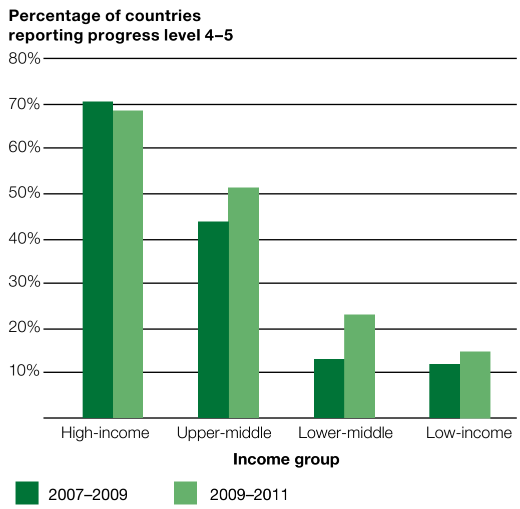


Figure 4.14
Countries reporting on urban and land use planning: 2007–2009 and 2009–2011

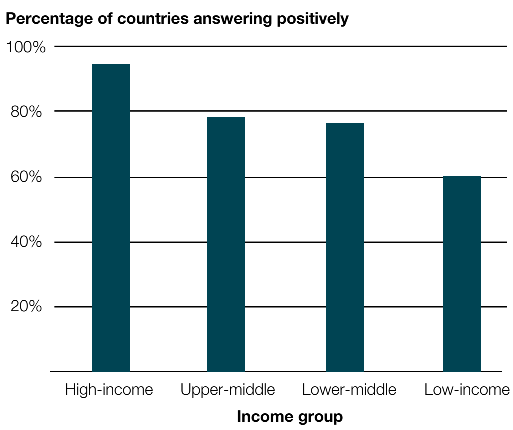


Figure 4.15
Countries reporting on investments to reduce vulnerable urban settlements

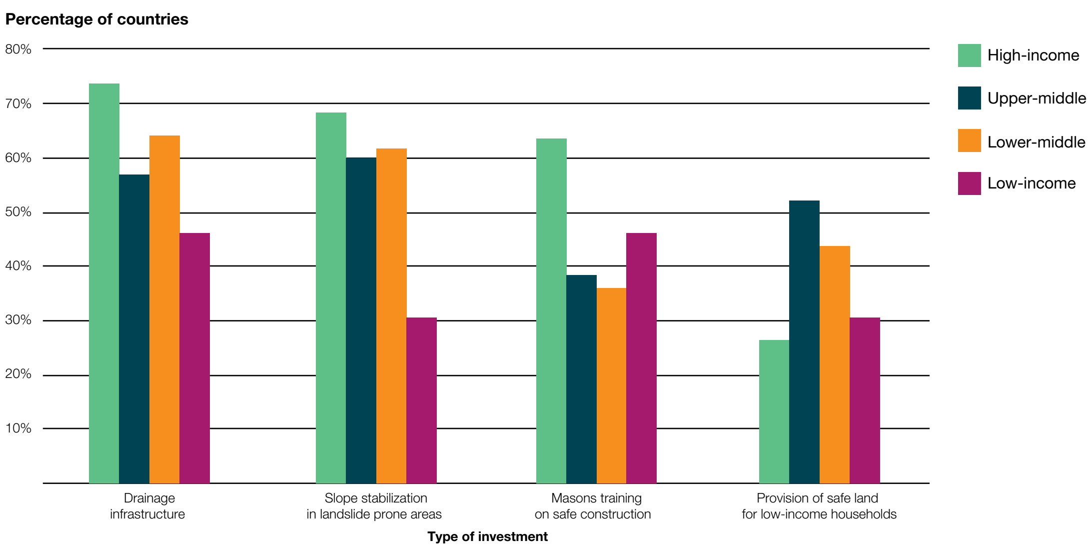


Figure 4.16
Countries reporting on DRM investments aimed at reducing urban risks

in drainage infrastructure in flood-prone areas. Less than a third (31 percent) of low-income countries took measures to counter landslide risk, compared with around 60 percent of lower- and upper-middle-income countries, and 68 percent of high-income countries. A less significant but similar trend was observed for the provision of safe land for low-income households and communities. This finding is consistent with the rapid increase in housing damage in urban areas reported in Chapter 2.

Some countries have introduced hazard-resistant building regulations only recently. The Syrian Arab Republic, for example, first introduced a seismic code in 1995. Weak implementation and enforcement mechanisms are common problems in countries where most urban development is informal.

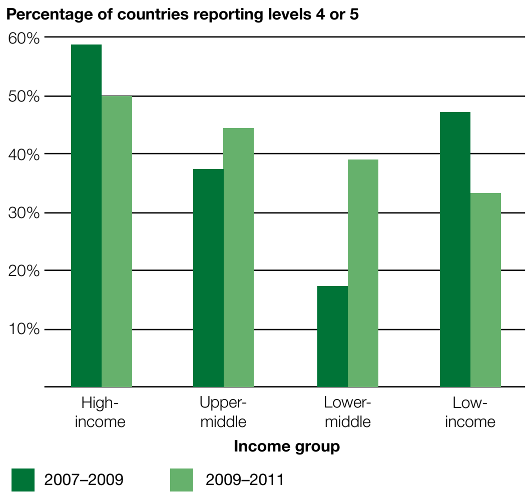
In addition, reports from several countries and territories reveal the trade-offs internalized in any decision to invest in DRM. For example, Croatia reported pressure from the construction industry to lower standards and codes to reduce overall construction costs, even in hazard-prone areas.

4.6.3 Environmental planning and management

Most countries and territories addressed the decline of regulatory ecosystem services and reported positively on provisions for protected areas legislation (77 percent), environmental impact assessments (83 percent), and climate change adaptation projects and programmes (73 percent). Fewer reported payments for ecosystem services, which is still a relatively new policy area. Integrated planning, such as risk-sensitive coastal zone management, was also lacking. Overall and except for middle-income countries (see Figure 4.17), less progress was made integrating DRM into environmental policies than in 2007–2009.

More than 95 percent of lower-middle-income countries have ecosystem protection measures in place, and more than 80 percent of countries globally have mechanisms to protect and restore regulatory ecosystem services. However, a number of countries claimed that existing laws needed stronger legislation or enforcement. For example, Sierra Leone reported that enforcement bylaws need updating to act as effective deterrents. Similarly, Indonesia points out that overlapping responsibilities and legislation on environmental and disaster management result in a lack of synergy and coordination, which hinders enforcement. Timor-Leste, along with several other countries worldwide, is hampered by protective-area legislation that does not take disaster risk into account.

Figure 4.17
Countries' reported progress and decline integrating DRM into environmental policies



4.6.4 Social protection

The lack of effective social protection erodes the resilience of poor households globally (ERD, 2010; UNRISD, 2010). GAR09 highlighted the role of social protection in DRM and Chapter 6 of this report discusses how countries are adapting various instruments designed to increase community and household resilience (Box 4.7). As well as supporting individuals and communities during and after a disaster, social protection is increasingly recognized as a means for increasing pre-disaster resilience.

Ensuring that micro-level social support and economic incentives – such as targeted welfare and employment programmes and micro-business development – are in place before a disaster strikes can be an effective way to assist vulnerable households. As Figure 4.18 shows, progress in this area since the last reporting period has been particularly significant for middle-income countries.

Different instruments scored very differently across income groups. Figures 4.19 and 4.20 show that, on one hand, penetration of crop and property insurance is far higher in high- and upper-middle-income countries than in low-income countries. On the other hand, 58 percent of low-income countries use micro-insurance instruments, compared with only 25 percent of high-income countries.

Low- and lower-middle-income countries and territories such as Bolivia, the Cayman Islands, Côte d'Ivoire, El Salvador, Guatemala, Indonesia, Madagascar, Maldives and Nicaragua all reported no or little progress on the provision of social protection instruments, such as cash transfers or employment programmes that can enhance households' disaster resilience.

Ecuador is one of few countries that implemented a wide range of social policy instruments as part of their disaster risk reduction strategy. As the country's Ministry for Agriculture is responsible for a number of these social development programmes, they are tightly linked with livelihoods and asset protection.

Myanmar and Timor-Leste reported limited progress in the provision of social development policies (levels 2 and 1, respectively). Their analysis of constraints and challenges echoes that of many disaster-prone countries. Social protection is often limited to areas that have recently experienced disasters, such as those affected by Cyclone Nargis in Myanmar (2008) or regions suffering recurring floods in Timor-Leste.

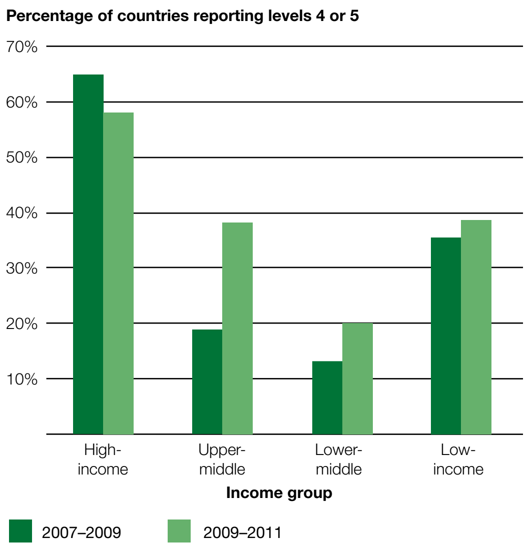
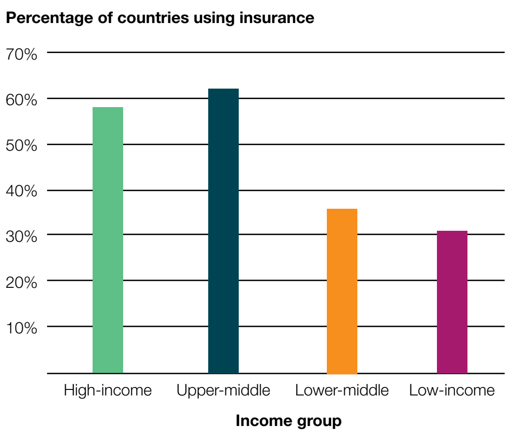


Figure 4.18
Countries reporting on the use of social protection to reduce vulnerability

Box 4.7 Linking social protection and disaster risk reduction

All of Malawi's social development policies are designed and implemented so as to reduce the vulnerability of at-risk communities. Its new Social Support policy, scheduled to be approved in 2011, explicitly links social protection with disaster risk reduction. Further, Malawi reported that a pilot cash-transfer programme, primarily targeted at orphans and the elderly, has already had a positive impact on a number of districts.



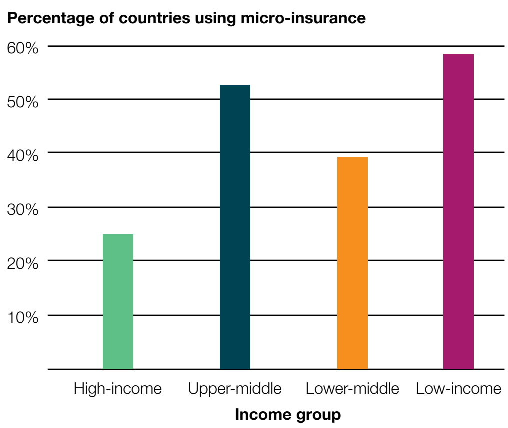


Figure 4.19 (left)
Countries reporting on the use of crop and property insurance

Figure 4.20 (right)
Countries reporting on the use of micro-insurance

Only 23 percent of countries globally reported the use of employment guarantee schemes (Figure 4.21). This is unsurprisingly low given that such schemes are perceived as a large burden on national budgets, though this is being countered by evidence from successful and affordable schemes across the globe (see Chapter 6). Conditional cash transfers, although considered more targeted and efficient, are used by only 31 percent of low-income countries, including Burundi, Kyrgyzstan and Zambia (Figure 4.22). Of all the countries that use these instruments, more than half are middle-income countries. High-income countries tended not to use these instruments because their social welfare systems usually operate via pensions, family benefits and other similar mechanisms.

Figure 4.21 Countries reporting on the use of employment guarantee schemes

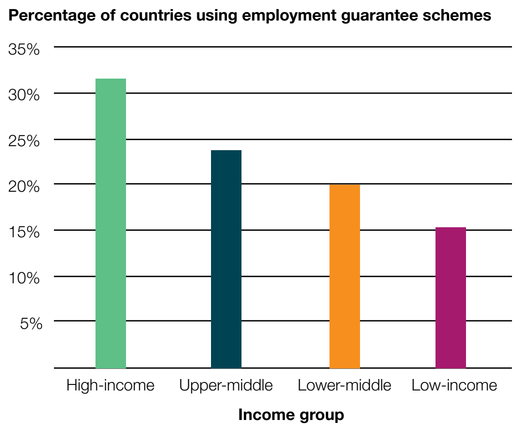
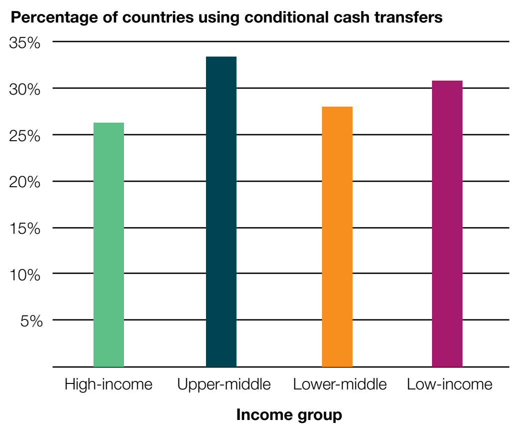


Figure 4.22 Countries reporting on the use of conditional cash transfers



4.7 Strengthening institutional and legislative arrangements

Often national DRM organizations lack the political authority and technical capacity to engage development sectors. A failure to strengthen local governments and make progress in community participation means that the gap between rhetoric and reality is widening.

The location within a government of authority for national policy on DRM can critically influence a country's ability to use national and sector development planning and investment to reduce its disaster risks. National DRM organizations often lack the political authority and technical capacity to engage development sectors. Timor-Leste, for example, failed to generate substantial momentum for DRM in sector ministries because of the relatively isolated and weak position of its National Disaster Management Department.

Some countries have made DRM apex bodies of presidents' and vice presidents' offices (or placed them within existing apex bodies). These include Myanmar, where the National Disaster Preparedness Central Committee is chaired by the prime minister; Nepal, which has moved the responsibility for its National Strategy for Disaster Risk Management under the chairmanship of the prime minister; and Botswana, where the National Disaster Management Office is an apex of the vice president's office. However, it is unclear whether this has improved the coordination of national or sector development planning and investment.

There is little evidence of countries locating responsibility for DRM in their economic and financial planning ministries. Only the United Republic of Tanzania reported such a move, developing its Zanzibar Strategy for Growth and Reduction of Poverty for 2010–2015 through the Ministry of Finance and Economic Affairs. This has provided a strong push for DRM, from reviewing and harmonizing laws and policies to infrastructure improvements, capacity building and community-based disaster preparation.

Several countries have spread the various functions of DRM across different levels of governance. In Nigeria, for example, a central coordinating body chaired by the vice president leads policy development, monitoring and response; at the lower levels of governance, states set up their own emergency management agencies with responsibility for disaster prevention, education and awareness raising, and local response preparedness.

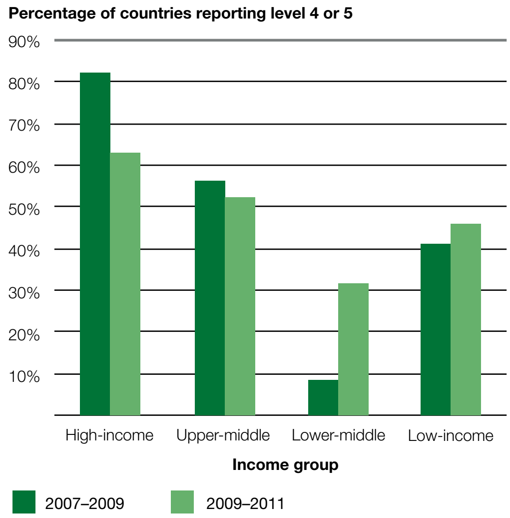


Figure 4.23
Countries reporting substantial progress (level 4 or 5) in community participation and decentralization for DRM

A number of countries reported major coordination challenges where DRM responsibilities are distributed across sectors. In addition, where responsibilities are spread horizontally and vertically, new laws and strategies may sit awkwardly next to outdated statutes and policies developed within sector departments. To address this challenge, Morocco, for example, has set up a working group with the Ministry of the Interior to conduct a joint revision of outdated laws and policies. However, as reported by Namibia, updating national policies and disaster management plans according to new legislation can be a slow process.

4.7.1 Limited local capacity and action

The central role of local governance in DRM is now acknowledged by most countries. However, across all indicators relating to decentralization, a failure to strengthen local governments and make progress in community participation means that the gap between rhetoric and reality is widening (Figure 4.23).

Local capacity was identified as a key gap in delivering effective DRM. While Yemen, for example, has structurally decentralized disaster risk management and reduction, existing financial and technical resources do not match local governments' new responsibilities. This is a common experience across the globe. In Madagascar, the legal framework for decentralized risk management does not include any provisions for budget allocations or specific responsibilities and procedures. As a result, local governments find it difficult to assume their roles as designated leaders in disaster risk reduction. As discussed in Section 4.5, dedicated budget allocations to local governments for DRM remain the exception rather than the rule. However, China and a handful of other countries reported comprehensive achievements in this area – though much of this progress concerns response preparedness rather than DRM in a broader sense.

4.7.2 Very limited progress in public awareness and education for DRM

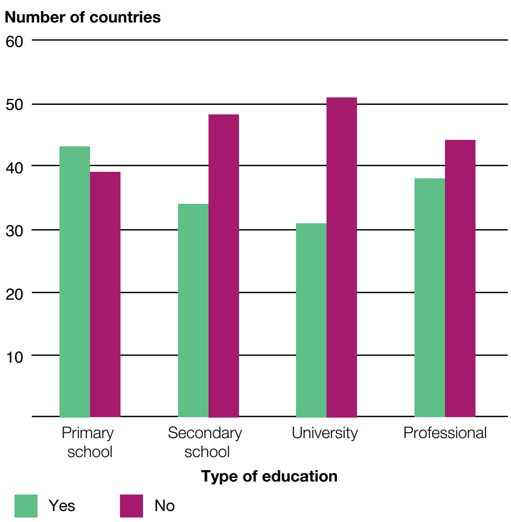
Public awareness of risks and of how to address them is a key to strengthening accountability and ensuring that disaster risk management is implemented. Yet, only 19 countries reported substantial progress in this area, with 63 indicating weak or average progress. Anguilla, Côte d'Ivoire, Kyrgyzstan, Poland and the Seychelles advanced least in this area, compared with all other HFA priority areas. Most countries reported significant efforts in campaigns to raise public awareness, including outreach to local governments and risk-prone communities. Despite these advances, around 60 percent of countries that rated themselves as making good overall progress, reported weak or average progress on making available information on disasters and disaster risk reduction issues.

China was a notable exception, reporting substantial and comprehensive progress on the availability of risk information, on developing a countrywide public awareness strategy, and on integrating DRM into school curricula (from primary to tertiary levels). As Chapter 7 of this report highlights, access to information and risk awareness drive social demand for disaster risk reduction. If countries have no established mechanism for accessing disaster risk information, their citizens will find it difficult to demand more effective risk reduction.

Almost 60 percent of countries have included DRM in the national educational curriculum. But, as Figure 4.24 shows, efforts have focused more on the primary level than the secondary or tertiary levels. However, while few countries included DRM in university and professional training, the literature analysed for the HFA Mid-term Review in 2010 highlighted a rapid expansion of specialized DRM courses at training institutes and universities. Distance-learning courses are also becoming more popular, particularly for developing the skills and knowledge base of governmental and NGO staff.

Another area where progress has been slow is in research; in particular, research on improved multi-risk assessments and cost–benefit analyses. Three-quarters (63 out of 82) of the reporting countries reported little or average progress in this area, with only 19 countries indicating substantial progress. Furthermore, most countries (85 percent) reported no research into the economic costs and benefits of disaster risk reduction.

Figure 4.24
Number of countries reporting on the integration of DRR into school curricula



4.8 Regional progress

Many regional inter-governmental organizations have successfully developed regional risk reduction frameworks and strategies. However, these often emphasize risk management over risk reduction and it has been difficult to engage non-governmental actors meaningfully in these processes.

Disaster risks associated with major hazards are often a regional concern. Most (74 out of 82) countries participated in regional and sub-regional DRM programmes and projects, and many countries also have action plans addressing trans-boundary issues.

Many regional inter-governmental organizations have successfully developed regional risk reduction frameworks. More than three-quarters (63) of the countries participated in the development of regional strategies – with SOPAC in the Pacific, ASEAN in South-East Asia, CDEMA in the Caribbean, CEPREDENAC in Central America, the African Union and NEPAD in Africa,[10] amongst others, all developing regional disaster risk reduction frameworks. The most recent success was provided by the Council of Arab Ministers Responsible for the Environment (CAMRE), which adopted the Arab Strategy for Disaster Risk Reduction 2020, endorsed by heads of state in January 2011. The Incheon REMAP initiative is another example of an innovative approach to regional learning and cooperation (Box 4.8).

Initiatives in Europe have resulted in agreement on a comprehensive strategy and implementation plan for the European Commission's support to disaster risk reduction.

Box 4.8 An Asian roadmap to cope with weather-related risks

In October 2010, 50 Asian and Pacific region governments agreed to make risk reduction part of their national climate change adaptation policies and jointly address the increase in severe weather events. The Fourth Asian Ministerial Conference on Disaster Risk Reduction approved a five-year regional roadmap, the Incheon REMAP, which brings together climate-sensitive risk management systems at the regional, national and community levels.

This new regional framework recognizes disaster risk reduction as a key tool for climate change adaptation. The main components include raising awareness on weather-related hazards, sharing information through new technologies, and integrating disaster risk reduction and climate change adaptation into sustainable development policies. The roadmap also promotes the sharing of information on, and new technologies related to, emerging risks and vulnerabilities. Goals include improving national hydro-meteorological capacities to increase preparedness, forecasting, risk transfer, and early warning and evacuation systems, as well as incorporating disaster risk into urban development for the most exposed communities. The roadmap's progress will be reviewed at the next Asian Ministerial Conference, to be held in Indonesia in 2012.

Moreover, the Council of Europe has taken steps toward a joint European approach to managing risk in member states (Box 4.9).

The South Asian Association for Regional Cooperation (SAARC) has agreed on a Comprehensive Regional Framework on Disaster Management, and has established its organizational structure. Despite this success, SAARC reported that although constitutional commitment has been attained, comprehensive or substantial achievements are still elusive (Box 4.10).

The regional progress report of the Arab States also highlights a lack of ongoing sub-regional and regional programmes that consider trans-boundary risks. Whereas national processes to better understand and monitor risk are underway (in Algeria, Egypt, Jordan, Morocco, Syrian Arab Republic and Yemen, for example), the lack of information at regional level affects

Box 4.9 The European and Mediterranean Major Hazards Agreement

Created in 1987, the Council of Europe's European and Mediterranean Major Hazards Agreement (EUR-OPA) is a platform for co-operation between European and southern Mediterranean countries in the field of major natural and technological disasters. Its remit covers the knowledge of hazards, risk prevention, risk management, post-crisis analysis and rehabilitation.

EUR-OPA's plan of action and activities are aligned with the priorities of the HFA and support the development of national platforms. Since 2008, in close collaboration and coordination with the UNISDR Europe Regional Office, EUR-OPA has supported the establishment of the European Forum for Disaster Risk Reduction (the acting regional platform for DRR in Europe), which was officially launched in 2009 and is composed of the European HFA focal points, national platform coordinators and regional organizations.

In the past four years, the activities carried out by EUR-OPA focused on the drivers of risk and disasters. Moreover, following the EUR-OPA 12th Ministerial Session in September 2010 in Saint Petersburg, Russia, a new five-year plan (2011–2015) was adopted. The new plan seeks to address persistent vulnerabilities and envisages the involvement of citizens in building resilience to reduce disaster risk and adapt to climate change.

Box 4.10 The challenges of addressing trans-boundary risks in South Asia

The South Asian Association for Regional Cooperation (SAARC) reported that the process of agreeing on the Comprehensive Regional Framework on Disaster Management was "painstakingly slow" and was hampered by limited commitment of member states, limited resources and the competing priorities and responsibilities of different government departments. The fact that the Framework is not legally binding is seen as a major impediment to effective implementation. Despite these challenges, SAARC has developed nine regional roadmaps, which cover coastal, marine and urban risk, and risks associated with earthquakes, landslides and droughts.

Information-sharing is another challenge. Bilateral exchange of information already exists on, for example, rainfall and river discharge data. Regionally, however, there is a reluctance to share data and information on trans-boundary hazards and vulnerabilities in a systematic and ongoing manner. SAARC sees this as a major gap in current progress and reports on three main challenges to trans-boundary risk assessment in South Asia: scarcity of quality data; lack of coordination between different and often competing ministries and member states; and lack of adequate financial and human resources (including technical capacity). These impediments mean that although the region has succeeded in getting high-level commitment to carrying out trans-boundary assessments, this has yet to translate into practice.

regional capacity for early warning on trans-boundary risks, particularly for multiple hazards. Regional access to national hazard analysis and loss databases has also been identified as a constraint for regional progress. The League of Arab States initiated the first review of progress on the current status of implementing disaster risk reduction in the Arab region in 2007. After encountering significant constraints in the start-up phase, the League has since seen a surge in member countries' interest in engaging in national as well as regional reporting and coordination (Box 4.11).

Many of the existing regional frameworks and strategies remain skewed towards disaster management and HFA Priority Area 5 (strengthening disaster preparedness). The European Commission, for example, admits that its contributions have to date been mostly to HFA Priority Area 5, but points to a number of 'projects fitting into a more holistic DRR approach.' Similarly, the SAARC report emphasizes achievements in response preparedness, particularly when it comes to capacity building.

Regional inter-governmental organizations also find it difficult to meaningfully engage non-governmental actors in their processes. For example, SAARC reported that efforts to reach out to a wider audience and involve NGOs and independent experts are regularly limited by the Association's own 'rigid rules and procedures', which can make it impossible to convene multi-stakeholder forums.

4.9 Global gender blindness

While most countries now have legislation, policies and institutions in place to promote gender equality in employment, health and education, progress on incorporating gender considerations into DRM has been much slower.

Integrating gender considerations into disaster risk reduction remains a major challenge. Only 20 percent of countries reported substantial achievement in this area in 2009. Two years on, there has been little improvement, with only 26 percent of countries reporting significant ongoing commitment to gender as a driver of progress (Figure 4.25).

Box 4.11 Regional progress on early warning for trans-boundary risks

While the Arab States reported limited progress in addressing trans-boundary risks from a multi-hazard perspective, some initiatives promise success in years to come. A number of specialized agencies of the League of Arab States have, in cooperation with their national and regional counterparts, developed sub-regional early warning systems for specific hazards such as drought and earthquakes.

As drought risk is significant in the region, the Arab Centre for the Study of Arid Zones and Dry Lands is establishing regional drought monitoring and warning systems and a Desertification Monitoring and Assessment Network (ADMAnet). Similarly, the Arab Organization for Agricultural Development has established early warning systems for insect infestation (particularly locusts) and for monitoring desertification, drought and floods.

The Arab Disaster Risk Reduction Network supports these efforts by facilitating cooperation and coordination of disaster risk management across the region and providing a platform for sharing technologies and lessons learned. Capacity building initiatives such as the Regional Centre for Disaster Risk Reduction – Training and Research, established in 2009, round out a list of significant efforts made in the region over the last few years.

Even countries that score their efforts as 'significant and ongoing' such as Brazil and Saint Kitts and Nevis, provided little detail on what constitutes progress or reflects gender across the different priority areas. This limited visibility of the role of gender in DRM is confirmed by the low proportion of countries that included gender considerations in different areas of DRM (Figure 4.26).

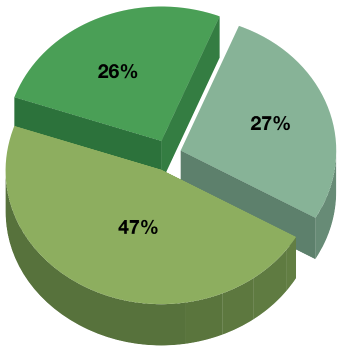


Figure 4.25
Countries reporting reliance on gender as a cross-cutting issue and driver for risk reduction

Few risk assessments consider or generate gender-disaggregated data (see Section 4.2), and few countries incorporate gender-based issues into recovery. Gender-differentiated needs and vulnerabilities remain neglected in recovery assessments with severe consequences for safety and health, particularly of women (Haiti, 2010; UNESCAP and UNISDR, 2010).

These gaps are echoed in country reports. Gender aspects are 'not taken into account in current risk reduction policies' in Comoros, and there is no 'specific policy on gender perspectives in risk reduction' in Antigua and Barbuda. Argentina, Bolivia, British Virgin Islands, Maldives and Nepal all reported existing gender policies but have difficulty integrating them with DRM. A large number of countries concur with the United Republic of Tanzania, which identifies the lack of appropriate knowledge of 'how and where to implement gender matters' as the main barrier. Many countries,

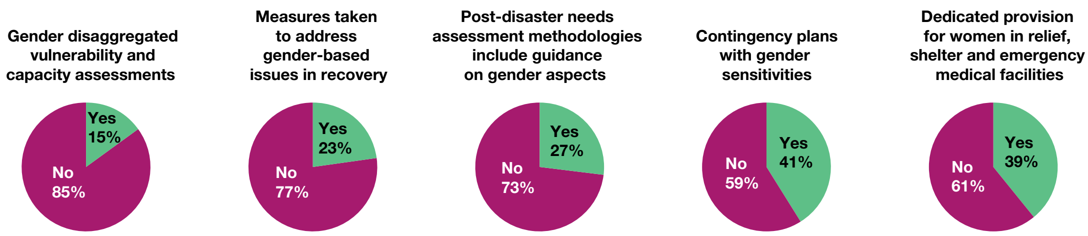


Figure 4.26
Countries reporting on progress in gender

including Honduras, reported on gender-based programmes and initiatives led and funded by international organizations, implying that addressing gender considerations remains a donor-driven priority rather than a government one.

Although most countries now have legislation, policies and institutions in place to promote gender equality in employment, health and education, progress incorporating gender considerations into DRM is much slower. Some countries, such as Egypt, appear to have difficulty promoting or even protecting the constitutional rights of women in practice. The lack of gender-disaggregated data, as identified by Bahrain, also hampers understanding of how women and men differ in their vulnerability and their specific contributions to reducing disaster risk.

As is the case in many countries generally, most of the progress is focused on response and preparedness. This is an obvious and practical area in which to ensure gender equality, but does not necessarily challenge dominant gender dynamics and power relations. Nevertheless, there are exceptions in low- and lower-middle-income countries. In Zambia, for example, assessments conducted for social protection programmes incorporate gender considerations and the different kinds of vulnerabilities of women and children.

Despite the hurdles, there are also encouraging and concrete examples of progress. In Ghana, a gender-based NGO was tasked by the national government to engage in a country-wide education campaign for women and humanitarian service providers. The programme included raising women's awareness of their right to humanitarian support and their role in reducing disaster risk. As a result, women have become more involved in planning and implementing risk reduction activities, particularly in the vulnerable northern regions of the country.

Notes

1 See Annex for core indicators. For more information on the methodology, a complete set of indicators, key questions and means of verification and the HFA Monitor reporting template, see www.preventionweb.net/english/hyogo/hfa-monitoring/?pid:34&pil:1.

2 Information provided by Hening Parlan, Indonesian National Platform, February 2011.

3 The 2010–2011 World Disaster Reduction Campaign "Making Cities Resilient" addresses issues of local governance and urban risk while drawing upon previous ISDR Campaigns on safer schools and hospitals, as well as on the sustainable urbanization principles developed in the UN-Habitat World Urban Campaign 2009–2013. For more information see www.unisdr.org/english/campaigns/campaign2010-2011.

4 Presentation made by Government of Albay at the "Future of Cities", ICLEI's 20th Anniversary Congress, Session A2 on City Resilience, Incheon, Republic of Korea, 7–9 October 2010 (http://incheon2010.iclei.org); and draft documentation of the work by Albay Province against the Ten Essentials, 20 December 2010 (unpublished).

5 A list of countries and territories is available online and the interim country reports are available on the GAR11 CD, and also at www.preventionweb.net.

6 World Bank country classification (http://data.worldbank.org/about/country-classifications/country-and-lending-groups).

7 10 percent of response suggested by the Under-Secretary-General for Humanitarian Affairs at the Kobe HFA conference, January 2005; and 2 percent of development and recovery noted in the proceedings of the Asia Regional Ministerial Conference, 2009.

8 A comprehensive questionnaire on all risk drivers included 24 questions on risk governance and governability, grouped under four categories: the state of democracy, government efficiency, the state of law, and the role of NGOs and international agencies. Almost 350 informants – from national and local government, the private sector, NGOs and organized civil society – responded to the questionnaire. Respondents were from all seven of the participating countries, and were all involved in risk management. Responses were made on a scale of 1 to 9; the lower the score, the worse the evaluation of existing conditions and capacities.

9 Civil society responses mirrored a generally negative view of both state and government efficiency.

10 SOPAC: Pacific Islands Applied Geoscience Commission; ASEAN: Association of Southeast Asian Nations; CDEMA: Caribbean Disaster Emergency Management Agency; CEPREDENAC: Coordinating Centre for the Prevention of Natural Disasters in Central America; NEPAD: New Partnership for Africa's Development.