

# GVR

## Global Assessment Report on Disaster Risk Reduction

# 2013

From Shared Risk to Shared Value:  
The Business Case for Disaster Risk Reduction



United Nations

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# GVR

Global Assessment Report  
on Disaster Risk Reduction

A white silhouette of a person standing and holding a large umbrella over their head. The umbrella is open and covers the person's head and shoulders. The person is standing with their feet together and arms slightly away from their body.

2013

From Shared Risk to Shared Value:  
The Business Case for Disaster Risk Reduction

The Global Assessment Report on Disaster Risk Reduction (GAR) 2013 has augmented reality (AR) icons sprinkled throughout it, which facilitate connection with its companion application GAR for Tangible Earth (GfT). To use them, first point the camera of your GfT-installed tablet computer or smartphone at these icons, then press the AR button as it appears, and a variety of dynamic information functions designed to enrich the reading experience will play in your device.

### Thailand floods



**The Earth Icon:** Links the user to a dynamic 3D globe, enabling geospatial data relevant to the subject in the text.

### U.S. droughts



**The Tablet Icon:** Opens dynamic animations and additional information on the static print charts in GAR.

### Extensive disasters



**The Researcher Icon:** Links to data about the researchers behind the article being read, their reports, web links, and videos.

To download the application, use the Qbarcode provided at the end of this document or visit [www.preventionweb.net/gar](http://www.preventionweb.net/gar).

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# Foreword

The third edition of the United Nations Global Assessment Report on Disaster Risk Reduction warns that the worst is yet to come.

This worrying news follows three consecutive years in which direct economic losses from disasters have soared past \$100 billion. If uninsured losses were included, the figure would be even more staggering.

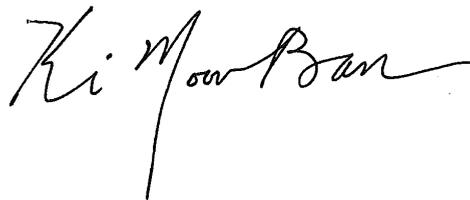
Based on a new state-of-the-art global risk model, the report's findings should raise concern among policymakers and businesses. In a world of on-going population growth, rapid urbanization, climate change and an approach to investment that discounts disaster risk, the potential for future losses is enormous. The global community continues to mix a destructive 'cocktail of disaster risk' despite catastrophic losses in recent years from the Japan earthquake and tsunami, floods in Pakistan and Thailand and the destructive Super Storm Sandy.

At the same time, the report documents encouraging signs of progress. Public-private partnerships in risk management have proven their worth during several disasters, including the 2010 and 2011 earthquakes in Christchurch, New Zealand.

Disaster risk management reduces uncertainty, builds confidence, cuts costs and creates value. More private sector senior executives are coming to recognize this. But growing recognition must be translated into a more systematic approach to disaster risk management that will make tomorrow's world a safer place.

As we move towards building a new, more inclusive and ambitious post-Hyogo Framework for Disaster Risk Reduction for the period following 2015, I call on governments, civil society and, in particular, the private sector to strengthen their partnerships for a safer future.

I commend this report to leaders from the public and private sectors as well as civil society in the hopes that it will inspire all to redouble our collective efforts to create and maintain resilient communities and nations.

A handwritten signature in black ink, reading "Ki-moon Ban". The signature is fluid and cursive, with the first name "Ki" and last name "Ban" clearly legible, and "moon" written in a smaller, more connected script between them.

Ban Ki-moon  
Secretary-General of the United Nations

**Direct disaster losses are at least 50 percent higher than internationally reported figures:** Total direct losses in 40 low and middle income countries amount to US\$305 billion over the last 30 years; of these more than 30 percent were not internationally reported (Part I-Intro).

**Disasters directly affect business performance and undermine longer-term competitiveness and sustainability:** When business leaves it may never return. Prior to the 1995 earthquake, the port of Kobe was the world's sixth-busiest. Despite a massive investment in reconstruction and efforts to improve competitiveness, by 2010, it had fallen to 47th place (Chapter 1).

**Globalised supply chains create new vulnerabilities: Toyota lost \$1.2 billion** in product revenue from the 2011 Japan earthquake and tsunami due to parts shortages that caused 150,000 fewer Toyota automobiles to be manufactured in the USA, and **reductions in production of 70% in India and 50% in China** (Chapter 1, Box 1.4).

**Businesses loses its lifeline when critical infrastructure is hit:** Most of the 1,300 businesses surveyed in disaster prone cities in the Americas noted **disruptions in power and water supply and telecommunications as top concerns** (Chapter 15). Over 90% of damage to these lifelines occurs in local disasters (Chapter 1).

## **GAR at a Glance**

**The “wake-up call”- disasters are even costlier than we thought**



**Small and medium enterprises are particularly at risk: A single disaster may wipe out all or large parts of business capital** of small enterprises, in turn affecting large companies relying on local suppliers. Yet, **less than 15 percent** of companies with less than 100 employees in disaster prone cities in the Americas have a **business continuity or crisis management plan** in place (Chapter 11).

**Disaster risk is a new multi-trillion dollar asset class:** Global capital flows have transformed the landscape of disaster risk, creating a new pile of toxic assets for businesses and governments that do not currently appear on balance sheets (Chapter 2). Globally, US\$71 trillion of assets would be exposed to one-in-250 year earthquakes. In Honduras, already a one-in-33 year disaster would create a significant financing gap for the government with impacts on future GDP (Chapter 5).

**Most disasters that could occur haven't happened yet: Total expected annual global loss** from earthquakes and cyclone wind damage alone now amounts to **US\$180 billion per year** (Chapter 3). This figure does not include the significant cost of local disasters from floods, landslides, fires and storms (Chapter 4) or the cost of business interruption. Agriculture is also at risk: in Mozambique a one-in-10 year drought would lower maize yields by 6 percent and GDP by 0.3 percent (Chapter 6).

**Risks to natural capital compromise future wealth:** Disaster risks include the loss and erosion of **natural capital** with serious consequences for business, households and a country's wealth. For example, **wild-land fires** now affect all continents with global annual losses to tropical ecosystems alone potentially **reaching US\$190 billion per year** (Chapter 6). Land degradation increases agricultural drought risk; in Africa, the total area with high degradation and high drought hazard is almost 260,000 square km.

**It's no longer "business as usual":** Recent major disasters such as Hurricane Sandy in 2012 and the 2011 floods in Thailand focused attention on the growing impact of disasters on the **private sector** (Chapter 1). Many large global businesses are now strengthening their risk management capacities. Yet, businesses still display a **'blind-spot' to disaster risk**, which is largely ignored in **economic forecasts and growth projections** (Chapter 12).

**Private investment largely determines disaster risk:** In most economies **70–85 percent of overall investment** is made by the **private sector**, including annual **institutional investments worth more than US\$80 trillion** globally. Both regulators and investors are increasingly demanding that businesses disclose their hidden risks, including disaster risks (Chapter 12).

**Insurance is critical to business resilience.** Yet insurance pricing often does not reflect risk levels or provide an adequate incentive for risk sensitive business investment, particularly in low and middle income countries with low penetration rates but rapidly growing markets (Chapter 13). In China, for example, **only 3 percent of properties are insured against earthquake and 5 percent against typhoons and floods.**

Governments report significant progress in developing more **effective disaster response and preparedness strategies** and are investing more to address risks. Yet, the required shift to **anticipate risks in public and private investment** remains a challenge for most (Chapter 14). **The number of export oriented Special Economic Zones has expanded** from 176 zones in 47 countries in 1986 to 3,500 zones in 130 countries in 2006. Many such zones are located in hazard-exposed areas increasing disaster risks.

**A new wave of urbanisation** is unfolding in hazard-exposed countries and with it, new opportunities for resilient investment emerge. In India alone, the urban population is expected to grow from 379 million in 2010 to 606 million in 2030 and 875 million in 2050. Private construction company Mori Building has **successfully invested in earthquake resistant housing developments** in Japan, where earthquake resistance is the most important criteria for choosing new offices for 92% of businesses (Chapter 8).

**Tourism investment in small island developing states comes with high levels of disaster risk – but also with large potential benefits from investment in disaster risk management: 6 of the top 10 countries** with the greatest proportion of assets **at risk to cyclone wind damage are small islands** (Chapter 7). The competitiveness of these countries, and businesses invested in them will depend on **effective disaster risk management**, through for example certification programmes and voluntary rating systems (Chapter 9).

**Current agribusiness practice feeds global food insecurity: Over 2 million hectares of land** have been acquired through **international agribusiness investment in drought prone countries** like Ethiopia (Chapter 10). Commodity markets, bio-fuel production, increasing demand and low stocks, can transform production shortfalls due to drought into **global food price spikes**, affecting low-income households, who buy most of the food they consume. But new partnerships between small-holder farmers and businesses show potential for a more resilient agriculture.



## The business case for disaster risk reduction

**The business case for stronger disaster risk management is three-fold:** It reduces uncertainty and strengthens confidence: Orion invested **US\$6 million** in seismic protection in New Zealand that **saved the company US\$65 million** (Chapter 8). It opens the door to cost savings: preventive investments by fishermen in Mexico **saved each individual entrepreneur US\$35,000** during Hurricane Wilma in 2005 (Chapter 11). And it provides an avenue for value creation: an Economist Intelligence Unit survey records that **63 percent of businesses** see opportunities to generate value from disaster risk reduction (Chapter 16). Businesses that have invested the most in risk management may financially outperform their peers.

**Business attitudes are changing:** Embedding disaster risk management in business processes is increasingly seen as a key to resilience, competitiveness and sustainability - a **business survival kit** in an increasingly unpredictable world. One business survey now lists disaster risk as the **16th most important out of the top 50 risks, and as the 6th most important driver strengthening risk management** (Chapter 16).

**A new paradigm for disaster risk governance will include the private sector:** Only **half the countries** assessing progress against the UN framework for disaster risk reduction (Hyogo Framework for Action) report on active engagement with business on disaster risk management. Canada is a notable exception with **20 private sector bodies represented** on its national platform (Chapter 15).

From managing “disasters”  
to managing “risks”



**Creating shared value through disaster risk management:** Most businesses are currently addressing disaster risk through the paradigm of **business continuity planning**. While essential, this is **only one part** of building resilient investments to disaster risk management. Important further steps are integrating disaster **risk information into investment decisions**; building **public-private** risk governance and **disclosing disaster risks and costs** on business balance sheets (Chapter 15). Innovative companies are beginning to move in this direction, identifying disaster hot spots in their supply chains, reporting on risk reduction measures and forging partnerships with municipal governments.

Disaster risk management is a **business opportunity**: The development of new crop-insurance products or more disaster resilient infrastructure **expands existing and opens up new markets**, particularly in emerging economies (Chapter 16). Companies are recognizing this and beginning to invest in the development of products and services in support of disaster risk management.

As we now approach 2015, international efforts are intensifying to formulate a **new framework for disaster risk reduction**. Ensuring that the business case for disaster risk reduction is explicitly included in that framework will provide a critical incentive for the **constructive engagement by business on which future resilience, competitiveness and sustainability depend**.



The GAR 2013 brand iconography is based on an image of a person holding an inverted umbrella. The inverted “A” in the GAR 2013 logo is a resonance of this motif.

The person holding an inverted umbrella is about seeing something from a new perspective, a call for creative responsiveness to change. A simple ubiquitous tool, proposed in a new way... the grandest breakthroughs often come from such humble beginnings.

The image represents acting to overturn a legacy of apathy and ignorance. GAR 2013 provides clear and actionable information about the risks and rewards of disaster risk reduction, as well as a wealth of information about how we unwittingly generate, and exacerbate, risks.

The icon also represents the key message of GAR 2013: “Creating Shared Value.” This is nowhere more evident than in the power that each of us has to work together to make our societies more resilient, to reduce disaster risks and enable responsible use of resources. Rain drops, one at a time, may seem insignificant, but given a platform to become pooled resources, they can quickly become a powerful force for good.

Thus, the inverted umbrella is an icon of positive empowerment, advocating disaster risk management as an opportunity rather than a cost, something which makes you — your city, your business, your supply chain, and yourself — more sustainable and more competitive.



# Preface

## The Global Assessment Report on Disaster Risk Reduction: a retrospective

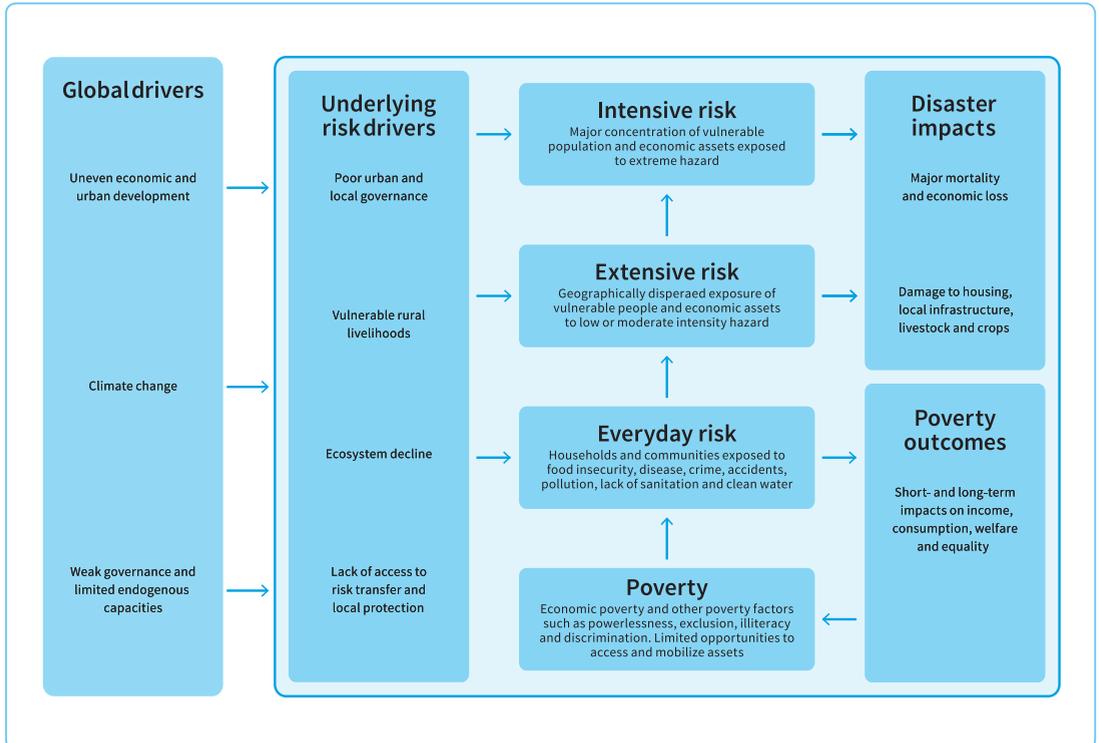
This 2013 Global Assessment Report on Disaster Risk Reduction, *From Shared Risk to Shared Value: The Business Case for Disaster Risk Reduction (GAR13)*, is the third biennial report coordinated by the United Nations Office for Disaster Risk Reduction (UNISDR).

The first Global Assessment Report on Disaster Risk Reduction, *Risk and Poverty in a Changing Climate (GAR09)*, as well as the second, *Revealing Risk – Redefining Development (GAR11)*, focused primarily on public policy and the role of national and local governments in disaster risk reduction. The key message of GAR09 was that addressing the underlying

risk drivers is critical not only to the achievement of the Hyogo Framework of Action (HFA)<sup>i</sup>, but also the Millennium Development Goals (MDGs) and climate change adaptation. GAR11 built on that evidence to provide guidance to governments on how to effectively manage their disaster risk.

GAR09 highlighted how intensive disaster risk is disproportionately concentrated in lower-income countries with weak governance. Within countries, it showed how underlying drivers—such as poor urban governance, vulnerable rural livelihoods and declining ecosystems—concentrate extensive disaster risk in low-income communities and households and drive further the depth and breadth of poverty, undermining development (Figure 0.1).

**Figure 0.1** GAR09 - Risk drivers and poverty outcomes



(Source: UNISDR, 2009)

It also found that, although progress was being made to strengthen capacities for disaster preparedness and response, governments were challenged to tackle underlying risk drivers.

GAR11 provided further evidence on why disaster risk was increasing and why existing efforts in its reduction were failing to address underlying risk drivers. The report provided an updated analysis of global disaster risk and loss trends and a second biennial review of progress against the HFA. It then identified political and economic imperatives for increased public investment in disaster risk reduction. A cost-effective strategy for layering disaster risk management was proposed—which layers of risks to reduce; which to insure; and which to retain.

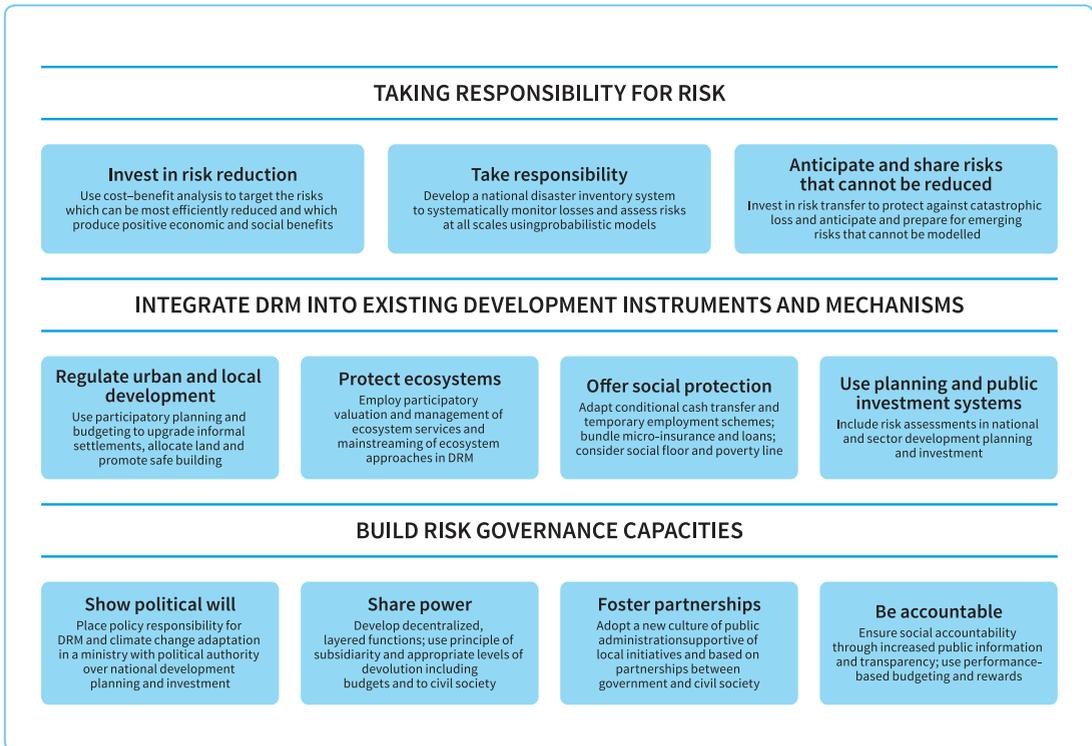
GAR11 described the mechanisms through which governments can deliver responsible and consistent policies for risk reduction, integrate disaster risk management into existing development

instruments, and build and strengthen risk governance capacities (Figure 0.2).

In most economies, public investment represents only 15–30 percent of gross fixed capital formation.<sup>ii</sup> How the other 70–85 percent of investment is made, therefore, has far-reaching consequences on disaster risk accumulation and on the underlying risk drivers identified in GAR09. In future, trillions of dollars of new business investment will pour into hazard-exposed regions, largely determining the future of disaster risk.

Despite their importance, business investment practices were neither highlighted in the HFA nor have interactions between business investment and disaster risk and the factors that mediate those interactions been seriously examined. Like the HFA, research and literature on this topic has concentrated on the role of governments, communities and households rather than of businesses.

**Figure 0.2** GAR11- Key elements for successful disaster risk management (DRM) across governance scales and development sectors



(Source: UNISDR, 2011)

Building on the findings of GAR09 and GAR11, this third Global Assessment Report on Disaster Risk Reduction seeks to fill that gap. It explores why increasing disaster risks represent a growing problem for the economic and business community at different scales. The report examines how paradoxically business investments that aimed to strengthen competitiveness and productivity may have inadvertently contributed to increasing risk.

GAR13 explores how businesses, by investing in disaster risk management, can reduce costs and interruptions represented by disaster losses and impacts; how performance and reputation can also be enhanced by minimising uncertainty and unpredictability; why effectively managing disaster risks should be the hallmark of a competitive, sustainable and resilient business; and why a broader approach to business value creation that also addresses underlying drivers of risk is required.

GAR13 highlights the interdependence of the public and private sectors and why business competitiveness, sustainability and resilience will also depend on governments' ability to manage disaster risk through effective policies. Governments depend on business investment to generate employment and the wealth required to provide public services. Likewise, businesses depend on reliable public infrastructure and utilities, on efficient urban systems, on an educated and healthy workforce and on a range of ecosystem services. Reducing disaster risks in business and in public investment presents a win-win situation for both.

The principal of shared value involves creating economic value that also benefits society by addressing its needs and challenges (Porter and Kramer, 2011). Risk drivers, such as badly planned and managed urban development, environmental degradation, climate change and poverty and inequality, are key societal challenges that also negatively affect business performance. Thus they create shared risks to both public and private sectors. Disaster risk reduction can and should transform these

shared risks into shared value for business, governments and civil society.

### Why do disasters challenge business?

The major disasters that struck Japan and Thailand in 2011 and the United States of America in 2012 revealed how disasters can impact businesses. Earthquakes, floods and storms can damage exposed and vulnerable factories, offices and other facilities and resources, interrupting and paralysing output and business processes.

But disaster risk does not stop at the factory gate. Businesses depend on infrastructure and urban systems run by utilities and the public sector. Damage to transport and energy networks, ports and airports or to neighbourhoods where employees live interrupts business and imposes additional costs. And in today's globalised world, even businesses in safe locations may be affected by disasters that hit suppliers and partners on the other side of the globe.

Extended insurance coverage may enable businesses to compensate for both direct loss as well as supply chain interruption. But disasters have broader, more pervasive effects on business competitiveness. When business is interrupted, skilled workers may leave, market share may be lost to competitors, relationships with key suppliers and partners may be severed and confidence and reputation may be eroded. Once business is lost, it may never come back.

Businesses, of course, come in many shapes and sizes. And different sizes are exposed to different kinds of risk. Small businesses, for example, that serve local markets are affected directly by localised extensive disasters, as associated with flooding or landslides. And these businesses also depend heavily on local public infrastructure. Destruction of a bridge in a flash flood, for example, may isolate a local smallholder farm, workshop or restaurant from markets and suppliers for days. And many such businesses go bankrupt because they lack the cash flow or reserves to be resilient.

Large global corporations, at the other end of the spectrum and owing to their diversity and scale, are largely buffered from local impacts in any particular place. However, a major intensive disaster may critically disrupt their supply chains and global operations; for example, if a major transshipment hub or key supplier is affected. And the recurrent impact of smaller disaster events in regions where corporations seek to establish effective clusters of suppliers and vibrant consumer markets may result in equally significant losses in the medium to long term. Medium-sized enterprises and national industries similarly face different kinds of disaster risk as they may be affected by both relatively small-scale localised events and larger disasters.

### Creating shared risks

Although hazards such as earthquakes, cyclones and tsunamis are natural in origin, there is nothing natural about the way disaster risk has become embedded in the contemporary business landscape. Decades of businesses decentralising and outsourcing production to facilities located in areas with comparative advantages, such as low labour costs and easy access to export markets, has been critical to enhancing business competitiveness and productivity. However, because many of these areas are hazard prone, it has dramatically increased the exposure of businesses and their supply chains to devastating hazards.

Investors have paid insufficient attention to this growing hazard exposure and its threat to business resilience, competitiveness and sustainability. Country briefings, analysts' reports, competitiveness indices and business forecasts rarely mention disaster risk, even in high-risk regions. Cities and countries, competing to attract investment, have generally downplayed the risks, in some cases even offering incentives to businesses to locate in hazard-exposed areas. And the pricing of risk in insurance markets has yet to act as an effective disincentive to investment in hazard-exposed areas.

In other words, economic globalisation has enabled

critical gains in business productivity and efficiency, but those gains have been at the expense of an over-accumulation of disaster risk in many business sectors and in the global economy as a whole.

Many of these risks and costs are externalised, transferred to and shared with governments, society at large and future generations. As GAR09 highlighted, disasters disproportionately affect lower-income countries, communities and households, and those who benefit least from wealth creation owing to economic globalisation.

However, from the perspective of shared value, this process of risk transfer is far from external to business. Losses to public infrastructure and services, to the workforce and to ecosystems also ultimately threaten the sustainability of all businesses—large and small—and thus in the medium to long term, become a shared risk.

### The business case for disaster risk reduction

In today's global economic and political turmoil, rapid technological change and increasing interconnectedness of global trade, financial markets and supply chains, larger businesses perceive an increasingly riskier world. For businesses, this means an array of complex, unpredictable events and sudden change in which risks can manifest swiftly and unexpectedly, with far-reaching ramifications.

Within this landscape, the reduction of disaster risks is taking on new significance and urgency for all global players. Investments in disaster risk management are increasingly being seen less as a cost and more of an opportunity to strengthen resilience, competitiveness and sustainability.

Larger businesses are investing to secure and strengthen their capacities and strategies for risk management. Institutional investors, with a fiduciary responsibility to their shareholders to ensure prudence and sustainability, are now exploring regulatory and voluntary actions to increase the visibility of all risks, including those associated

with disasters and climate change.

More important, if business investment becomes more risk-sensitive, governments will be encouraged to invest more heavily in disaster risk reduction. Effective disaster risk management will become a basic requirement for competitive countries and cities that are successful in attracting business investment.

A growing convergence of public and private initiatives to model and estimate disaster risks is beginning to underpin these efforts. Disaster risk management platforms and applications are now being developed to allow businesses to incorporate these data into their investment decisions. Accurate risk data, in turn, facilitate the development of insurance markets, with appropriate pricing that encourages risk-sensitive investment.

But above all, businesses now begin to perceive investments in disaster risk management as a compelling proposition to create shared value. Investments in climate change mitigation, sustainable water management and green cities directly address underlying risk drivers and at the same time become increasingly important in value creation for businesses of all types.

Businesses are finding huge opportunities in disaster proofing new and existing infrastructure, buildings and supply chains, which are also critical to risk reduction and global sustainability. Investing to reduce the vulnerability and strengthen the resilience of smaller businesses that are suppliers and partners of larger businesses not only strengthens the latter's business sustainability but also generates shared value in securing local employment, increased productivity, tax revenue and welfare.

Disaster risk reduction, therefore, is a compelling shared value proposition for business. This component needs to be recognised in the formulation of the revised international frameworks for development and disaster risk reduction that will be adopt-

ed in 2015,<sup>iii</sup> as well as for future international negotiations around the challenge of climate change, if the world is to achieve a socially inclusive, low-carbon and resilient economy laid out by the Secretary-General of the United Nations (United Nations Secretary-General, 2012).

### **A new and advanced GAR13**

The previous two editions of the Global Assessment Report were predominantly written for an audience of policy- and decision-makers in government departments. GAR09 laid out key recommendations for governments as well as civil society actors engaged in disaster risk management; GAR11 sought to reach beyond this traditional audience and targeted its analysis and findings particularly at finance and planning ministries of national governments.

In expanding its analysis to include and focus on the role of private investment, GAR13 aims at business leaders and private investors, on the one hand, and at local and national regulators, on the other hand. This report seeks to engage businesses in a dialogue on disaster risk management that goes beyond the current emphasis on response and preparedness and instead identifies opportunities for the creation of shared value for business and society.

As with previous Global Assessment Reports on Disaster Risk Reduction, GAR13 has been developed on the basis of original research commissioned to and contributed by a wide range of partners, including academic, scientific and technical organisations, governments and regional organisations, international and non-governmental bodies and most importantly by the private sector on a global scale. This report offers businesses as well as investors for the first time a review of practices that can reduce their risk of disaster loss.

### **Key features of GAR13 include:**

#### **A global assessment of economic disaster risk**

A completely new probabilistic multi-hazard GAR global risk model is being developed in collaboration with scientific and technical partners to replace

the earlier model used in GAR09 and GAR11. This major modelling initiative will provide a unique vision of global disaster risk, generating information and metrics for risk-sensitive investment planning for governments and business, as well as for analysts and forecasters. An overview of the methodology is provided in Annex 1 of the online version of GAR13.

GAR13 also explores the resilience of national economies to these risks through a number of different models, indexes and simulations, including the development of hybrid loss exceedance curves, building on the pioneering work in GAR11.

### **A more complete estimation of disaster losses**

The number of countries developing national disaster loss databases continues to grow. GAR13 features detailed national disaster loss data from a total of 56 countries, including new data from Djibouti, Ethiopia, Guyana, Honduras, Jamaica, Kenya, Lebanon, Laos, Mali, Nicaragua, Timor Leste, Uganda, Uruguay and a regional database for the Pacific Island nations.

A new approach to modelling direct economic losses from these data permits most likely the most complete estimation to date of the real cost of disasters. This approach combines internationally reported economic losses from intensive disasters, as recorded in the EM DAT database, with modelled economic losses in the housing, infrastructure and agriculture sectors from extensive disasters captured in national disaster databases. The detailed methodology and summary of results are available in Annex 2 of the online version of GAR13.

### **Understanding how businesses manage disaster risk**

A centrepiece of GAR13 is an in-depth analysis of how businesses are currently managing their disaster risks.

In partnership with a major consultancy company, workshops were held with 14 global corporations

from Asia, Europe and North America to understand current approaches to disaster risk management, challenges and opportunities. Based on an innovative risk management framework, these workshops provide lessons learned and unique insights into how large global businesses assess disaster risks and how this information is used to inform risk management.

A survey of about 1,200 businesses in six disaster-prone cities in the Americas (Bogota, Kingston, Miami, San Jose, Santiago and Vancouver) provides valuable information on another perspective, in particular, on the capacities of small and medium-sized businesses to manage disaster risks. This survey also examines the enabling environment for private sector involvement in disaster risk reduction.

### **Reviewing progress in disaster risk reduction**

At the time of writing, 131 countries are reviewing their progress against the HFA for 2012–2013, and 94 countries have submitted reports that provide unique insights into the implementation of the HFA. Governments have reviewed their progress against each of the priority areas of the HFA, and provided supporting evidence on challenges in critical areas such as public investment and risk assessment. GAR13 highlights these developments, and a fuller analysis of all national reports is presented in Annex 3 of the online version.

In addition, governments in eight countries in Asia and Latin America have provided detailed case studies of their investments in disaster risk reduction and how these are measured. As new investments flood into emerging economies, results reported in these case studies provide useful context.

In partnership with a major global social research organisation, 30 senior officials in national finance and planning ministries, regional and international organisations were interviewed, providing additional insight into how policy- and decision-makers view the risk landscape.

## **A focus on the urban development, tourism and agribusiness sectors**

GAR13 also commissioned research to examine the challenges and opportunities to risk-sensitive business investment in three sectors: urban development; tourism; and agribusiness. These sectors are not only some of the most dynamic in the world economy, but also play a key role in the configuration of disaster risks. In each sector, GAR13 examines the interactions between business and the public sector and the incentives and constraints for disaster risk reduction.

## **Finance, insurance and public regulation**

Business investment decisions in these and other sectors are mediated by the availability of finance, insurance pricing as well as public sector regulation and incentives.

In partnership with the insurance industry, and through a set of case studies, GAR13 examines the challenges faced in the development of insurance markets that contribute towards risk-sensitive business investment. It also looks at the role of capital markets and financial institutions in providing incentives or disincentives for risk-sensitive investment.

Public regulation has traditionally been privileged as a means to avoid the externalisation of risks and costs by business investments to the public sector and community. But GAR13 also examines how the incentives provided by countries and cities to attract foreign direct investment (FDI) may actually encourage investment in hazard-prone areas. Further, it seeks to identify examples where it has been recognised that the costs of the resulting shared risks are becoming untenable for both business competitiveness and the sustainability of societies.

## **Nascent business practices in disaster risk management**

GAR13 also identifies and describes nascent business practices that are starting to positively transform the landscape of disaster risk management.

These practices include efforts to strengthen corporate risk management strategies; new approaches to supply chain resilience; initiatives to increase the accessibility and usability of risk information; investors' growing appetite for risk disclosure and transparency; and new opportunities for creating shared value by investing in disaster risk management in partnership with the public sector.

## **How to use this report**

GAR13 has been structured around a set of contributed and commissioned Background Papers, as well as risk and disaster data. More in-depth research and case studies than ever before have been developed for this edition of the GAR, including studies submitted in response to a Call for Papers issued to relevant academic institutions and networks in early 2012. GAR13 is available in a number of different formats.

- The Augmented Reality print GAR13 contains enhanced content that provides access to additional digital information, such as dynamic maps, videos, photos and case studies, for users with smartphones and tablets.
- The Pocket GAR provides the main evidence and messages of the report in a short and easy-to-use format.
- GAR13 is also a feature on Tangible Earth<sup>iv</sup> – the world's first interactive digital globe that allows users to view and understand the condition of our planet. Global risk and disaster data that underpin the report, as well as case studies and in-depth analysis of particular disaster events, are presented in a format that offers readers a unique way to visualise disaster risk and its reduction.
- Tablet computer and smartphone users can also enjoy the GAR for Tangible Earth (GfT) free application. GfT, or "gift", is a fully interactive stand-alone application, which features a 3D globe interface that contains decades of dynamic earth science data sets, including disaster events from

all GARs. These data sets are illustrated with interactive risk scenarios, maps, and photos and are searchable by time (including real-time), place, risk driver, hazard, disaster event, and more.

- Finally, GAR13 is also available as an interactive web version, including all Annexes and Background Papers with much of the functionality available in all the above products.

## Notes

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i The World Conference on Disaster Reduction, held from 18–22 January 2005, in Kobe, Hyogo Prefecture, Japan, adopted the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters.

ii In OECD countries, the share of private sector investment in total fixed capital formation was 85 percent in 2010 (OECD, 2013). In low and middle-income countries, the share of private sector investment is lower (almost 70 percent in low and lower middle-income countries and about 64 percent in upper middle-income countries in 2009), but has increased steadily, significantly contributing to total GFCF growth. Especially the share in lower middle-income economies increased by almost 10 percent since 1996 (based on World Development Indicators: <http://data.worldbank.org/data-catalog/world-development-indicators>).

iii 2015 is the year in which three major international development processes will be reviewed and efforts towards sustainable development renewed in the form of the reviewed Millennium Development Goals, the follow-up to Rio+20 in the form of Sustainable Development Goals, and the successor agreement to the Hyogo Framework for Action. To which degree these processes will converge or remain distinct has to be seen.

iv Tangible Earth was first conceived by Shinichi Takemura in 2001. For more information, see: <http://www.tangible-earth.com/en>.



# Contents



<b>Foreword</b>	<b>iii</b>
-----------------	------------

---



<b>GAR at a Glance</b>	<b>iv</b>
------------------------	-----------

---



<b>Preface</b>	<b>xiii</b>
----------------	-------------

---



<b>Chapter 1</b>	<b>Introduction: Risky Business</b>	<b>023</b>
------------------	-------------------------------------	------------

---



<b>Part I</b>	<b>The Globalised Landscape of Disaster Risk</b>	<b>037</b>
---------------	--	------------

---

<b>Chapter 2</b>	The Hidden Risks of Economic Globalisation	<b>041</b>
------------------	--	------------

<b>Chapter 3</b>	Intensive Riskscapes	<b>051</b>
------------------	----------------------	------------

<b>Chapter 4</b>	Invisible Risks	<b>067</b>
------------------	-----------------	------------

<b>Chapter 5</b>	The Resilience Challenge	<b>077</b>
------------------	--------------------------	------------

<b>Chapter 6</b>	Natural Capital Risk	<b>089</b>
------------------	----------------------	------------

<b>Chapter 7</b>	Small Islands, Big Opportunities	<b>105</b>
------------------	----------------------------------	------------



## **Part II Private Investment and Disaster Risk 117**

---

**Chapter 8** Urbanising Risk 121

**Chapter 9** Hazardous Leisure 141

**Chapter 10** No Free Lunch: Agribusiness and Risks to Food Security 151



## **Part III Business Strategies and Risk Governance 177**

---

**Chapter 11** From Managing Disasters to Managing Risks 181

**Chapter 12** Risk Blind Investment 191

**Chapter 13** Securing Investment: Insurance Revisited 199

**Chapter 14** Risk Governance: In Search of the Missing Paradigm 209

**Chapter 15** Anticipating Risk 223



## **Chapter 16 Conclusion: From Shared Risk to Shared Value 235**

---

Glossary	ccxlviii
Acknowledgements	ccl
References	cclviii
Index	cclxxx



Disasters can **seriously undermine business competitiveness** and longer-term economic sustainability. In the last two years, many businesses experienced **direct losses or impacts in the supply chain** affecting their profitability. If critical infrastructure such as transport networks and power supply are affected, businesses suffer. But business is affected not only as a consequence of direct and indirect losses but also owing to **wider impacts and macroeconomic effects**.

Market share may be lost as **clients transfer their business to competitors**; skilled workers may move or find other jobs; and relationships with suppliers and retailers can be severed. Consequently, business **image and reputation** may be permanently **damaged**, affecting longer-term sustainability.

Critically, global trade, financial markets and supply chains have become increasingly interconnected. When **local disasters occur in globally integrated economies**, the **impacts ripple** through regional and global supply chains causing indirect losses to businesses on the other side of the globe.

## 1.1 Like pouring water into a bamboo basket

The 1990s were what they call a “lost decade” for the Japanese economy as a whole, and the Port of Kobe was already losing its comparative advantage. However, it was the 1995 Great Hanshin-Awaji Earthquake that drastically accelerated its decline.

During the 1960s and 1970s, the Port of Kobe, Japan, was the principal transport hub between Asian manufacturers and markets in North America. In the 1980s, however, its market share began

to fall owing to high costs, inflexible operations and powerful labour unions (Containerisation International, 1998a).

Prior to the 1995 earthquake, Kobe was the world’s sixth-busiest port. After the quake, it failed to recover that prominence (see Box 1.1 below). Following two years of rebuilding, in March 1997, Kobe had fallen to 17th place worldwide (Chang, 2000b); by 2000, it fell further to 23rd place; and by end-2010, it ranked 47th (Nagamatsu, 2007). During the port’s reconstruction period, a big boost in trans-shipment business was given to other Asian ports, which provided lower costs, a large productive

### Box 1.1 The Great Hanshin-Awaji Earthquake

At 5:46 am on 17 January 1995, a 7.3 Mw earthquake in the southern part of Japan’s Hyogo Prefecture killed 6,437 people (Government of Japan, 2011). Direct damage was estimated at US\$100 billion (Chang, 2000a; Nagamatsu, 2007) and damage to Kobe’s port accounted for 10 percent of that total, affecting all 35 container shipping berths; 177 out of 186 non-container shipping berths; and all gantry cranes, warehouses, bridges and utility lines (Chang, 2000a).

When the port shut down, devastating impacts rippled outward—the port had provided 39 percent of Kobe’s income and employed 17 percent of its population (City Government of Kobe, 2010). Disruption of port services cost US\$300 million per month—the equivalent of income loss for 40,000 employees in port-related businesses, manufacturing, wholesale and retail trade (Chang, 2000a). Businesses absorbed higher transportation costs, and only from March to December 1995, these secondary costs amounted to approximately US\$4 billion.





hinterland and growing consumer markets (Containerisation International, 1998a). Busan, Republic of Korea's second largest city, in particular, stood to gain substantially (OECD, 2009).

Booming business never returned to the port despite efforts to improve competitiveness—efforts included reducing harbour dues, wharfage and land rental fees, and operating around the clock. It was like “pouring water into a bamboo basket” said Rinnosuke Kondoh, former deputy secretary general of the Tokyo-based International Association of Ports and Harbours (Containerisation International, 2003). Even without the earthquake, the port would have most likely gradually lost market share; but there is no doubt that its competitiveness was fatally weakened by the quake.

An investment of US\$163 billion in rebuilding Kobe meant that its damaged infrastructure was quickly reconstructed. But this did not lead to sustainable economic recovery. Until 1995, Hyogo Prefecture was growing roughly in line with Japan as a whole. Except during the post-earthquake stimulus, when reconstruction spending gave a temporary boost, its economy then slid into a long decline (Hayashi, 2011).

## 1.2 Dimensions of disaster

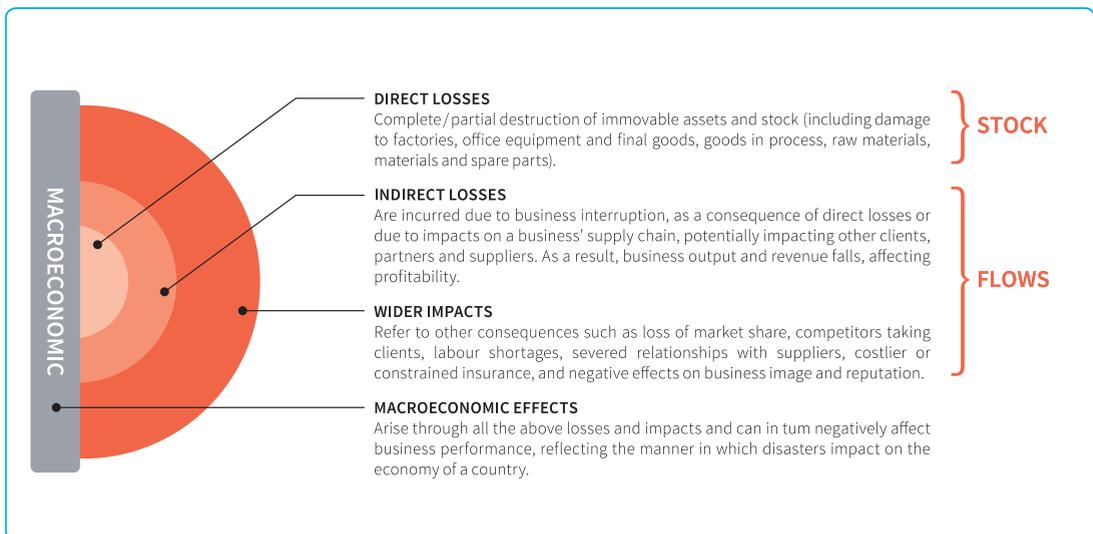
**The increasing frequency and scale of disasters is demonstrated by how businesses today suffer direct and indirect losses and a series of wider impacts and macroeconomic effects.**

Businesses are increasingly concerned with disaster-related direct losses to their assets or indirect losses in their supply chain causing a fall in output and revenue, thereby affecting profitability. But business is affected not only as a consequence of these losses but also owing to wider impacts and macroeconomic effects<sup>ii</sup> (Figure 1.1).

Businesses suffer direct losses when they have invested in locating factories, offices, plant, warehouses and other facilities in locations exposed to hazards such as floods, cyclones, earthquakes or tsunamis and without adequate investments to reduce risks.

But there are critical differences regarding how these losses affect business, depending on the kind

**Figure 1.1** The different dimensions of disaster losses, impacts and effects on business<sup>ii</sup>



(Source: UNISDR, adapted from PwC)

of disaster and size of business. Large global businesses are rarely at risk from smaller extensive disasters, but may be severely affected by major intensive events such as the 2011 Great East Japan Earthquake or the 2011 Chao Phraya river floods in Thailand. Such intensive disasters often cause massive direct capital losses to factories, plant and stock as well as to critical infrastructure such as ports, airports, power stations and urban mass transit systems.

For example, on 11 March 2011, the Great East Japan Earthquake and tsunami generated direct losses of about US\$206 billion,<sup>iii</sup> representing approximately 20 percent of average annual gross fixed capital formation from 2008 to 2012.<sup>iv</sup> Similarly, direct losses from the Chao Phraya river floods were approximately US\$45.7 billion, which equals more than 60 percent of Thailand's average annual gross fixed capital formation from 2006 to 2010.<sup>v</sup> Because so many businesses suffered simultaneously, the respective national economies were severely impacted. For example, at the beginning of 2011, Japan's projected annual GDP growth was 1.5 percent. Following the Great East Japan Earthquake, GDP fell by 3.1 percent in the first quarter of 2011 and by 2.1 percent in the second quarter of 2011 (Funabashi and

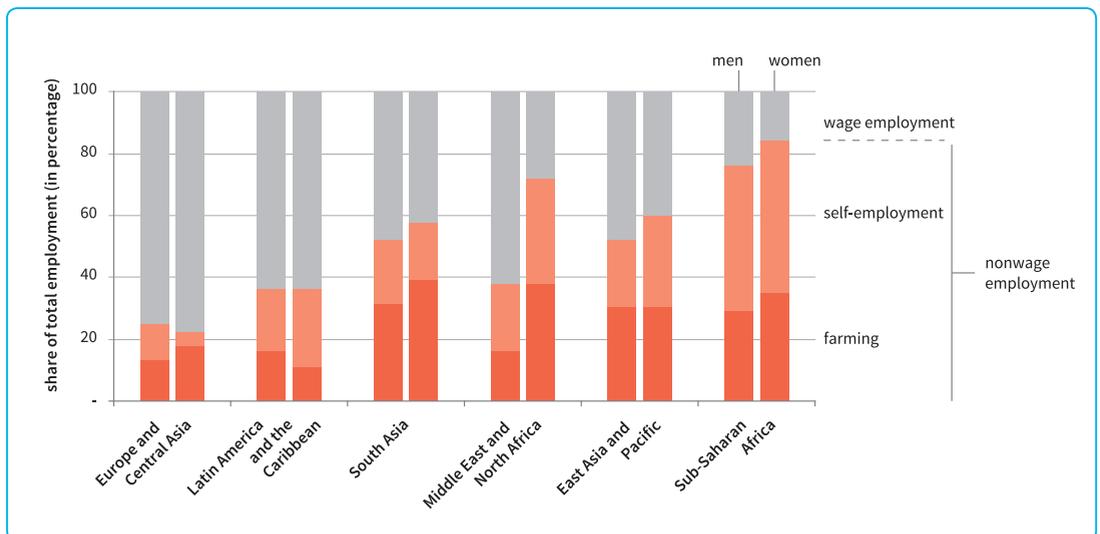
Takenaka, 2012). In Thailand, owing to damage to industrial estates<sup>vi</sup> by the Chao Phraya river floods, GDP fell by 9.0 percent in the fourth quarter of 2011 compared with the same quarter in 2010.

Following intensive disasters large global businesses may be less hard-hit owing to diversified facilities and operations spread over many countries and regions and to insurance coverage; often only a small percentage of such companies' global capital stock is affected at any given time.

Micro and small and medium enterprises (SMEs)<sup>vii</sup> play an important role in low, middle and high-income economies. They account for one-third of low-income countries' employment, and estimates of their contribution to total employment in high-income countries range from more than 50 percent (IFC, 2012) to 65 percent in OECD countries (UNDP, 2004) and 70 percent globally (ILO, 2012). In addition, they contribute between 51 percent and 55 percent of GDP in high-income countries (UNCTAD, 2005; Dalberg, 2011) and play a fundamental role in community dynamics (UNDP, 2013).

The informal business sector also plays a key role in employment in many economies. Smallholder

**Figure 1.2** Share of wage and non-wage employment across the globe



(Source: World Bank, 2012a)



farmers and informal small and micro-enterprises occupy the bulk of the labour force in many parts of Asia and Africa (Figure 1.2).

Compared with global businesses, informal sector producers and SMEs are far less resilient, particularly in low and middle-income countries. Smaller businesses are at risk to recurrent localised extensive disasters, such as landslides, fires, floods and storms. More likely to be located in hazardous areas, with evolving extensive risk, these businesses are less likely to have invested in protective risk-reducing schemes.

A single disaster may wipe out all or a large part of businesses' capital; and only a small percentage of these smaller businesses have insurance coverage. In Pakistan, for example, uninsured SMEs took longer to recover from the major floods in 2010 than larger businesses; a good majority of SMEs did not survive (Asgary et al., 2012).

These losses may result in poverty outcomes. In normal times, asset holdings in small businesses—ranging, for example, from fishing boats, carpentry and welding equipment and tools to farm implements—increase the income generating potential of poor households, leading to higher welfare and less poverty. Asset holdings also offer a crucial means to buffer disaster losses (UNISDR, 2009). In the absence of formal and informal credit and insurance markets or safety nets and social security, however, the loss of asset holdings can reduce consumption in the short term and lead to an observable deterioration in health, nutritional and educational status and other welfare problems in the longer term. Disasters for business thus translate into disasters for households and communities.

## 1.3 When business loses its lifelines: indirect losses and infrastructure damage

**Infrastructure—such as road, power and water networks, and health and primary education facilities—is a basic requirement of a competitive economy. Businesses rely on functioning utilities and communications networks, which are provided by a range of public and private actors. It is therefore vital for competitiveness and sustainability of an enterprise to ensure that critical infrastructure is resilient to shocks.**

When infrastructure fails, businesses experience indirect losses, as production, distribution and supply chains are interrupted; consequently, production, output and throughput are reduced. Even when businesses do not experience direct losses, they depend on publicly managed or regulated roads and transportation lines, energy and water networks as well as on a workforce that in turn depends on housing, education and health facilities.

In New York and New Jersey, for example, many businesses that did not suffer direct losses caused by Super-storm Sandy (Box 1.2) were affected by transport and power network failures, airport closures and difficulties faced by employees whose homes were damaged or unable to get to work.

Intensive disasters such as Super-storm Sandy or the 2011 East Japan Earthquake can damage major infrastructure facilities such as mass transit systems, power stations, ports and airports. However, most damage to local infrastructure is associated with extensive disasters. In Figure 1.4, disaster loss data from 56 countries show that more than 90 percent of damage to roads, power and water supplies and telecommunications is associated with extensive risk.

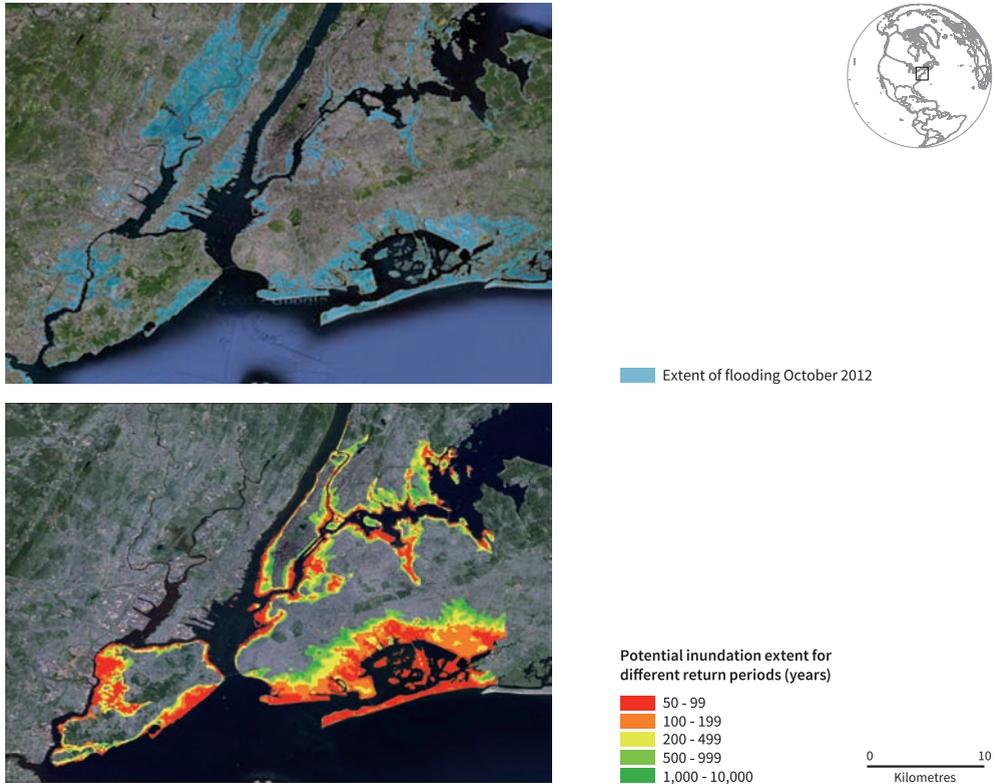
This example highlights the critical interdependence between business and the public sector. Although public investment may be no more than 15 percent

**Box 1.2** 'Super-storm' Sandy<sup>viii</sup>

In October 2012, sub-tropical storm Sandy triggered the evacuation of thousands from the East Coast of the United States of America, leading to the shut-down of national and local transport systems and severely disrupted electricity and communication supplies, with power cuts affecting an estimated 8.5 million homes and businesses (RMS, 2012). Of the refineries in the East Coast of the United States of America, 70 percent had to be shut down for days; many New York City metro line subways were flooded; and about 15,000 flights were grounded across the Northeast (Time, 2012). Equity trading on all markets was cancelled for two days—the first two-day shutdown since 11 September 2001 (IHS Global Insight, 2012).

As Figure 1.3 shows, the event confirmed results from existing models that showed how New York would be at risk of severe losses from storm surges and flooding.

**Figure 1.3** Extent of flooding in New York City due to Super-storm Sandy (top) compared with a hazard map showing areas that could be expected to be flooded due to storm surges (bottom)



(Source: Swiss Re Hurricane Storm Surge Model)

Soon after the storm passed, it was clear that indirect losses to business activity caused by disruption to public transport and energy supplies were likely to be greater than direct losses (EqCat, 2012; IHS Global Insight, 2012). The disaster revealed the dependency of businesses on publicly managed or regulated infrastructure.

(Source: UNISDR)



**Figure 1.4** Proportion of infrastructure damaged in extensive disasters in 56 countries and 2 Indian states, between 1970 and 2011



(Source: UNISDR, based on National Disaster datasets for 56 countries and 2 states)

**La Niña in Colombia** 

**Box 1.3** La Niña in Colombia

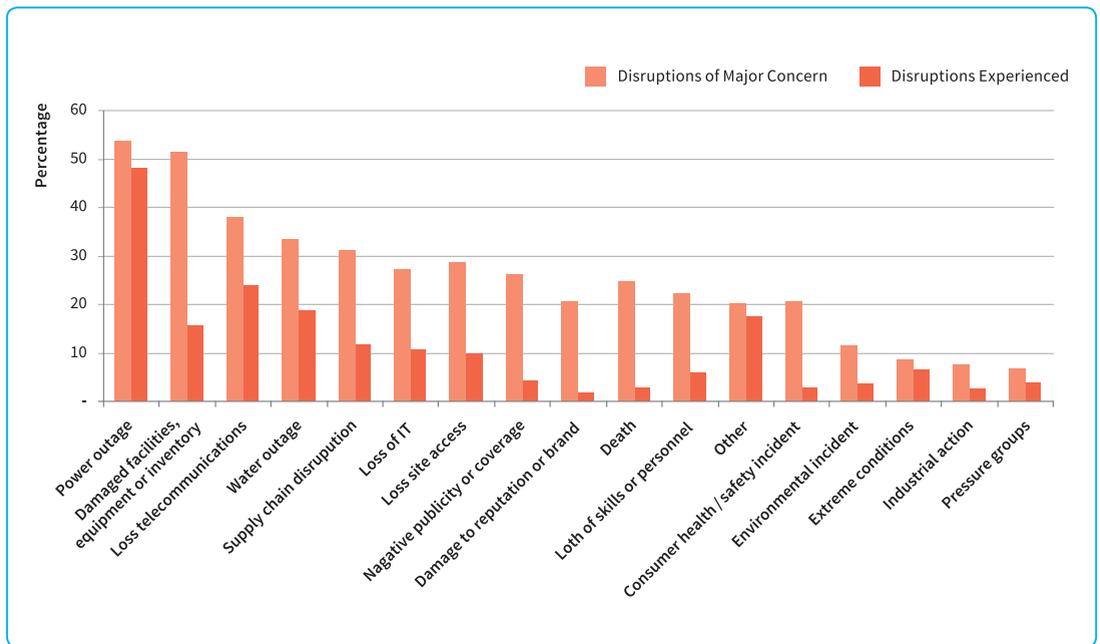
Between 2010 and 2012, a very strong, though not exceptional, La Niña affected Colombia. Of the country’s 1,041 municipalities, 93 percent were affected, mainly by flooding (OSSO, 2012) over a 14-month period.

Direct economic loss was estimated at about US\$6 billion, representing nearly 6 percent of the country’s gross capital formation (CEPAL, 2012). By the end of 2011, insured losses had exceeded US\$600 million, including US\$76 million to repair a flooded thermoelectric power plant (Marsh, 2012). Although only a small proportion of total losses were insured, the disaster resulted in an increase in deductibles for insurance of flood-related damage and loss. SMEs were particularly affected given that many were uninsured and did not have access to resources required for business recovery. Similarly, 93–95 percent of estimated household losses were uninsured (Fasecolda, 2011).

The housing and infrastructure sectors (transport and energy) each accounted for 38 percent of total direct losses. In particular, 14 percent of the national road network and 3 percent of its bridges were damaged. This represented US\$1.7 billion in repairs in 2011 alone (Government of Colombia, 2011).

(Source: UNISDR)

**Figure 1.5** Hazard-related business disruptions: of major concern and that actually had been experienced during the last five years (in percent)



(Source: Sarmiento and Hoberman, 2012)

of total capital formation in many countries, how that investment is made, managed and regulated is fundamental to business resilience, competitiveness and sustainability. If public infrastructure is vulnerable, business is also at risk.

In Costa Rica, for example, direct disaster losses totalled US\$1.8 billion between 1988 and 2009. Of these, 62 percent were in public infrastructure, of which more than half was located in the business-critical transport sector (Government of Costa Rica, 2010).

In Colombia, road networks represent a major challenge to business competitiveness. As Box 1.3 shows, this competitiveness was eroded during the 2010–2011 El Niño Southern Oscillation (ENSO) episodes,<sup>ix</sup> when a large number of extensive disasters caused major damage.

The importance of public infrastructure for business is confirmed in a survey carried out for this report in six disaster-prone cities of the Americas.<sup>x</sup> As Figure 1.5 shows, three of the top four hazard-related

business disruptions – both of major concern and that had actually been experienced during the last five years – were related to disruptions in power, telecommunications and water utilities (Sarmiento and Hoberman, 2012).

Although larger businesses normally have the cash flow and reserves to absorb indirect losses, many smaller businesses simply never recover. Smaller businesses have a reduced, more localised customer base—often affected during disasters (UNDP, 2013; Battisti and Deakins, 2012). When lack of local customers reduces demand and thus cash flow, smaller businesses’ financial resources for recovery are limited (Villarroel, 2012; Vitez, 2013).

## 1.4 Globally integrated disasters: supply chain interruption

**Global trade, financial markets and supply chains have become increasingly interconnected. When disasters occur in globally integrated economies, the impacts ripple through regional and global supply chains causing indirect losses to businesses on the other side of the globe.**

As supply chains become globalised, so does the vulnerability of businesses to supply chain disruptions, for example, when disasters affect critical production nodes or distribution links. The interruption of one critical node or link produces regional and global ripples throughout the supply chain.

Global supply chains increasingly supply disaster risks as well as parts and services. For example, a survey of businesses in 62 countries found that 85 percent of organisations had experienced at least one supply chain interruption in 2011. Of these, 51 percent were caused by weather-related hazards and another 20 percent by earthquakes in Japan and New Zealand (BCI, 2011).

The impacts of the Eyjafjallajökull volcanic ash cloud in Iceland in April 2010 demonstrated how an eruption could affect business in a globalised world (Munich Re, 2010). For up to six days, air traffic in most European countries was shut down; and airlines lost US\$1.7 billion in revenues.<sup>xi</sup> At its peak, the crisis impacted 29 percent of global aviation and affected

### 3.11 Tsunami



**Box 1.4** From Japan to Thailand and back again

Following the 2011 earthquake and tsunami, automobile and electrical component production in Japan declined by 48 percent and 8 percent, respectively. But automobile production also fell by 20 percent in Thailand, 18 percent in the Philippines and 6 percent in Indonesia. Electrical component production fell by 18 percent in the Philippines and 8 percent in Malaysia (Ye and Abe, 2012).

The Renesas Electronics Corporation, the world's largest custom manufacturer of microchips for the automobile industry, and which serves Japanese automobile manufacturers, suffered estimated losses of US\$615 million. Toyota lost US\$1.2 billion in product revenue owing to parts shortages that caused 150,000 fewer Toyota automobiles to be manufactured in the United States of America; production stoppages at five plants in the United Kingdom; and reductions in production of 70 percent in India and 50 percent in China (Asano, 2012).

Following Tropical Storm Nock-Ten and heavy monsoon rains, the Chao Phraya River flooded in Thailand, inundating 15 provinces of the country (Haraguchi and Lall, 2012). From October to December 2011, more than 1,000 factories of 804 companies were flooded for up to two months. Of these companies, 451 were Japanese (Ibid.).

Although the factories of Nissan and Toyota were not flooded, they had to suspend car production owing to the difficulty in obtaining parts from affected suppliers. In November 2011, automobile production fell by 84 percent compared with the same month in 2010. Given that Thailand plays a key role in global supply chains in the electronics and automobile industries, Honda factories in Malaysia, North America and Japan had to reduce or halt production. Total loss of operating profit to Toyota and Honda was estimated at US\$1.25 billion and US\$1.4 billion, respectively. As in the case of the Japan earthquake, a significant proportion of these losses were because of one affected supplier that produced critical electronic components (Haraguchi and Lall, 2012).

At the time, Thailand also produced 43 percent of the world's hard disk drives (Okazumi et al., 2012). Leading producers such as Seagate, Western Digital, Toshiba and Hitachi were all located in the flooded area. During the floods, hard disk drive production fell by 77 percent, causing the price of some hard disk drives to triple between November 2011 and February 2012 (Ye and Abe, 2012).

Given the large number of Japanese companies in Thailand, Japan's manufacturing production index fell by 2.4 percent between October 2011 and January 2012, led by a reduction in electrical component production, which fell by 3.7 percent (Ibid.).

(Source: UNISDR)

1.2 million passengers a day.<sup>xiii</sup> Businesses also lost billions in uninsured losses (Munich Re, 2010). Insurance payments are only made if business interruption is preceded by physical damage to the insured property itself or – with extended coverage – a supplier of parts or utility company. In this case, aircraft were not damaged; they were simply grounded.

In Japan and Thailand, businesses in areas affected by the 2011 disasters suffered direct loss to property, plant, equipment and stock or were indirectly impacted by power shortages or by damage to roads, railways and ports. As Box 1.4 shows, these losses and impacts had systemic regional and global implications.

Many large global businesses rely on SMEs as partners and suppliers, which means that supply chain risk is directly related to the capacity of SMEs to manage their disaster risks. Given that, as

highlighted above, the most frequent disaster risks faced by SMEs are related to utilities such as power, water and telecommunications; interdependence also exists between disaster risk management in the public sector and supply chain risk.

## Thailand floods



# 1.5 When business leaves, it may never return

**As the decline of the Port of Kobe highlighted, some businesses never recover from disaster. The wider impacts of disaster can linger for years, undermining longer-term competitiveness and sustainability.**

As investors have learned, market share may be lost after disasters occur. Business image and reputa-

### Box 1.5 Impacts of disasters on the nuclear industry

Less than an hour after the 11 March 2011 Great East Japan Earthquake hit, tsunami waves reached the Fukushima Daiichi nuclear power plant, exceeding the design parameters of the plant by approximately 5 metres and knocking out the emergency power and seawater cooling pumps. In the next days, three reactors suffered hydrogen explosions and fuel meltdowns causing a major release of radioactivity. Approximately 150,000 residents were evacuated, a restricted area of 20 kilometres around the plant was enforced, restrictions were placed on food produced in the region and all nuclear reactors in the country were shut down, immediately reducing national electricity production by approximately 30 percent (National Diet of Japan, 2012).

Before the disaster, the global nuclear industry was enjoying something of a renaissance, with plans for an expansion of generation capacity, averaging about 1 percent per year in OECD countries and 6 percent in non-OECD countries (Joskow and Parsons, 2012). These plans were driven by a number of considerations, including meeting targets for reductions in CO<sub>2</sub> emissions by 2020 and 2050, rising fossil fuel prices, technological improvements and a more favourable political environment. China, for example, planned to increase electricity generated by nuclear power from 1 percent to 6 percent by 2020, and Japan planned to increase the contribution of nuclear power from 30 percent to 50 percent (Ibid.).

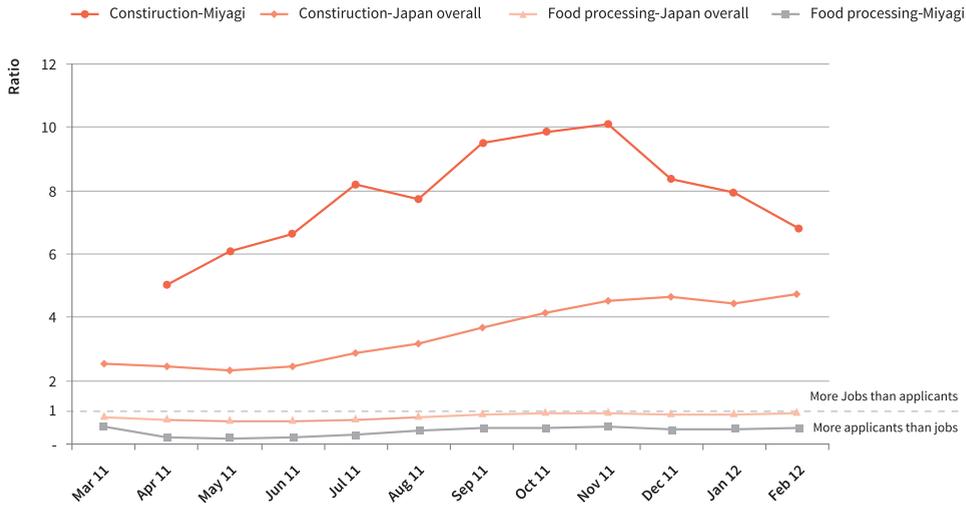
The Fukushima disaster questioned the safety of the nuclear power industry. Before the disaster, Germany, Switzerland and Japan together accounted for approximately 20 percent of global nuclear power production (Joskow and Parsons, 2012). In September 2012, following the Official Report of the Fukushima Nuclear Accident Independent Investigation Committee (National Diet of Japan, 2012), Japan announced that it would phase out nuclear power by 2040, although subsequently the new administration announced they would not follow this commitment, after considering energy and economic issues. Four days after the earthquake, on 15 March 2011, Germany permanently shut down the 8 oldest of its 17 nuclear units and in June 2011, Parliament passed a law to phase out the remaining plants by 2022 (Joskow and Parsons, 2012). The Swiss Federal Council also recommended that existing reactors be closed at the end of their licenses and not replaced; the final reactor would close in 2034 (Ibid.).



**Box 1.6** Disaster impact on employment and SMEs

Employment in the Tohoku region of Japan was affected by both the global financial crisis beginning in 2008 as well as by the Great East Japan Earthquake in 2011. Though employment recovered quickly after both shocks, following the earthquake, there was a mismatch between labour demand and supply. For example, in the construction sector, there were 10 jobs available for every applicant, but in the locally important food-processing sector, there were 2 applicants for every job (Figure 1.6). Employment for women recovered slower than for men, partly because of the slow recovery of the female-dominated food processing sector, whereas new employment opportunities in the construction sector were mainly for men.

**Figure 1.6** Ratio of job openings per application in construction and food processing, in Miyagi prefecture and Japan overall after the Great East Japan Earthquake



(Source: UNISDR, based on Miyagi Labor Bureau)<sup>xv</sup>

The disaster affected SMEs particularly hard. One-third of SMEs had still not restarted business 10 months after the disaster in January 2012 (Government of Japan, 2012a). SMEs processing marine products were particularly affected by the tsunami. By January 2012, 50 percent had not resumed business and 30 percent had decreased their workforce (Ibid.).

After reconstruction is completed, labour demand in the construction sector in Tohoku will decrease. A Japanese think-tank estimates that unless new employment opportunities are created, 14,000 employees will have to change jobs and 82,000 will be forced to migrate to other regions by 2017 (Nomura Research Institute, 2011). Although reconstruction temporarily supports employment, efforts will be needed to boost and strengthen promising new industries as well as to invest in disaster risk reduction.

In the area affected by the Canterbury Earthquakes in New Zealand in 2010 and 2011, 97.2 percent of all enterprises were SMEs as of February 2011.<sup>xvi</sup> In New Zealand, 75 percent of all enterprises in all sectors are SMEs, employing 30 percent of the working population and producing an estimated 40 percent of total value-added output. Although it is not known how many SMEs went out of business, in April 2012, 37 percent out of 128 surveyed SMEs in Christchurch reported reduced revenues. In another survey, 51 percent of businesses reported reduced revenue.

Employment declined significantly, on the one hand, in the women-dominated retail trade, accommodation and food services sectors—from 54,100 in June 2010 to 41,600 in June 2012 (Parker and Steenkamp, 2012). Employment in the construction sector, on the other hand, boomed from 25,900 to 32,800 in the same period (Ibid.). These phenomena show, as in Tohoku, Japan, that problems emerged with job mismatch creating new challenges for women in the labour market.

(Source: UNISDR)

tion may also be permanently damaged affecting longer-term sustainability. Insurance may become more expensive and its availability constrained. The 2011 Thailand floods, for example, caused a number of insurance and reinsurance companies to pull out of the Thai market altogether (AON Benfield, 2012a).

And these wider impacts may undermine entire industry sectors, as occurred with the global nuclear industry following the 2011 East Japan Earthquake and tsunami (Box 1.5).

The fate of businesses and cities and countries where they are located are mutually dependent. For example, productive and resilient businesses boost the prosperity of cities and countries that are attractive to investors, competitive and more likely to sustain growth. Likewise, competitive and resilient cities and countries provide an environment for productive and competitive businesses.

Disasters, however, can negatively affect the basic requirements for competitiveness, including sound infrastructure, macroeconomic stability and a healthy and educated workforce (WEF, 2012). As such, countries that are unable to manage their disaster risks are likely to be less competitive in the medium and longer terms. For example, disaster losses in Costa Rica from 2005 to 2009 were equivalent to 20 percent of its total public investment during that period. The resources spent on rehabilitating and reconstructing damaged infrastructure could have been spent on new roads, schools and health facilities and in building a more competitive economy (Government of Costa Rica, 2010).

Following intensive disasters, countries may find it more difficult to attract foreign direct investment (FDI), as investors flow to geographic competitors. Following the 2011 Chao Phraya river floods, several large companies relocated their plants either to less hazard-exposed areas of Thailand or to other countries in the region.<sup>xiii</sup> More than 60 percent of directly affected manufacturers, mainly from

the electronics sector, temporarily relocated their production to other Asian countries, and several considered permanent relocation (Ye and Abe, 2012; JCCB, 2012).

In Japan, a survey undertaken just two months after the 2011 disaster shows that companies were concerned with increased production costs due to power outage induced interruptions and fragile supply chains.<sup>xiv</sup> Almost 70 percent of companies surveyed considered the possibility of relocating parts or all of their production and suppliers abroad (Ibid.). Partly due to the disaster, the government postponed important policy decisions; such as its participation in the Trans Pacific Partnership (TPP) Agreement and a proposed reduction in corporate income tax, which would have improved competitiveness (Funabashi and Takenaka, 2012).

Disasters also have crucial consequences on employment. They directly affect the labour market for businesses, particularly SMEs, as well as for household economies and the macroeconomic environment. Box 1.6 highlights how disasters affected the labour market and SMEs following the 2011 Great East Japan Earthquake and the Canterbury Earthquake in New Zealand.

These wider impacts of a disaster are difficult to quantify but ultimately and over and above the direct and indirect losses suffered, may define disaster, both for business as well as for their employees and the countries and cities competing to attract business investment.



## 1.6 Business as usual?

**It's no longer business as usual. Disaster losses and impacts are presenting critical problems for businesses of all sizes, ranging from major global corporations to SMEs to informal sector producers.**

This chapter has highlighted how businesses not only face massive direct losses from floods, storms and earthquakes, but also depend on publicly managed and regulated infrastructure and services that can be interrupted by disasters. In a globalised economy, supply chains may be vulnerable to events occurring on the other side of the globe. Disasters can also lead to longer-term declines in business competitiveness and sustainability.

For these reasons, disaster risk is becoming a growing concern to business. Businesses are now getting to know their risks and exploring ways in which to reduce them. These nascent efforts are more often than not based on voluntary mechanisms within businesses and among business partners.

All business investment decisions have the potential to either increase or decrease disaster risk. The rest of this report is concerned with how those decisions are made and with the factors that mediate and condition those decisions. The report also highlights how investing in disaster risk management can be a compelling proposition in shared value, for businesses themselves as well as for the cities and countries competing to attract investment.

GAR13 comprises three main parts. Part I examines the new landscape of intensive and extensive risk (Chapter 2) and presents results from the new global risk model for earthquakes and tropical cyclones, as well as new exposure data for tsunamis and a proof of concept for floods (Chapter 3). In addition, this part features an analysis of the scale of economic losses associated with extensive risk (Chapter 4) and the implications for a country's economic and

financial resilience (Chapter 5); the risks to natural capital posed by wild-land fires, land degradation and agricultural drought (Chapter 6) and the special case of Small Island Developing States (Chapter 7).

Part II explores how disaster risk has become endogenous to the contemporary globalised economic landscape through business investment decisions that have usually externalised disaster risk. It analyses how investors have made business investment decisions that increase risks in key sectors such as urban development (Chapter 8), tourism (Chapter 9) and agribusiness (Chapter 10).

Part III presents how both global corporations and smaller businesses are managing disaster risk, including in global supply chains (Chapter 11) and how their investment decisions are mediated by investment markets and the role of insurance (Chapters 12 and 13). It further analyses how governments as regulators and mediators of investment, in a global economy, occupy changing roles and have yet to fully embrace a prospective approach to disaster risk management (Chapters 14 and 15).

Chapter 16 concludes and brings together several key findings of the report. It elaborates on how creating shared value can become a key feature of effective disaster risk management and – more important – how disaster risk management contributes to creating shared value for business and society essential for achieving economic stability, growth and sustainable development in a globalised landscape beyond 2015.

## Notes

i Macroeconomic effects are included to some extent in all of these estimates but are a different way of representing them; they should therefore not be added to the direct and indirect losses or wider impacts.

ii This figure constitutes a simplification of the different categories that might partly overlap. Care must be taken when calculating total loss to avoid double counting. For example, the direct structural losses to a plant may be assessed either through the damage to the capital stock (e.g. production plant) or the equivalent loss of flows (i.e. future production).

iii Exchange rate of 1US\$=JP¥81.84. The estimate was reported in June 2011 by the Cabinet Office of the Japanese Government (<http://www.bousai.go.jp/oshirase/h23/110624-1kisyu.pdf>). It estimates damages to buildings, lifeline facilities and infrastructures and excludes the impact of the Nuclear Power Plant accident.

iv Here and in the next case of Thailand, data of gross fixed capital formation of the World Bank's World Development Indicators were used: <http://data.worldbank.org/indicator/NE.GDI.FTOT.CD?page=1>.

v Economic loss as estimated by the World Bank in December 2011 (<http://www.worldbank.org/en/news/2011/12/13/world-bank-supports-thailands-post-floods-recovery-effort>). This estimate includes not only loss to physical investment but also other components such as loss to lost revenue by tourism and loss of agricultural output.

vi In the same quarter, the manufacturing sector declined by -21.8 percent. Given that manufacturing represented 39 percent of Thailand's GDP in 2011, it was the disruption of the manufacturing sector that had such a large influence on the Thai economy.

vii Small and medium enterprises are independent companies that have a smaller number of employees than a defined threshold. This threshold is different across countries. The OECD mentions the following thresholds: less than 250 employees in the European Union and fewer than 500 in the United States of America. However, in many countries, the threshold may be significantly lower, and small firms can be defined as having 10-50 employees, while micro-enterprises can be defined as having 1-10 workers (<http://stats.oecd.org/glossary/detail.asp?ID=3123>).

viii References used in this box: NOAA National Climatic Data Centre, 2012 [www.ncdc.noaa.gov/news/summary-information-post-tropical-cyclone-sandy](http://www.ncdc.noaa.gov/news/summary-information-post-tropical-cyclone-sandy); NOAA National Weather Service, 2012 [www.erh.noaa.gov/phi/storms/10292012.html](http://www.erh.noaa.gov/phi/storms/10292012.html); RMS, 2012 [www.rms.com/news/newsannouncements/Newspress.php?id=0.xml](http://www.rms.com/news/newsannouncements/Newspress.php?id=0.xml); Time, 2012 <http://business.time.com/2012/10/31/hurricane-sandy-estimated-to-cost-60-billion>; IHS Global Insight, 2012 <http://www.ihs.com/products/Global-Insight/industry-economic-report.aspx?ID=1065972961>; EqueCat, 2012 [www.eqecat.com/catwatch/post-landfall-loss-estimates-superstorm-sandy-released-2012-11-01/](http://www.eqecat.com/catwatch/post-landfall-loss-estimates-superstorm-sandy-released-2012-11-01/); Financial Times, 2012 <http://www.ft.com/cms/s/0/c8f6c208-24f4-11e2-86fb-00144feabdc0.html#axzz2CtH3Q5xJ>.

ix El Niño Southern Oscillation (ENSO) refers to the interaction between the global atmosphere and the tropical Pacific Ocean. It results in changes to weather patterns and ocean temperature across the globe, including changes in rainfall and storm patterns, and occurrence of floods and droughts. Within these changes, the El Niño phenomenon is associated with unusually warm ocean surface temperatures; La Niña is associated with particularly cold oceanic temperatures. Both occur approximately twice in a seven-year period and last for typically 9–12 months and occasionally up to two years. For exact definitions and more information, see: UNISDR terminology - [preventionweb.net/english/professional/terminology/v.php?id=480](http://preventionweb.net/english/professional/terminology/v.php?id=480) and WMO factsheets - <http://www.wmo.int/pages/mediacentre/factsheet/LaNinaQA.html>.

x This survey, carried out by Florida International University (FIU), York University and the Central American Institute for Business Management (INCAE), covered Vancouver, Canada; Miami, United States of America; Kingston, Jamaica; San Jose, Costa Rica; Bogota, Colombia and Santiago, Chile.

xi <http://www.iata.org/pressroom/pr/Pages/2010-04-21-01.aspx>.

xii <http://www.iata.org/pressroom/pr/Pages/2010-04-21-01.aspx>.

xiii Western Digital and Nidec, two important global players in the production of hard disk drive components, have relocated some of their manufacturing to Malaysia, China and less hazard-prone regions in Thailand. For more information: <http://e.nikkei.com/e/fr/tnks/Nni20121006D06JF389.htm> and <http://www.ft.com/cms/s/0/7d36186e-2937-11e1-8b1a-00144feabdc0.html#axzz2DuUmiO4x> (accessed 02/12/2012).

xiv Ministry of Economy, Trade and Industry, Government of Japan: [http://www.meti.go.jp/committee/summary/0003410/013\\_s01\\_00.pdf](http://www.meti.go.jp/committee/summary/0003410/013_s01_00.pdf)

xv Miyagi Labor Bureau, "Balance of job openings and application," [http://miyagi-roudoukyoku.jsite.mhlw.go.jp/jirei\\_toukei/kyujin\\_kyushoku/toukei/anteisyobetsu\\_kyujinkyusyoku\\_balance.html](http://miyagi-roudoukyoku.jsite.mhlw.go.jp/jirei_toukei/kyujin_kyushoku/toukei/anteisyobetsu_kyujinkyusyoku_balance.html).

xvi Data in this paragraph are taken from Hatton, Seville and Vargo (2012), unless otherwise stated.





**Part I**

# **The Globalised Landscape of Disaster Risk**

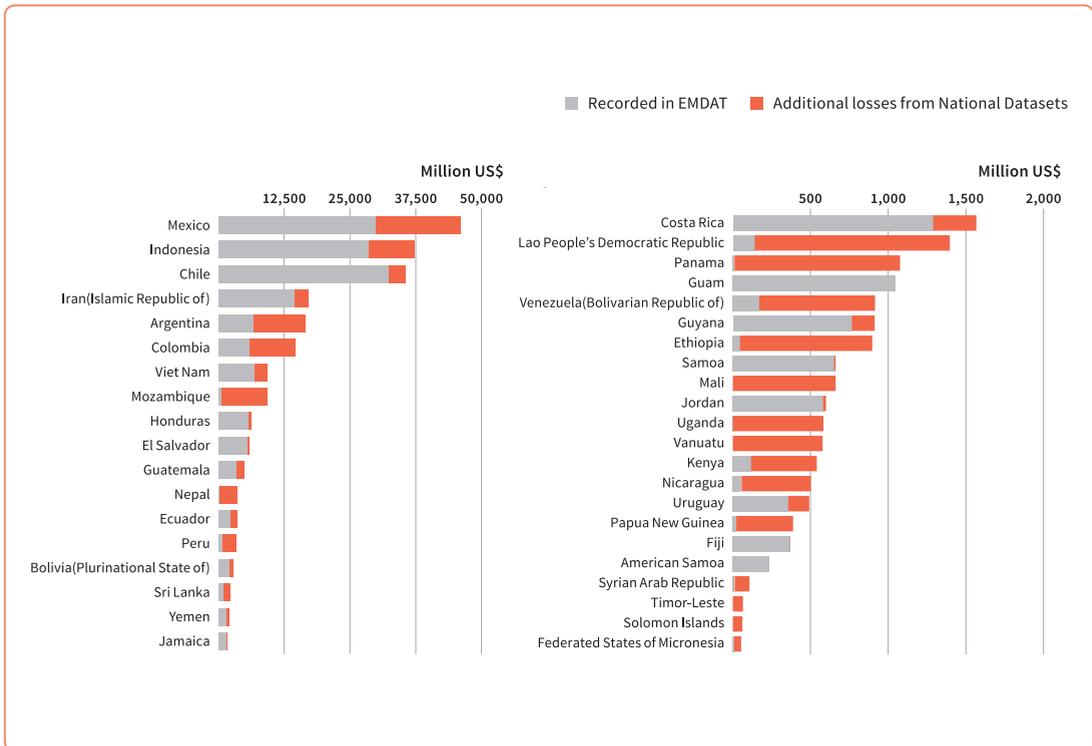
“One trillion dollars have been lost in the last decade due to disasters and one million people killed”.<sup>i</sup> Such statements are familiar to investors and business developers. But they only partially reflect total disaster losses.

The full scale of disaster losses is still not fully understood. Reliable data exist on insured losses<sup>ii</sup> and many major, intensive disasters are comprehensively assessed.<sup>iii</sup> Between 2001 and 2011, global reinsurer Munich Re. reported about US\$1.68 trillion in losses (Munich Re., 2012), a calculation based on insured losses and estimates of insurance market penetration. Over the same period, EMDAT<sup>iv</sup>, the major public global disaster database, reported US\$1.25 trillion in losses. But neither provides a complete picture of global disaster losses, as none accounts for uninsured losses associated with recurrent, smaller-scale, extensive disasters, particularly in low and middle-income countries.

A growing number of national disaster databases now provide access to detailed data on these losses. When combined with assessments of direct losses in major disasters as recorded by EMDAT, these data provide a more complete picture of the real dimension of direct disaster losses. Figure I.1 shows what this picture might look like in the 40 low and middle-income countries with the largest losses recorded in national disaster databases.

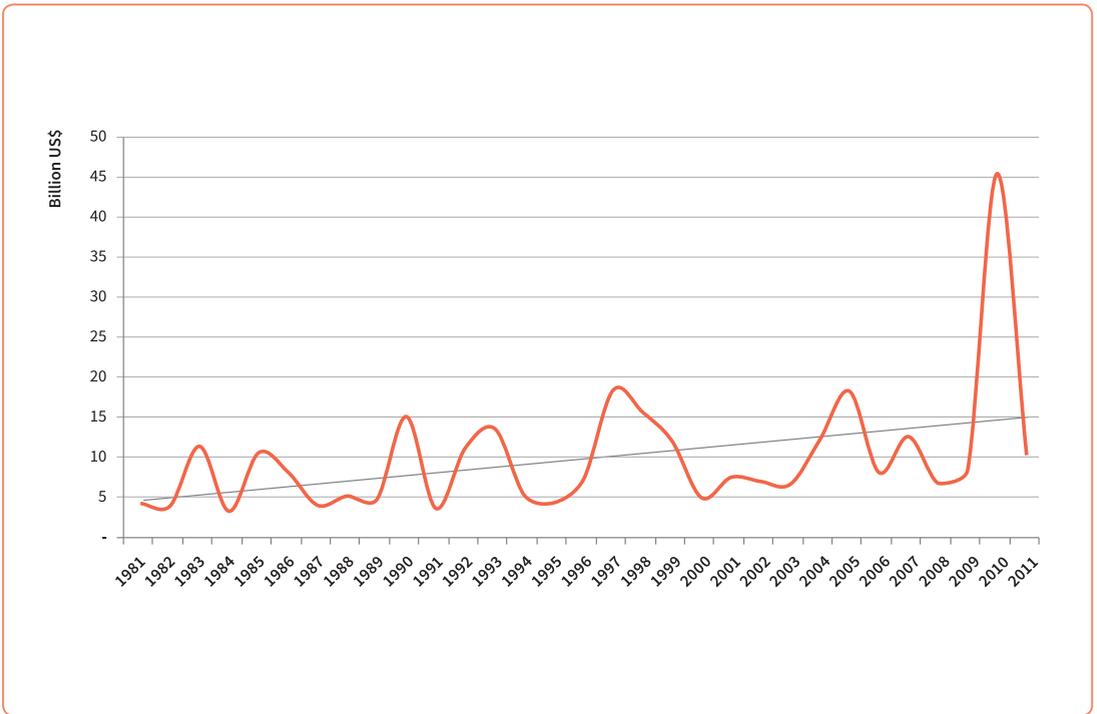
Direct economic losses in housing, local infrastructure and agriculture were modelled for all smaller disasters documented by national disaster databases but not captured by EMDAT. Losses documented in EMDAT for larger disasters include estimates of damage to large capital intensive infrastructure that are generally not captured in national disaster databases. The resulting combined dataset provides the most complete estimate of direct disaster losses possible with

**Figure I.1** Direct economic losses in 40 countries as estimated from national and global loss databases, 1981–2011 (in million US\$)<sup>v</sup>



(Source: UNISDR, based on DesInventar and EM-DAT combined datasets)

**Figure I.2** Loss trends in 40 countries as estimated from national and global loss databases, 1981–2011 (in billion US\$)<sup>vii</sup>



(Source: UNISDR, based on DesInventar and EM-DAT combined datasets)

existing publicly available data. The detailed methodology used to model and estimate economic losses is described in Annex 2.

Between 1981 and 2011, total direct losses in these countries were approximately US\$305 billion, of which internationally reported events represent about 67 percent. The implication is that the headline-grabbing figures recorded in global datasets over the last decade may be quite conservative. Once the losses associated with nationally reported smaller disasters are included, those figures are likely to be at least 50 percent higher. At the same time, these figures refer only to direct losses and thus exclude the cost of indirect losses and wider effects of disaster.

As Figure I.2 shows, disaster losses in the same set of countries have been trending upward over this period.

The chapters that follow in Part I explore how investment decisions and capital flows are internalising disaster risk in different kinds of capital stock, thereby increasing the overall stock of risk.

Chapters 2 and 3 examine the new landscape of intensive and extensive risk and present results from the new global risk model for earthquakes and tropical cyclones, as well as new exposure data for tsunamis and regional examples for floods and landslides.

Chapter 4 features an analysis of the scale of economic losses associated with extensive risk, and Chapter 5, the implications for a country's economic and financial resilience.

The risks to natural capital posed by wild-land fires, land degradation and agricultural drought are presented in Chapter 6, and the special case of Small Island Developing States in Chapter 7.



## Notes

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**i** See for example: [http://www.undp.org/content/undp/en/home/presscenter/events/2012/october/international\\_day\\_disaster\\_reduction](http://www.undp.org/content/undp/en/home/presscenter/events/2012/october/international_day_disaster_reduction).

**ii** Swiss Re. publishes regular updates on insured losses globally via its SIGMA statistics and publications (e.g. Swiss Re 2012). MunichRe., via its NatCatService platform and its Touch – Natural Hazards service portal, provides analyses, statistics and services on all aspects of natural hazards: <http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx>.

**iii** Governments, with the support of the UN, the World Bank or regional development banks, conduct economic assessments of intensive disasters using variations of the ECLAC methodology (ECLAC, 2003).

**iv** EMDAT: The OFDA/CRED International Disaster Database: [www.emdat.net](http://www.emdat.net). Université catholique de Louvain – Brussels – Belgium. EMDAT is a global database that registers reports of disasters above its threshold of 10 deaths, 100 affected people, or a call for international assistance.

**v** Only the 40 countries with the highest losses were selected for this graph to enable visualisation at common scales. See Annex 2 for information on progress in the development of national disaster loss databases, economic loss estimation and merging of global and national datasets.

**vi** See [www.munichre.com/touch/naturalhazards](http://www.munichre.com/touch/naturalhazards) and [www.emdat.be](http://www.emdat.be).

**vii** Only the 40 countries with the highest losses were selected for this graph to enable visualisation at common scales. See Annex 2 for information on progress in the development of national disaster loss databases, economic loss estimation and merging of global and national datasets.

## Chapter 2

# The Hidden Risks of Economic Globalisation



Disaster risk has been etched into the contemporary economic landscape largely through investment decisions. In most countries, **70 percent to 85 percent of total investment is made by the private sector** – small and large companies, investors and households. How these **investments** are made, directly **determines levels of disaster risk**. They shape the direction of capital flows and the level of disaster risk that is **internalised in the capital stock** or assets produced. To date, these investments have largely **increased disaster risk**.

As a consequence, the **wealth of countries** has repeatedly been eroded by disasters through **loss of and damage to its capital stock**. When produced, human and natural capital is affected by disasters; the **competitiveness and sustainability** of economies can be **severely compromised** with long-term negative impacts. These **risks and the resulting costs are often transferred to and shared with other locations, actors or times**.

## 2.1 The wealth of nations at risk

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**The wealth of a country in the form of produced, human and natural capital can be severely affected by disasters. In such cases, even a temporary inability of local and national economies to attract capital may have long-term negative impacts.**

Disasters are often still described as exogenous shocks (G20/OECD, 2012). In reality, disaster risk is endogenous to investment and assets. Extreme hazards, such as major earthquakes, volcanic eruptions and destructive tsunamis, can certainly be described as exogenous events. But the losses and impacts that characterise disasters usually have as much to do with the exposure and vulnerability of capital stock as with the severity of the hazard event.

Capital stock can be divided into three categories: produced capital (including machinery and structures and urban land); intangible capital (including human and institutional capital); and natural capital (including energy, mineral and forest resources, crop and pasture land and protected areas) (World Bank, 2011; UNU-IHDP and UNEP, 2012).<sup>i</sup>

Disaster risk becomes internalized in and endogenous to these different categories of capital stock,

reflecting how and where investment decisions orient capital flows, in the context of a range of mediating factors, including government regulation and incentives, insurance availability and pricing and financing. In other words, disaster risk is not natural but is produced through investment decisions and the range of factors that mediate those decisions.

Since the last global economic crisis of the mid-1970s, a new economic globalisation has transformed the world beyond recognition—in its economy, society, politics, culture, territory and environment. It is beyond the scope or objective of this report to analyse the complexity or dynamics of these transformations. But if economic globalisation has changed the pathways through which capital flows, then the landscape of disaster risk will also have been transformed.

Over recent decades, spatial barriers to investment have been continuously eroded. Technological innovations such as containerization, satellite communication and the internet; the liberalization of trade and financial markets; new organizational models based on networks rather than hierarchies and the emergence of important new markets are only some of the components that have enabled and encouraged large businesses to decentralize, outsource or off-shore all or part of their operations to different locations worldwide (Castells et al., 2012).

In doing so, businesses have enhanced productivity and profitability by exploiting the comparative advantages of different geographies, such as in countries and cities that offer attractive labour costs and skills, easy access to export markets, good infrastructure, a stable economic and political environment, and many other factors. Although in many cases, low labour costs may have been the principal incentive driving production, distribution, research and development, sales and services to other locations, each business sector responds to a particular range of requirements and incentives.

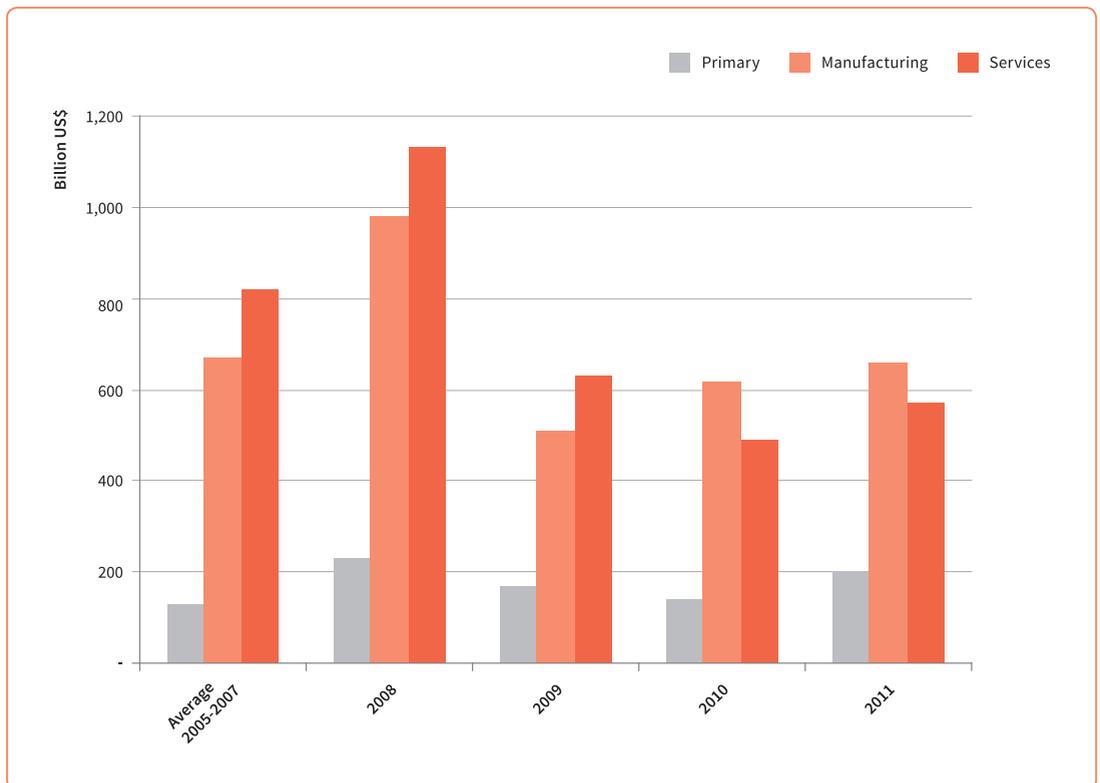
As business investment becomes increasingly foot-loose and freed from spatial constraints, at the same time, it has become increasingly sensitive to the mix of comparative advantages internalised in each location. In other words, choosing the right location to invest becomes increasingly important to maintain and enhance competitiveness.

At the same time, as business investors scan the horizon in search of locations that can provide a competitive edge, competition between cities and countries to attract investment has become increasingly fierce. National and city governments promote their comparative advantage and attract investors by improving infrastructure, urban development and cultural landmarks.

The volume of foreign direct investment (FDI) provides an indication of the size of global capital flows. As Figure 2.1 highlights, FDI peaked at US\$2.35 trillion in 2008, of which US\$1.13 trillion went into services, including infrastructure; US\$0.98 trillion into manufacturing; and US\$0.23 trillion into primary activities such as mining, oil and gas and agriculture.

Globally, one of the results of these flows has been a substantial increase in the value of produced capital. In absolute terms, produced capital remains

**Figure 2.1** FDI projects by sector, 2005-2011<sup>ii</sup>



(Source: UNISDR, based on estimates by UNCTAD, 2012)



concentrated in OECD countries. The value of produced capital in OECD countries increased by about one-fifth from US\$75.3 trillion in 1995 to US\$93.4 trillion in 2005 (World Bank, 2011).

In relative terms, however, there have been spectacular increases in the value of produced capital in those low and middle-income countries that have been successful in attracting investment. The value of produced capital in East Asia and the Pacific,<sup>iii</sup> for example, more than doubled from US\$4.6 trillion in 1995 to US\$10 trillion in 2005.

In contrast, the value of produced capital in regions that have been less successful in attracting investment has grown from a small base and at a slower rate. For example, the value of produced capital in sub-Saharan Africa increased from US\$1.1 billion in 1995 to only US\$1.3 billion in 2005, representing less than 1% of the world's total.

Figure 2.2 highlights the contrast between China, where the stock of produced capital has more than quadrupled over the last 20 years, and the United States of America, where it has increased by only

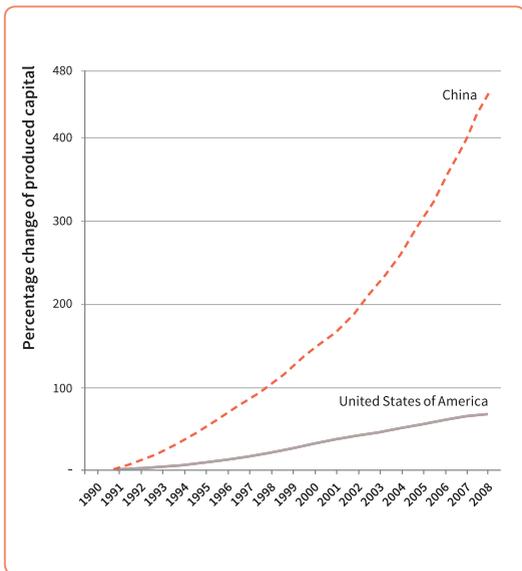
70 percent over the same period (UNU-IHDP and UNEP, 2012).

Since 2009, and as Figure 2.1 previously shows, FDI flows have fallen as a result of the global crisis. FDI flows from countries such as China, however, are growing rapidly, reaching US\$77 billion in 2012. Although still relatively small, this trend indicates changes in the direction of capital flows. At the same time, as labour costs increase and access to skilled workers becomes limited in some markets, some previously attractive locations for FDI may lose some of their comparative advantage.

## 2.2 Increasing exposure

**New data confirm that a rapid increase in exposure is a major driver of disaster risk today. Investments in flood plains or on cyclone-prone coastlines lead to spiraling risk levels but are still considered profitable as special industrial zones, a skilled workforce and large markets bring comparative advantages and continue to attract business.**

**Figure 2.2** Produced capital growth in China and the United States of America



(Source: Adapted from UNU-IHDP and UNEP, 2012)

Some regions that are successfully attracting investment and have seen the largest increase in produced capital are also exposed to hazards such as earthquakes, tropical cyclones and tsunamis. As such, benefits to business from globalisation have also been accompanied by major boosts in population and value of assets in hazard-exposed areas. These areas include tsunami and cyclone-prone coastlines, flood-prone river basins and earthquake-prone mega-cities. Seasoned investors have not acted irrationally in flocking to these areas. On the contrary—many such areas offer higher productivity and comparative advantages. For example, export-oriented production and distribution tends to cluster around international ports; tourism is attracted to tropical beaches and islands (Hallegatte, 2011). These areas, however, present disaster risks,

which are not necessarily factored into business investment decisions.

Between 1970 and 2010, for example, while global population growth was 87 percent, populations living in flood plains grew by 114 percent and in cyclone-prone coastlines by 192 percent. Similarly, the proportion of global GDP exposed to tropical cyclones increased from 3.6 percent to 4.3 percent over the same period. Most of this increase occurred in Asia (UNISDR, 2011). This implies that through economic globalisation, populations and assets located in hazard-exposed areas have grown faster than in other areas. Figure 2.3 below, for example, highlights the concentration of produced capital in areas exposed to cyclonic winds in East Asia.

This growth in exposure is one of the principal drivers of increasing disaster risk. Simply put, the concentration of individuals and produced capital in

hazard-exposed areas today is greater by an order of magnitude than it was 40 years ago.

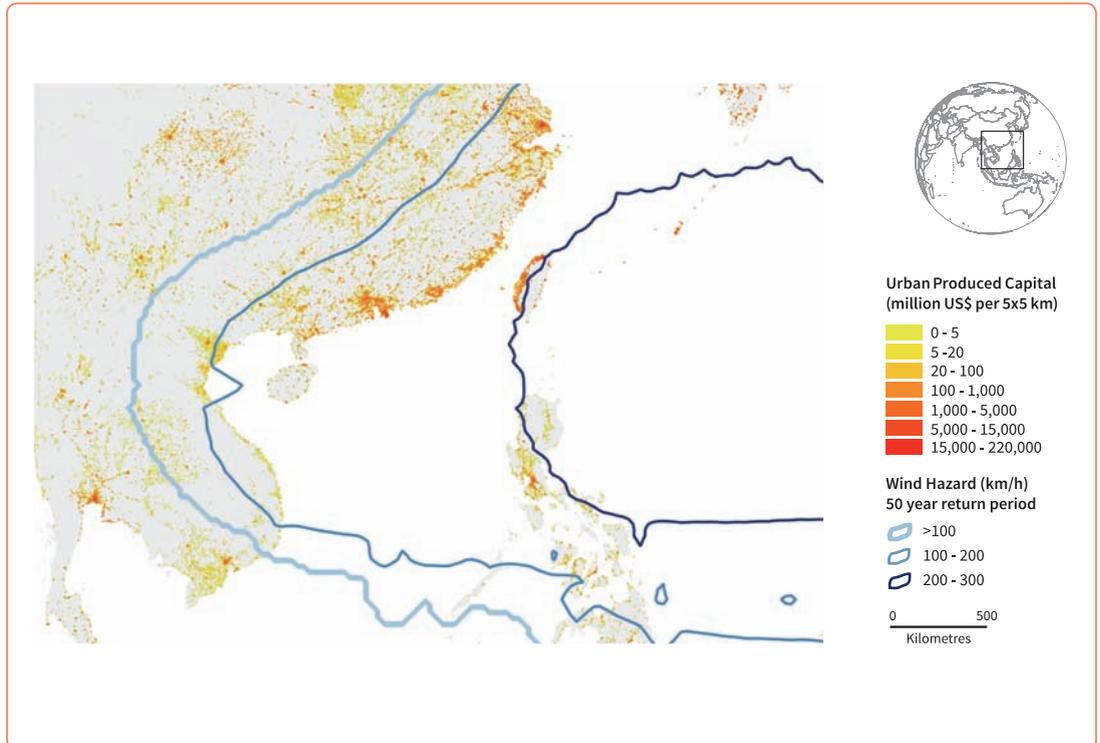
## 2.3 Reducing mortality risk and increasing economic risk

**Exposure is a key driver, but vulnerability levels still strongly shape the different levels of disaster risk that can be found between and within countries. Several countries have been successful in significantly reducing mortality risk. But many countries have struggled to reduce economic risks—particularly those with limited capacities for managing development process and investments.**

Disaster risk not only depends on the severity of hazard or volume of population or assets exposed, it also is a function of the susceptibility of people

### Cyclonic winds

**Figure 2.3** Produced capital stock in Southeast Asia and cyclone wind hazard (50 years return period)



(Source: GAR global risk model)



and economic assets to suffer loss and damage—in other words, their vulnerability. And vulnerability has also been modified by economic globalisation.

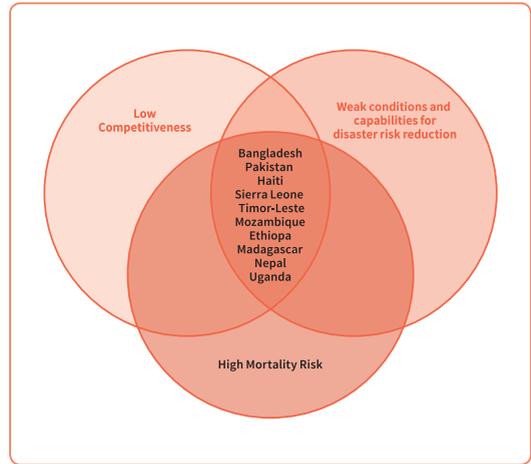
In general, higher-income countries and those with rapid economic growth over recent decades have successfully reduced their mortality risk. With economic development, capacities in disaster and emergency management generally improve. Since 2007, countries reporting progress against the Hyogo Framework for Action (HFA) have consistently highlighted good progress in strengthening disaster preparedness and response and in developing institutional and legislative capacities to do so (UNISDR, 2009 and 2011).

With improved transport infrastructure and health facilities, which facilitate evacuation and prompt medical attention, this leads to reduced vulnerability, at least in the case of floods and tropical cyclones, even though the exposed population increases (Kahn, 2005; UNISDR, 2011). For example, it was estimated that mortality risk associated with tropical cyclones in East Asia and the Pacific fell by 50 percent between 1980 and 2010 (UNISDR, 2011) although exposure increased by about 160 percent.

In contrast, in regions with slower economic growth, mortality risk is still high. For example, in sub-Saharan Africa, flood mortality risk has been growing consistently since 1980 (UNISDR, 2011) because the rapid increase in exposure has not been accompanied by a commensurable reduction in vulnerability. These examples confirm that the underlying risk drivers as identified in previous Global Assessment Reports are key challenges for several countries.

Figure 2.4 compares an index of mortality risk (UNISDR, 2009) with an index of competitiveness (WEF, 2012) and an index of conditions and capabilities for disaster risk reduction—for example, managing urban development, setting up effective governance structures, protecting the environment and alleviating poverty and vulnerability (DARA, 2012). Some countries, such as Haiti, Madagascar and Sierra Le-

**Figure 2.4** Countries with high mortality risk, low competitiveness and weak conditions and capabilities for risk reduction



(Source: UNISDR, based on the WEF Competitiveness Index 2011; GAR Mortality Risk Index 2011; DARA Risk Reduction Index 2012)

one, have not been successful in attracting investment, have low capacities to manage disaster risks and have high mortality risk.

Many countries have been far less successful, in contrast, in reducing the vulnerability of their produced capital, including housing, infrastructure and productive assets. Low and middle-income countries, in particular, report that they are challenged to use tools such as land-use planning, environmental management and building codes to reduce these vulnerabilities (UNISDR, 2009 and 2011). As a consequence, as mortality risk has decreased in successful economies, economic disaster risk has been increasing in concert with the growth in exposure (Neumeyer and Barthel, 2010). In some regions, including in OECD countries, the risk of losing produced capital in disasters may now be growing faster than the capital being produced (UNISDR, 2011; Hallegatte, 2011).

Earthquake mortality risk differs from the mortality risk associated with floods and tropical cyclones. While warning systems are becoming increasingly sophisticated, earthquake mortality is closely correlated to building collapse. This implies that earthquake-prone countries with rapidly growing econo-

mies and the inability to reduce the vulnerability of their building stock may also have increased earthquake mortality risk.

In countries that are not competitive and have been unsuccessful in attracting investment, economic loss risk, in absolute terms, has not risen in the same way. This is not because their produced capital is not vulnerable but because the density of hazard-exposed capital is far lower.

These trends have clear implications for business investment. Although vulnerability may be lower in high-income countries, as the value of produced capital increases, disaster risk also increases simply as a result of increased exposure. However, businesses that invest in low and middle-income countries may face increased disaster risk, not only as a result of increasing exposure but because these countries have not yet developed the capacities to reduce their vulnerabilities. If businesses do not factor these vulnerabilities into their investment decisions, they may be assuming risks and liabilities that will only become apparent when hazard events occur.

## 2.4 The globalisation of risk: vulnerable supply chains

**Today's globalised production systems and supply chains have created new vulnerabilities. While increasing efficiency and saving costs for businesses, global supply chains may contain hidden disaster risks with potentially devastating consequences, including for investors and markets.**

Economic globalisation has increased sharply the value of produced capital exposed to hazards in countries challenged to reduce their vulnerabilities; it has also provided changes to the structure of supply chains. These changes magnify and transmit disaster risk to other countries and regions not directly exposed.

As different business functions have been outsourced and decentralised, the global economy has become structured around an integrated web of supply chains.<sup>iv</sup> For example, faced with growing competition, the Japanese automobile industry decentralised production to other countries. As Figure 2.5 highlights, this led to a doubling in the export of automobile parts, from about 1.3 million manufactured parts in 1999 to about 3.2 million in 2010. The industries supply chain has thus become increasingly globalised.

To become successful, businesses not only procure materials and parts from overseas suppliers, but also outsource functions, such as product design and logistics. Productivity therefore increases because each business in the supply chain can strategically allocate resources to those activities where it has a comparative advantage. The supply chain thus becomes a web involving multi-tier suppliers and service providers.

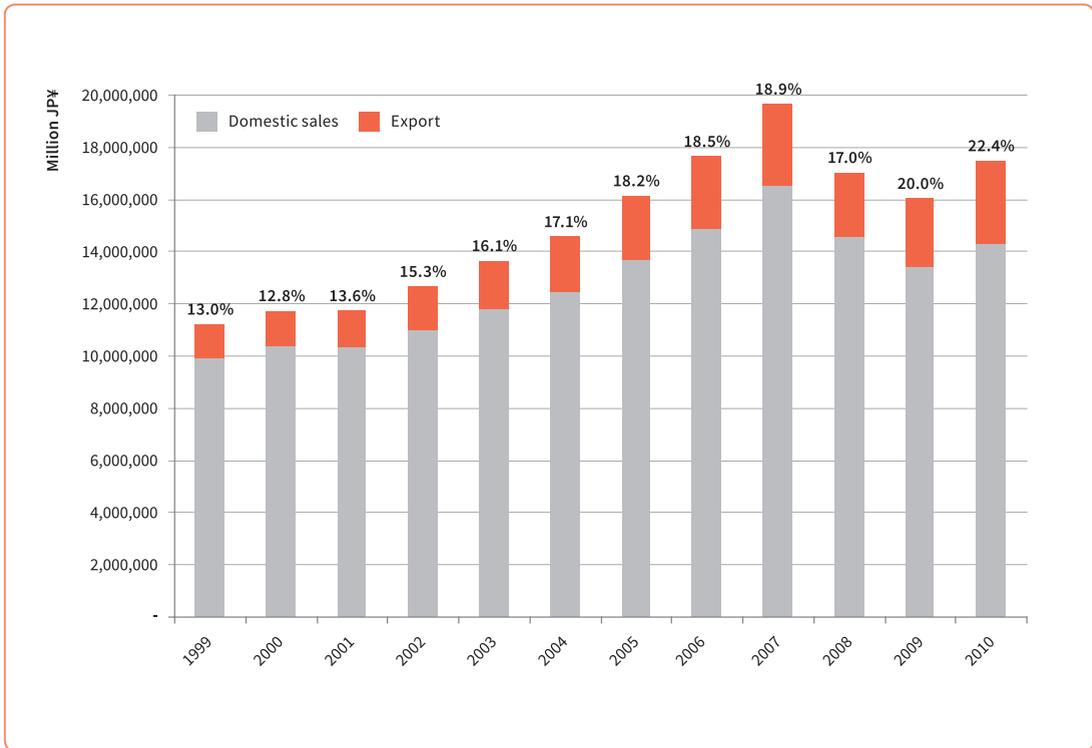
Various trends have characterised global supply chain evolution: the production process has been split into separate nodes in different locations, linked by multi-modal distribution facilities; supplier consolidation has emerged to increase economies of scale and reduced transaction costs; production agglomeration in areas with low transport costs (such as coastal areas and river basins) has facilitated knowledge spill-over, labour market pooling, input sharing, lower product shipping costs and logistics consolidation, increasing the dependence of supply chains on international distribution facilities such as major ports and airports (Ye and Abe, 2012).

Although globalisation of supply chains may have increased productivity, it has also globalised risk; when business at a critical node in a supply chain is affected by a disaster, the effects quickly ripple throughout the entire supply chain.

As highlighted above, as supply chains have evolved, production has been clustered in areas that may provide businesses with low transport costs but are



**Figure 2.5** Increased export of parts in the Japanese automobile industry (in JP¥ 1 million)<sup>v</sup>



(Source: UNISDR, based on data from the Japan Auto Parts Industry Association<sup>v</sup>)

**Rapid urbanisation**



**Box 2.1** Port cities with high exposure and vulnerability to climate extremes

Maritime transport handles over 80 percent of the volume of global trade and accounts for over 70 percent of its value. Since 1970, global seaborne trade has expanded by an annual average of 3.1 percent and has doubled in the last 30 years (UNDESA, 2012).

Port cities are a vital nexus in global supply chains. In 2005, 13 of the 20 most populated cities in the world were port cities. Many of these are exposed to flooding and storms. An analysis of a sample of 136 port cities with populations of more than 1 million highlighted that currently North America has the highest volume of exposed economic assets and Asia the largest proportion of exposed population (Nicholls et al., 2008).

Owing to economic and urban growth, natural and artificial subsidence, sea level rise and climate change, this exposure is likely to increase dramatically, particularly in low and middle-income countries. Whereas the estimated exposure of economic assets is expected to increase from US\$416 billion in Miami, United States of America, in 2005 to US\$3,513 billion in 2070, in Mumbai, India, asset exposure would increase from US\$46 billion to US\$1,598 billion, and in Guangzhou, China, from US\$84 billion to US\$3,557 billion (Nicholls et al., 2008). In Dhaka, Bangladesh, it would increase from US\$8 billion to an extraordinary US\$544 billion (Ibid.).

Low and middle-income countries are driving growth in global merchandise trade. For example, the share of low and middle-income countries in total global unloaded goods rose from 18 percent to 56 percent between 1970 and 2010 (UNCTAD, 2012). Increased hazard exposure therefore not only poses a threat to the competitiveness of cities and ports but increasingly to global trade flows and supply chains.

(Source: UNISDR)

often hazard-exposed. As Box 2.1 shows, the dependence of supply chains on logistical and transportation nodes such as ports and airports, further increases risk.

Businesses have demonstrated that supply chain efficiency can be increased by reducing inventories, shortening transportation times and streamlining production. However, these measures may undermine supply chain resilience (Haraguchi and Lall, 2012). Lean supply chains and ‘just-in-time’ delivery systems require more frequent deliveries of supplies, minimising inventories and turnover time. While maximising efficiency, they further increase the interdependence between businesses and remove the buffer provided by stocks (Ye and Abe, 2012). In turn, this increases the probability that a disaster at one critical point of a supply chain will have a systemic impact.

Investors need to be aware that small and medium enterprises (SMEs) often play a key role in supply chains, providing small quantities of labour-intensive components and services. As noted above, SMEs may be more vulnerable and less resilient than larger businesses, as they are generally undiversified and underinsured.

## 2.5 Shared risks

**The risk of losses and negative impacts from disasters is often transferred or shared over space and time. Business investments that increase disaster risk may directly increase the cost of disasters to affected communities. Government regulation that fails to protect critical infrastructure may result in high costs to businesses from power outages, communications failures and collapse of transport systems. Similarly, today’s new risks will be experienced by tomorrow’s generations.**

As new business investments are made in hazard-

exposed areas, disaster risks to the business itself are generated. But other risks, often referred to as external social and environmental costs, are in effect transferred to or shared with other sectors including the public sector. When investment decisions are made, businesses may not take into account how disaster risks may threaten their own operations—it is even less usual for businesses to account for risks that are shared with others. These shared risks are not priced; thus, market mechanisms to account for them usually do not exist.

One of the most well-known examples of risk transfer or sharing is through greenhouse gas emissions. Anthropogenic climate change may exacerbate weather-related hazards in other regions and thus lead to increased disaster losses. However, these costs are not borne by the emitter. Small island developing states (SIDS), for example, are responsible for less than 1 percent of total global greenhouse gas emissions but are likely to suffer disproportionately from the effects of sea-level rise or risks associated with storm surges and coastal flooding.

But climate change is only one mechanism through which risk is shared. For example, new road and real estate developments in urban areas may decrease the capacity of water management systems and soils to absorb excess water during storms in a city. New urban development may therefore produce flood risks, which are then shared with low-income households located in the most flood-prone areas and who would experience the greatest losses. City governments would also lose, as they would have to invest in drainage infrastructure. Box 2.2 highlights how, during the Chao Phraya floods in Thailand in 2011, a transfer of risks to low-income households took place.

Other mechanisms of risk sharing include when business investments contribute to a depletion of regulatory or productive ecosystem services—for example, when mangroves are destroyed for shrimp farms; when groundwater resources are overexploited for commercial agriculture or recreational



**Box 2.2** The impact of the Thailand floods on the urban poor

Although media attention on the 2011 Thailand floods focused on the impact on supply chains in the automobile and electronics industries, there were also major impacts on the urban poor.

Located only 1–2 metres above mean sea level, Bangkok is naturally prone to flooding. But flood hazard has been magnified by urbanisation. Canals, which provided the backbone of the city’s transport network and fulfilled an important drainage function, have been filled in; dense urbanisation has decreased the area of permeable surface; groundwater extraction is causing the city to subside at a faster rate than climate change-induced sea level rise. Watersheds in the Chao Phraya river basin have been degraded, while weakly implemented urban planning and management led to the growth of both private developments and informal settlements in flood-prone areas. Informal settlements, for example, often encroach on canals and are the first to be affected.

Although approximately 21 percent of the population of Bangkok was affected by flooding, this percentage increased to 73 percent of low-income households affected. The Thai Government’s National Housing Authority estimates that 90,362 homes out of a total of 135,582 were of low-income families. Five years ago, the IPCC had issued a warning of the particular vulnerability of the Chao Phraya river basin and the danger to the growing population living there (Nicholls et al., 2008).

(Source: UNISDR)

activities such as golf courses; or when forests are cut down for agricultural or urban development.

According to a recent survey the external environmental costs of eleven key industry sectors rose by 50 percent from 2002 to 2010, from US\$566 to 854 billion and are doubling every fourteen years. In the agribusiness sector alone, external environmental costs outweighed the sectors entire earnings (KPMG International, 2012). These social and environmental risks and costs are not on the balance sheets of businesses but are shared with other sectors as well as future generations.

However, risk sharing is not unidirectional. Failure by the public sector to manage risks in public infrastructure shares risks with businesses that face interruption owing to power outages or transport disruption. Similarly, failure to effectively regulate land-use or to control building standards increases risks for city regions. These risks and externalised costs are then borne by businesses.

Ultimately, however, risk sharing may have a ‘boomerang effect’ (Beck, 1992), given that entities or individuals that produce these risks will also be exposed to them. From this perspective, disaster risk

is a shared risk, and businesses, the public sector and civil society all participate in its construction. Disaster risk management, therefore, must be considered a shared value—an issue that we revisit in the final chapter of this report.

## Notes

- i These categories are those defined and measured empirically by the World Bank (World Bank, 2011) but many other classifications exist. The items included here are only an example of the components included in each category.
- ii ‘Primary’ refers to mainly mining, quarrying and petroleum.
- iii Economic regions as defined by the World Bank. East Asia and the Pacific exclude OECD countries such as Australia, Japan and New Zealand.
- iv A system of organisations, technology, information and resources that moves products and services from suppliers to customers.
- v Figures given at 2010 prices, using GDP deflators from the World Bank database (<http://data.worldbank.org/indicator/NY.GDP.DEFL.ZS>). The percentage presented is the share of export to the total product sales. The performance for each fiscal year is based on data from 360–450 large automobile parts producers in any given year.
- vi See <http://www.japia.or.jp/research/index.html>.

## Chapter 3

# Intensive Riskscapes



Patterns of **intensive risk** have developed along the fault lines of four decades of **economic development** and globalisation. The potential consequences of these risks can now be estimated and visualized. A first ever global probabilistic **assessment allows for a better understanding of intensive risk for earthquakes and cyclonic winds**.

**The results from the global assessment are a wake-up call: global average annual losses from earthquakes alone are estimated to exceed US\$100 billion. Of these, 80 percent are concentrated in high-income countries. Probable maximum losses for Japan and the United States of America in the case of a catastrophic one-in-250 year earthquake are over US\$100 billion. In these countries, high exposure is the key driver of disaster risk.**

**Vulnerability continues to determine risk levels, particularly in low and middle-income countries. Philippines and Puerto Rico could lose more than 15 percent of their exposed capital stock to winds from a catastrophic one-in-250 year tropical cyclone.**

Roughly **80 percent of cyclonic wind risk is concentrated in Asia**. The continent also has significant tsunami exposure, with **Japan leading in both absolute and relative exposure** of its people. However, **smaller economies, including many SIDS, can expect higher losses relative to their capital stock** for all hazards



Risk maps

## 3.1 The past is not a good guide to the future

No two disasters are alike. Along a major earthquake fault line, in a large river basin or along a coastline, an infinite number of hazard events could occur. However, most of these have yet to happen. Therefore, although patterns and trends of disaster loss provide a guide to the past, they are often not sufficient to predict and estimate losses that may occur at present and in the future.

Historical records may provide information on hazard events that have occurred, even over several hundred years. However, in any given location, many events, particularly extreme events that only occur every thousand years or so have yet to materialise. In order to explore future risks, therefore, it is necessary to look beyond historical losses.

For GAR13, a probabilistic approach to risk modelling has been adopted. This approach estimates the probability of events of different severity occurring in a given location, including extreme and infrequent events that have not yet occurred (or which we have no records of), but which could potentially occur in future. Historical losses are integrated into this model, as they are an important source of information.

Of interest to investors and businesses exploring new terrain, a new global analysis, carried out for the GAR, is beginning to map the contours of this risk landscape. The objective of the GAR global risk model is to provide comparable disaster risk metrics for all countries and territories in the world.

As Figure 3.1 highlights, initial global risk estimates for earthquakes and cyclonic winds and an improved estimate for tsunami exposure are now available.

At present, the estimates refer to the risk of direct loss to urban produced capital<sup>i</sup> and are agglomerated at the country level.<sup>ii</sup> The model does not estimate the risks of indirect loss owing to business in-

**Figure 3.1** GAR Global Risk Model deliverables for 2013 and 2015

Hazard Type		GAR 13		GAR 15	
		Output	Scale	Output	Scale
Earthquakes		AAL and PML 250	Global	AAL and PML multiple	Global
Tsunami		Exposure	Global	PML multiple	Global
Cyclones	Winds	AAL and PML 250	Global	AAL and PML multiple	Global
	Storm Surges	-	-	AAL and PML multiple	Global
Floods	River Flood	AAL	Thailand	AAL and PML multiple	Global
	Ponding Flood	AAL and PML 250	Caribbean	AAL and PML multiple	To be confirmed
Volcanic Ash		-	-	Exposure	Global

AAL = Annual Average Losses  
PML250 = Probable Maximum Losses for 250 years return period

(Source: UNISDR)

terruption, risks to agriculture, forestry or other rural sectors nor mortality and injury.

By quantifying the value of urban produced capital exposed to each potential hazard event that could occur in each location, and by assessing its likely vulnerability, it is then possible to estimate the probability of how much disaster loss could occur in a given time period.

Maximum losses associated with events of specific return periods are described as probable maximum losses (PML): for example, the maximum loss that might occur once every 250 years would reflect a 0.4 percent probability of the loss occurring in any given year. When PML for all events that could occur are averaged over a long period, then annual average loss (AAL) can be calculated.

Depending on the hazard profile of a country, the AAL represents the probability of both frequently occurring losses, for example, with return periods of five or ten years, as well as highly infrequent losses that may occur, for example, once every thousand years. For that reason, AAL should not be confused with the average observed losses that have occurred, even if records go back a century or more. A country may have a relatively high AAL—from earthquakes, for example—if catastrophic loss is expected from a rare thousand-year event, even though

there may be no recorded earthquake loss over the last 100 years.

Annex 1 provides a technical description of how the new GAR global risk model is being developed.

Risk estimates are computed using highly simplified global hazard models, a proxy for the exposure of urban produced capital and a standardised global set of vulnerability curves. Owing to the simplification inherent to global modelling and to the limitations of the current input data on hazard, exposure and vulnerability, the estimates obtained from the model have an intrinsic degree of error and uncertainty. As such, estimates are presented as a set of risk classes rather than as absolute numbers and represent the likely order of magnitude of loss.

Given that the estimates are calculated using the same methodology and with consistent global level proxy data, risk classes are internally coherent at the global level and provide a point of comparison between risk levels in countries and territories. These risk classes should be considered as starting points to understand the degree of possible annual losses for a country, enabling a government to discuss which disaster risk management strategies are most appropriate for its risk profile. The risk classes may also help investors to understand the degree of risk faced by different countries.



However, the results are unlikely to be comparable with national or local AAL and PML estimates calculated with detailed hazard, exposure and vulnerability data or for specific portfolios of insured assets. This should not be considered a defect of the model. However much it is enhanced, a global model can never provide nor substitute for the detailed risk estimates required for designing national and local risk reduction investments or insurance schemes. However, the estimates provided

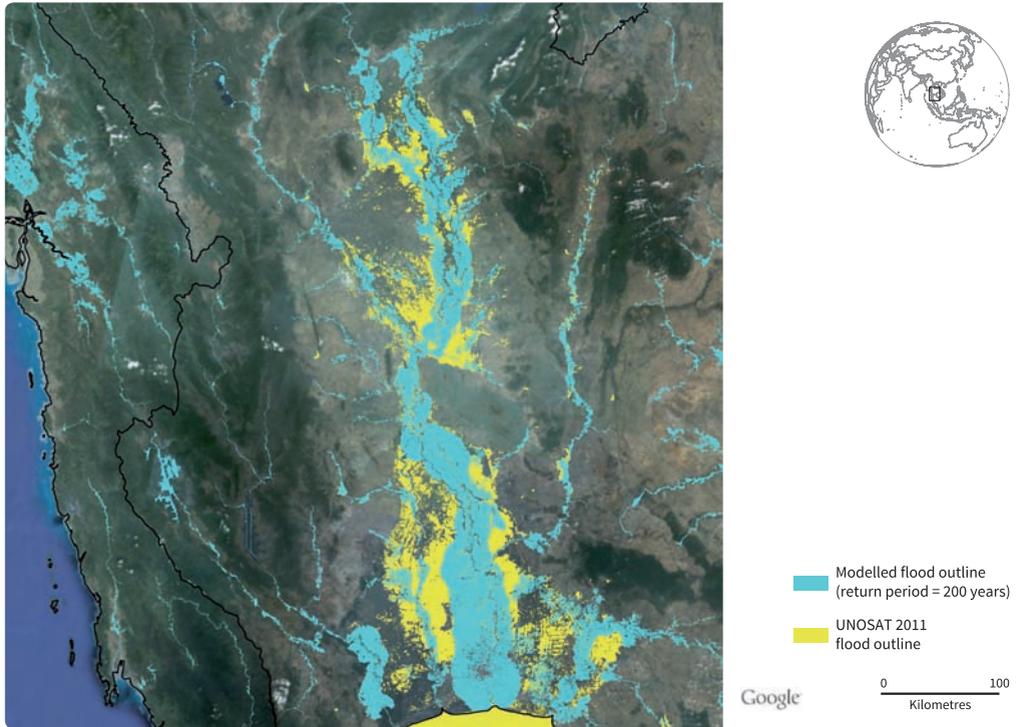
by the global model may encourage governments to develop the more specific risk models required to implement disaster risk reduction.

The development of the global model is iterative and the current release should be considered as a starting point. Between 2013 and 2015, the different hazard models, exposure proxy and vulnerability curves will be enhanced and further developed, taking into account peer review and the best available

**Box 3.1** Proof of concept for the GAR flood model

While river floods will not be included in the GAR risk model until 2015, a national level proof-of-concept study shows promising results. As Figure 3.2 shows, in Thailand, modelled results were compared with the outcomes of the Chao Phaya river floods of 2011.

**Figure 3.2** Flood hazard for Thailand compared with actual flood footprint of 2011



(Source: GAR global flood model; UNOSAT™)

The modelled results were largely coherent with the maximum flood depths of between 3 metres and 4 metres recorded in different sites upstream from Bangkok.

science and data to provide greater accuracy. By 2015, the model should also include global risk estimates for flooding, storm surges, volcanic ash and tsunamis. Box 3.1 presents a proof of concept for the global flood model.

## 3.2 Earthquake risk

**Absolute earthquake risk is concentrated in high-income countries. But many small and low-income countries have a higher proportion of their urban produced capital at risk.**

Total global annual average loss (AAL) for earthquakes is estimated at more than US\$100 billion. As Figure 3.3 shows, these economic risks are highly concentrated in countries with large volumes of

exposed produced capital and high earthquake hazard.

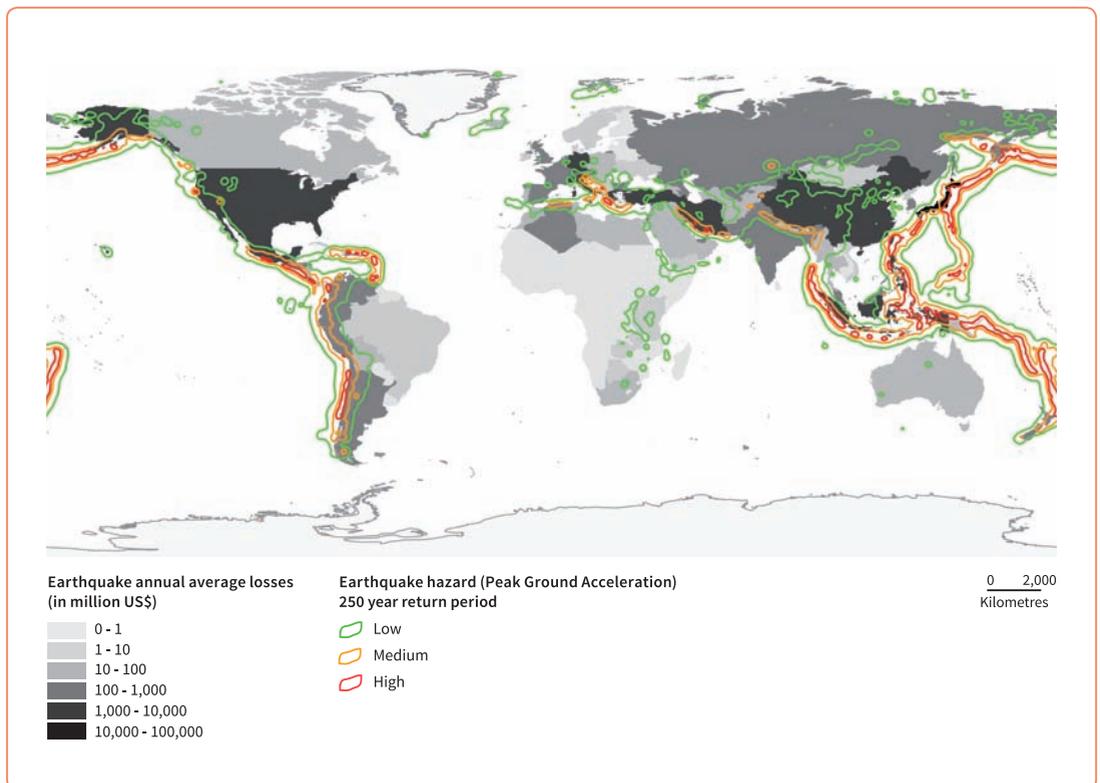
As highlighted in the previous chapter, given investment decisions and capital flows, global produced capital remains heavily concentrated in high-income countries. Therefore, the highest absolute levels of earthquake risk are also found in these countries, which is where approximately 80 percent of global AAL is concentrated.

In terms of regional distribution, about 76 percent of total global earthquake AAL is concentrated in Asia, 9 percent in Europe, 8 percent in North America and 5 percent in Latin America.

Figure 3.4 shows the distribution of earthquake AAL for countries in different risk classes. For example, the value of urban produced capital in Japan and



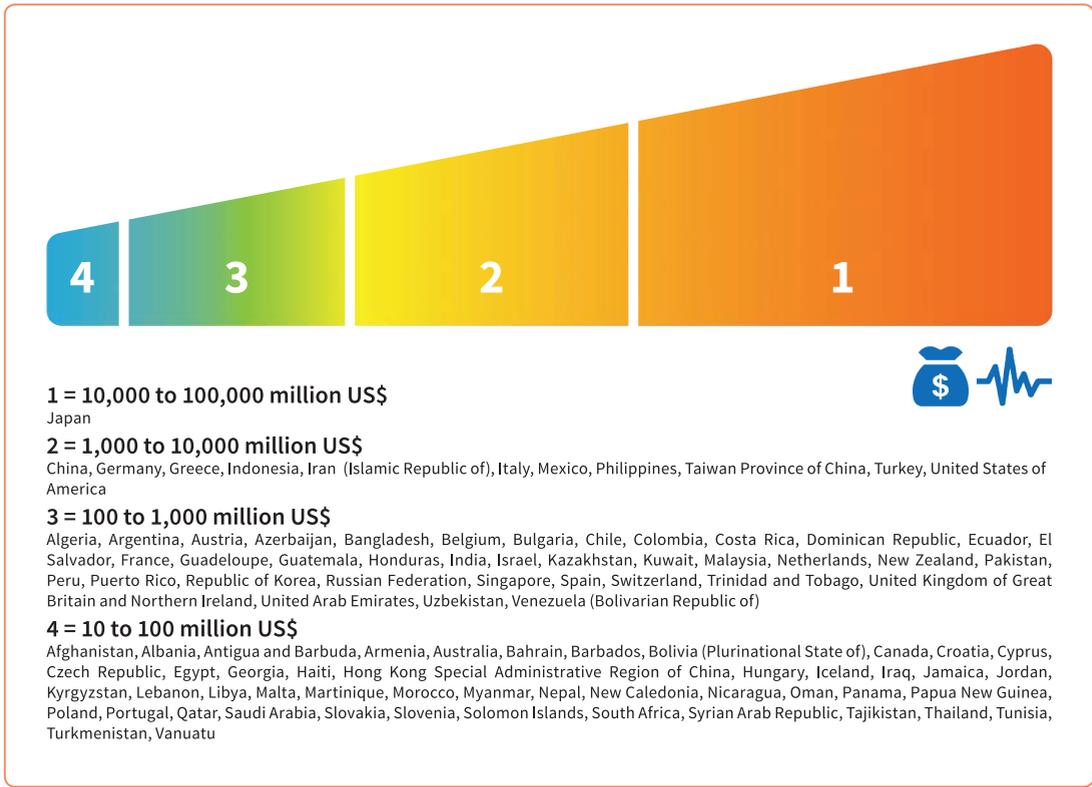
**Figure 3.3** Annual average loss (AAL) from earthquakes and earthquake hazard (250 year return period)



(Source: GAR global risk model)



**Figure 3.4** Annual average losses from earthquakes by risk class



(Source: UNISDR, based on GAR global risk model)

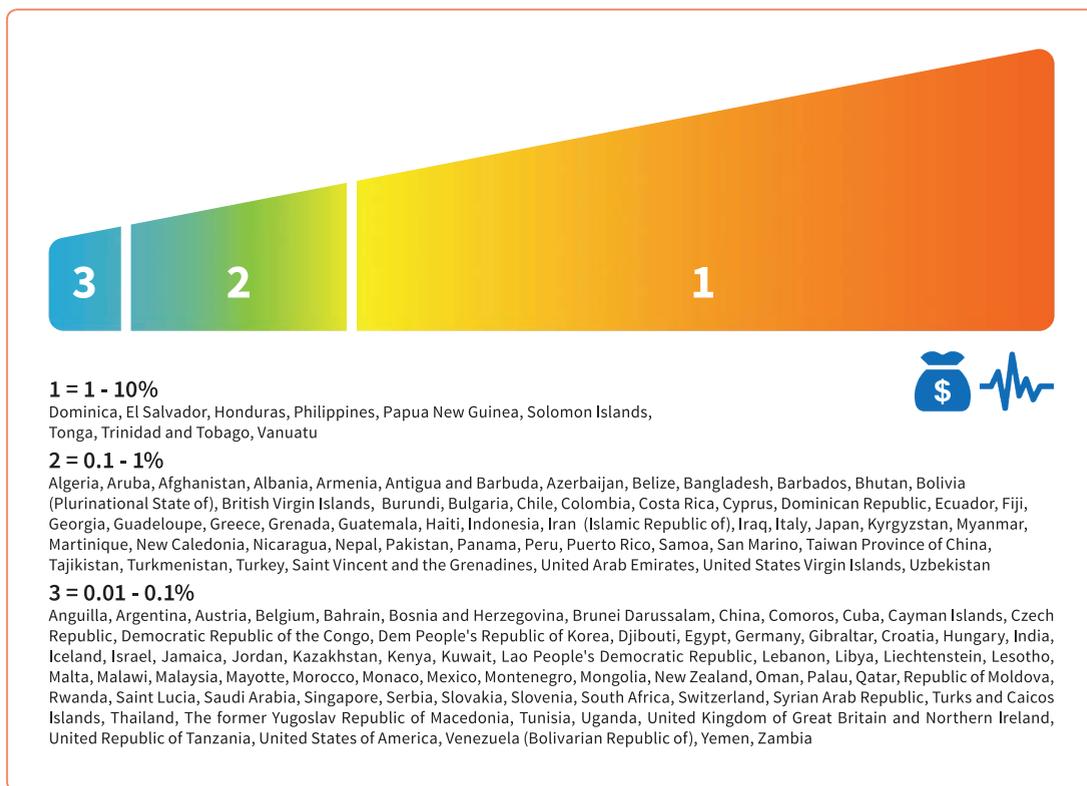
the United States of America is US\$14 trillion and US\$22 trillion, respectively, representing 15 percent and 22 percent each of global urban produced capital. However, although about 100 percent of Japan’s produced capital would be exposed to a 250 year earthquake, only about 34 percent of the produced capital of the United States of America would be exposed. Therefore, the AAL of Japan is an order of magnitude higher than the AAL of the United States of America.

Some middle-income countries, such as China, Iran (Islamic Republic of) and the Philippines, also have high levels of risk because their exposed produced capital is more vulnerable than in high-income countries, for example due to weaker building structure and material. The impact that this has on expected AAL highlights the risks of making business investments in countries with higher levels of vulnerability an important consideration for investors.

Although estimates of absolute loss are important, the impact of an earthquake on a country’s economy will depend on the proportion of its urban produced capital that could be affected. Figure 3.5 shows that many low and middle-income and smaller countries can be expected to lose a higher proportion of their urban produced capital, which in turn could be expected to generate serious indirect losses for business and macroeconomic effects.<sup>iv</sup>

For example, the absolute value of AAL for countries such as Papua New Guinea and Vanuatu is low compared with other countries (between US\$10 and 100 million), but this value represents between 1 percent and 10 percent of these countries’ total urban produced capital. In contrast, for the United States of America and China, expected annual average losses, although totalling between US\$1,000 and 10,000 million, represent only 0.01 percent to 0.1 percent of their total urban produced capital.

**Figure 3.5** Annual average losses from earthquakes as a percentage of urban produced capital by risk class



(Source: UNISDR, based on GAR global risk model)

Probable maximum losses for a one-in-250 year earthquake have been estimated both in absolute terms as well as relative to countries' urban produced capital. Although there is only a 0.4 percent probability of these losses occurring in any given year, these values are indicative of the potential extent of losses owing to catastrophic earthquake events. As expected, countries with highest probable maximum losses are Japan and the United States of America—with more than US\$100 billion. Countries such as Iran (Islamic Republic of) and China follow closely behind, possibly incurring earthquake losses of more than US\$10 billion.

Comparing these expected losses with total urban produced capital provides an indication on what the impact of an event would be on a country's assets. For example, in the Philippines they would correspond to almost 19 percent of its total urban produced capital. Haiti faces losses of more than 25

percent of its urban produced capital again indicating the possibility of a serious impact on business and the economy as a whole. Some small-island developing states, such as the Solomon Islands, risk losing over 40 percent of the value of their exposed capital in a catastrophic quake.

Vulnerability also remains a key determinant of earthquake risk levels. If countries with similar values of exposed capital are compared, the assets of countries with higher PML are likely to be more vulnerable.

For example, probable losses for Spain and Hong Kong (Special Administrative Region of China), with a high value of exposed urban produced capital (about US\$1.9 trillion and US\$1.1 trillion, respectively) are lower than losses for Iran (Islamic Republic of) and Haiti, which have a significantly lower value of exposed capital (US\$0.7 trillion and US\$8.5 billion, respectively). These results reflect the much higher



**Figure 3.6** Probable maximum losses from earthquakes as a percentage of exposed urban produced capital (250 year return period)



(Source: UNISDR, based on GAR global risk model)

vulnerability of exposed assets in Iran (Islamic Republic of) and Haiti compared with exposed assets in Spain and Hong Kong (Special Administrative Region of China) (Figure 3.6).

### 3.3 Risk from cyclonic winds

**As in the case of earthquakes, expected economic damage from tropical cyclone wind is mainly concentrated in high-income countries and in Asia. However, in relative terms smaller countries, such as SIDS could be expected to lose a far higher proportion of their assets. In many low and middle-income countries, risk is heavily conditioned by vulnerability.**

Global annual average losses from cyclonic winds are estimated to be over US\$80 billion. Currently,

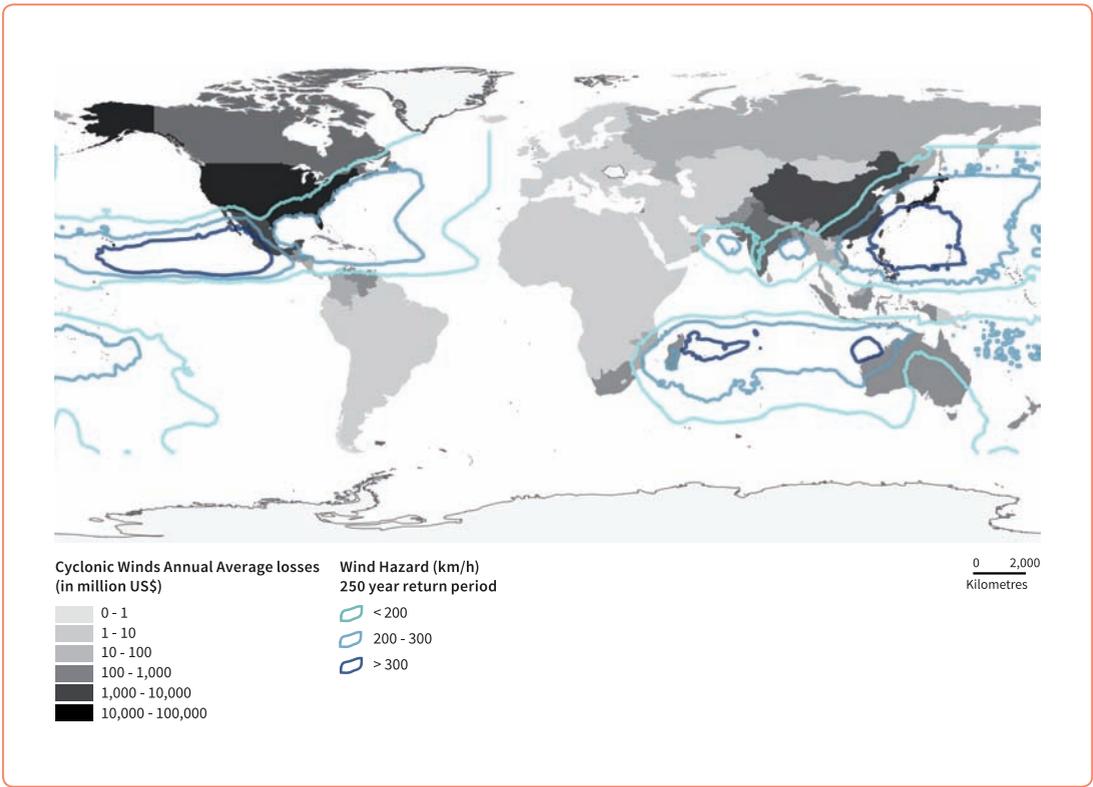
the risk model does not include losses owing to storm surges or coastal flooding but only wind damage. However, it does estimate the losses incurred as cyclones in tropical areas move southward or northwards (depending on the hemisphere) and become sub-tropical or extra-tropical storms (as in the case of Sandy in 2012, for example). At present the tropical cyclonic wind hazard model may have a greater degree of uncertainty and error than the earthquake hazard model and will be further validated and enhanced for GAR15.

Figure 3.7 shows the geographical distribution of the risk. About 80 percent of the risk from cyclonic winds is concentrated in Asia, 13 percent in North America, 4 percent in Latin America and about 2 percent in the Caribbean.

In terms of absolute losses, about 82 percent of risk is concentrated in high-income countries, corre-

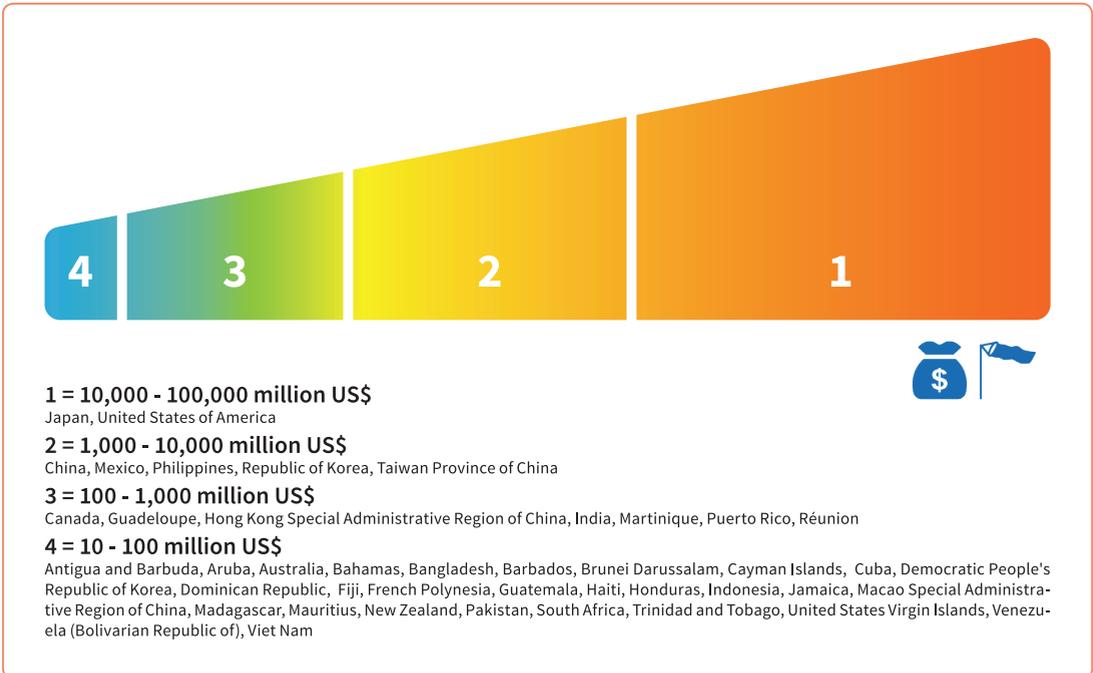


Figure 3.7 Annual average losses from cyclonic winds and tropical cyclone wind hazard (250 year return period)



(Source: GAR global risk model)

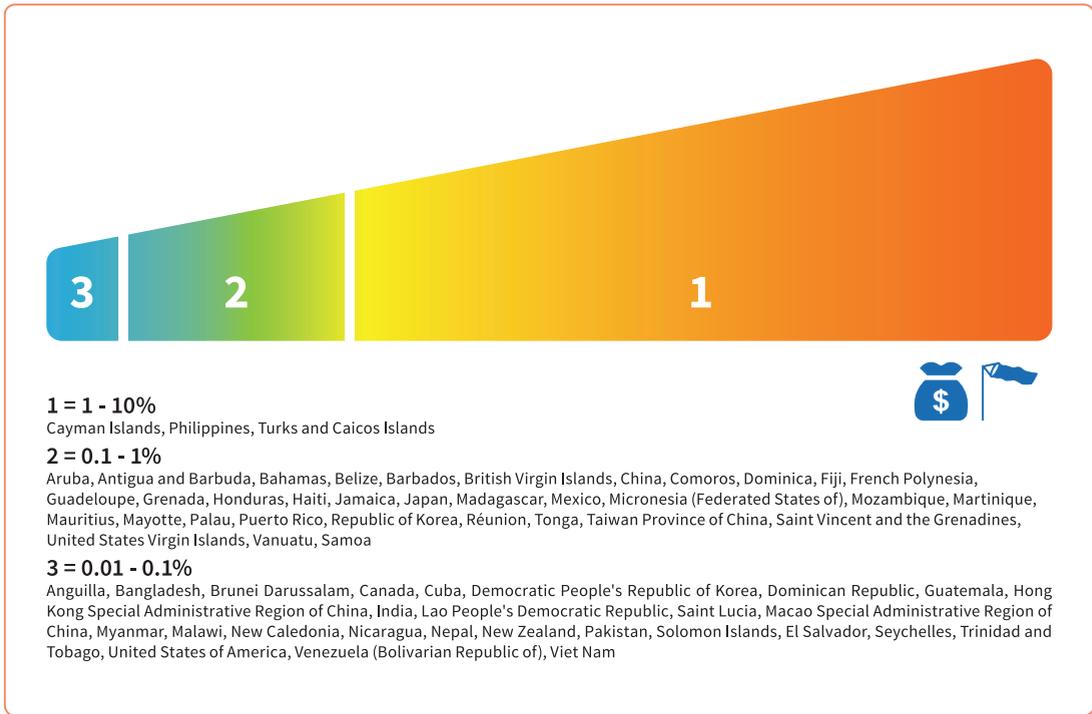
Figure 3.8 Annual average losses from cyclonic winds by risk class



(Source: UNISDR, based on GAR global risk model)

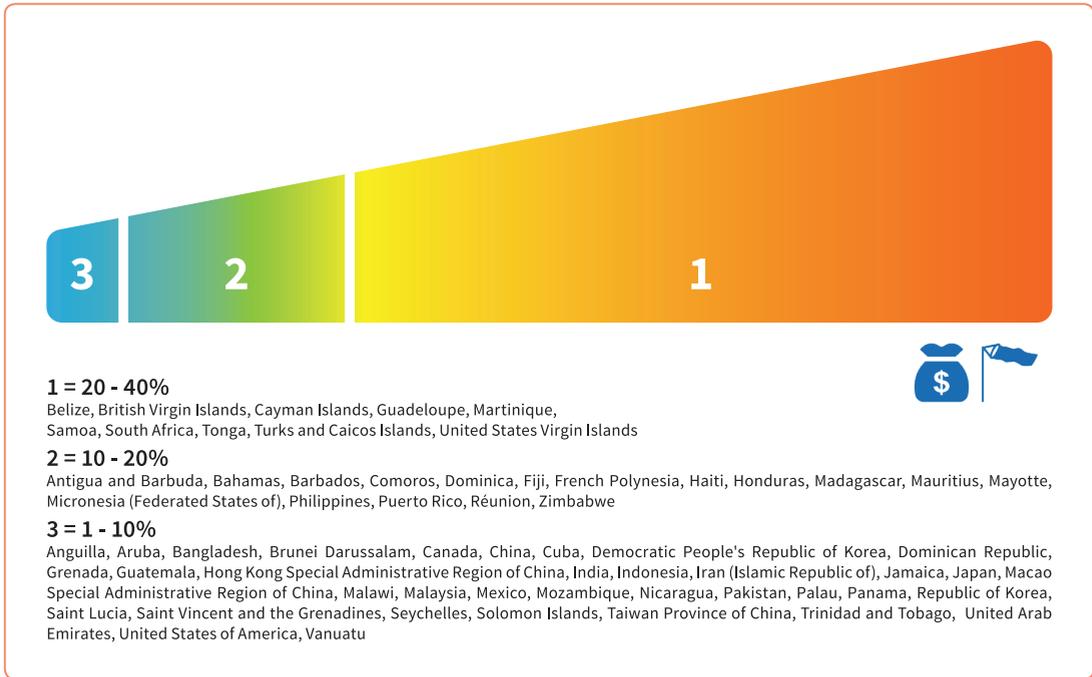


**Figure 3.9** Annual average losses from cyclonic winds compared with urban produced capital



(Source: UNISDR, based on GAR global risk model)

**Figure 3.10** Probable maximum losses from cyclonic winds (250 year return period) compared with the exposed urban produced capital



(Source: UNISDR, based on GAR global risk model)

sponding to the highest concentration of urban produced capital. Middle-income countries concentrate 18 percent of risk from cyclonic winds, corresponding to about US\$16 billion. Distribution of AAL across countries by risk class is shown in Figure 3.8.

Japan and the United States of America concentrate 56 percent of global risk from cyclonic winds, corresponding to the high value of their exposed capital.<sup>v</sup> Urban produced capital exposed to cyclonic winds<sup>vi</sup> in Japan and the United States of America is valued at about US\$14 trillion and US\$11.6 trillion, respectively. This corresponds to 100 percent and 52 percent, respectively, of total urban produced capital of both countries.

Middle-income countries such as China, Mexico and the Philippines all have high AAL in terms of absolute value. However, in relation to the countries' produced capital, the losses vary significantly: although the AAL for China and Mexico corresponds to about 0.2 percent of the country's urban produced capital, the AAL for the Philippines corresponds to more than 1 percent of the country's total produced capital (Figure 3.9).

Absolute probable maximum losses from a catastrophic one-in-250 year cyclone are also estimated to be significant, particularly for countries with high asset exposure.

When calculated as a percentage of total urban produced capital, the probable maximum losses from such as catastrophic event become particularly threatening to small countries. For example, countries such as Belize, Guadeloupe, Martinique and Samoa could lose between 20 percent and 40 percent of their total urban produced capital from cyclonic wind disasters (Figure 3.10).

As in the case of earthquakes expected losses are also influenced by vulnerability. For example, in terms of absolute probable maximum losses, countries and territories such as Hong Kong (Spe-

cial Administrative Region of China), the Philippines and Puerto Rico are in the same risk class. However, in relative terms, Hong Kong (Special Administrative Region of China) faces losses of only 2 percent, whereas the Philippines and Puerto Rico face losses of more than 15 percent of their exposed capital.

## 3.4 Tsunami exposure

**Exposure to tsunamis is a good proxy for the risk associated with highly destructive one-in-500 year tsunamis. Japan has the highest exposure of produced capital in absolute terms and the third highest in relative terms but many smaller countries and territories, including Hong Kong and Macau (Special Administrative Regions of China) have high levels of relative risk. Of major global concern is the exposure to tsunamis of critical facilities such as airports and nuclear power plants.**

Produced capital in coastal areas is also at risk from tsunamis. Tsunamis are relatively infrequent, with only 5–10 events reported globally per year, but they can be devastating, causing massive loss of life, large economic losses and the destruction of critical facilities. The Indian Ocean tsunami in 2004 is estimated to have caused about 220,000 deaths and more than US\$10 billion in damages (Cosgrave, 2007). The East Japan tsunami in 2011 resulted in 15,875 deaths, 2,725 missing persons<sup>vii</sup> and approximately US\$206 billion in damages<sup>viii</sup>.

The global tsunami model has been updated for GAR13. Compared with the first global scale tsunami hazard and exposure assessment carried out for GAR09, the GAR13 model adopts improved methodologies and provides a more complete coverage of the global earthquake sources that might produce destructive tsunamis. This improved the model in many locations, such as Japan and Latin America.<sup>ix</sup> As Box 3.2 at the end of this chapter shows, the results from national

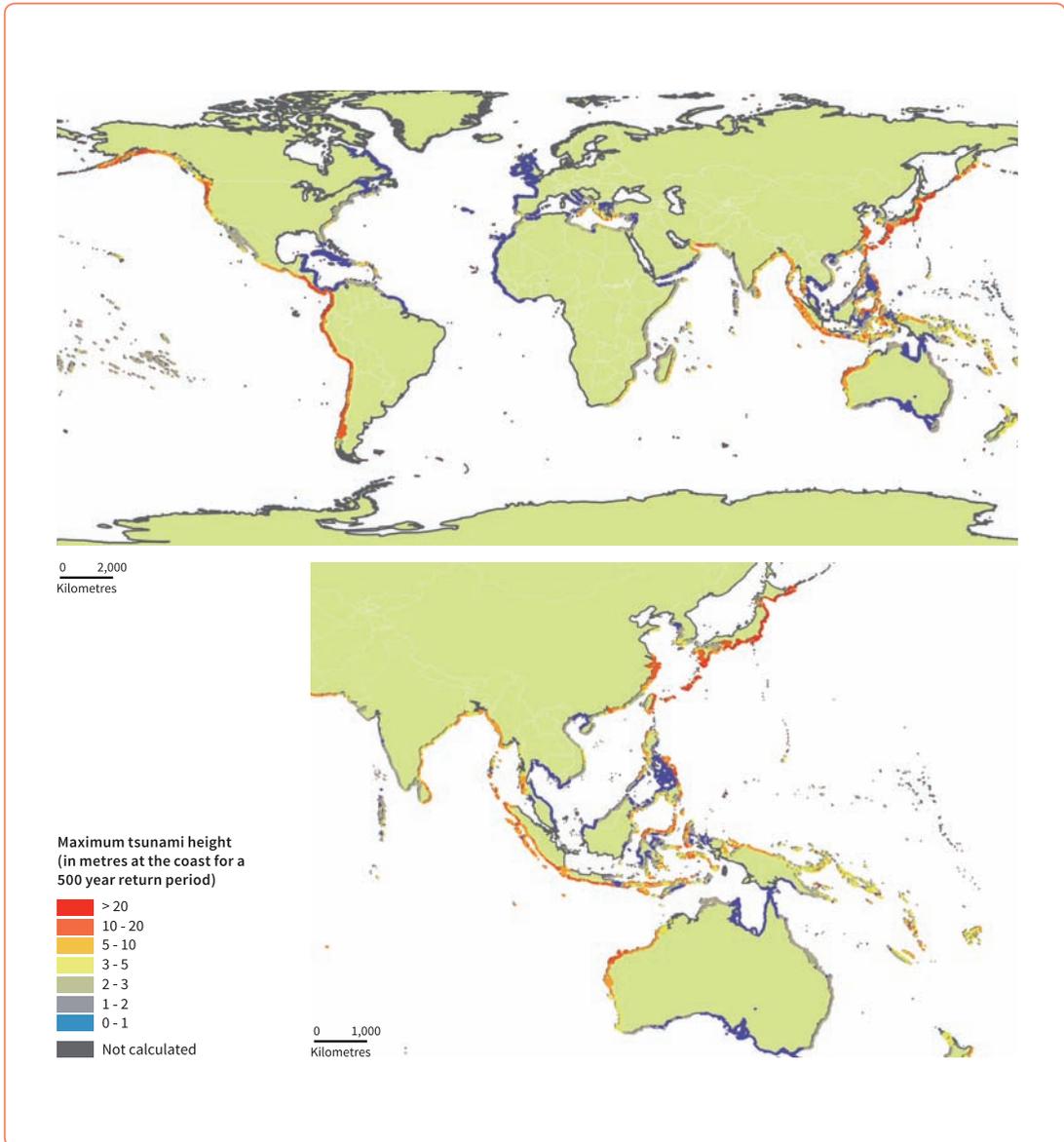


models of some countries, such as Indonesia, also contributed to the global modelling effort.

Figure 3.12 below shows the global distribution of infrequent but severe tsunamis generated by large earthquakes with return periods of approximately 500 years, equivalent to a 0.2 percent probability of occurrence in any given year.<sup>8</sup>

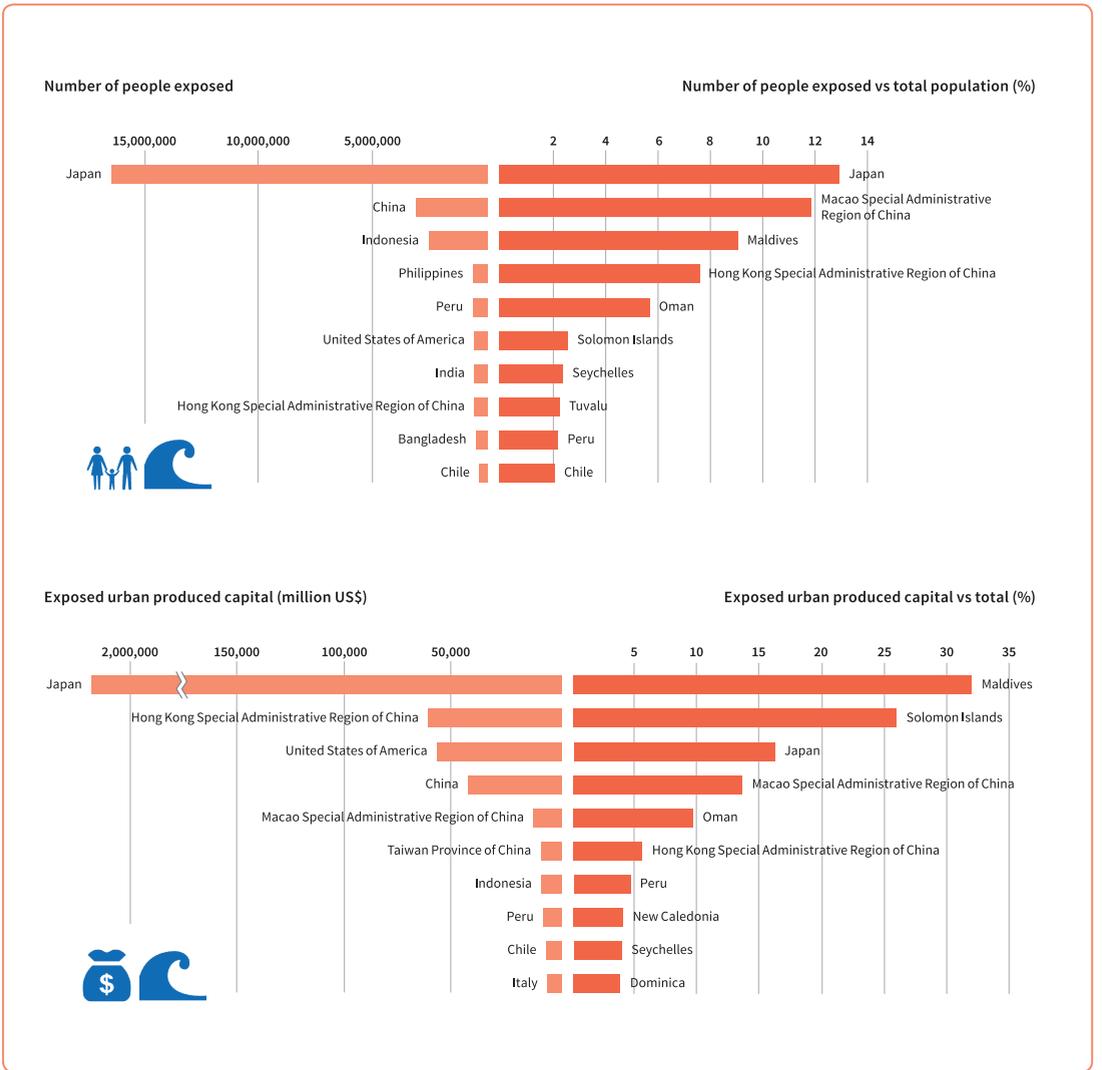
Figure 3.13 highlights the exposure of both people and produced capital to these tsunamis. Japan is highly exposed in both relative and absolute terms, and concentrates about 16 percent of exposed global produced capital. Macao (Special Administrative Region of China) also ranks high in relative and absolute capital exposed. Many smaller countries and territories also have a high

**Figure 3.12** Global distribution of estimated inundation height from earthquake-generated tsunamis (500 year return period)



(Source: UNISDR, based on NGI, 2013a)

**Figure 3.13** Top ten countries in terms of population and stock of urban produced capital exposed to tsunamis (absolute and relative)<sup>xlii,xliii</sup>



(Source: GAR global risk model)

relative exposure. Maldives has over 30 percent of its produced capital stock exposed, followed by the Solomon Islands with over 25 percent; Oman with 9.5 percent; and Hong Kong (Special Administrative Region of China) with about 5 percent.

Although tsunami exposure is not the same as tsunami risk, in the case of extremely destructive 500 year return period tsunamis, exposure is probably a good guide to risk, as vulnerability tends to become binary—assets that are exposed are at risk and those that are not exposed are not.

Of particular concern is the location of critical facilities, including nuclear power plants and airports, in areas exposed to destructive tsunamis.<sup>xi</sup> In the United States of America, a total of 13 nuclear power plants are either in or close to areas exposed to tsunamis; in China, Japan and the United Kingdom of Great Britain and Northern Ireland, the numbers of such plants are 12, 10 and 7, respectively. However, nuclear facilities are subject to rigorous local risk assessments and thus likely to have countermeasures in place to reduce risk.

Airports are similarly at risk. In the United States of America, 58 airports are in areas exposed to destructive tsunamis; in Japan, there are 40. Airport exposure is most critical in small island states,

whose economies may depend on a single airport or where all airports will be affected at the same time. In the French Polynesia archipelago, for example, a total of 26 airports are exposed.

**Box 3.2** Unveiling tsunami hazard in Indonesia

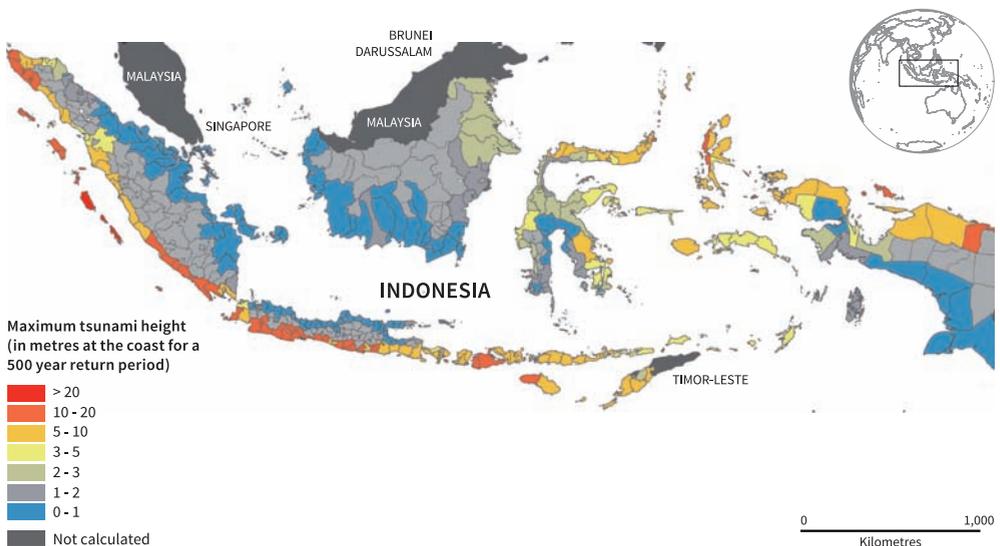
Indonesia has high tsunami risk. In the past 100 years, 24 tsunamis have killed more than 235,000 people. To better manage this risk, the national disaster management agency (Badan Nasional Penanggulangan Bencana, BNPB) and AusAID, through the Australia-Indonesia Facility for Disaster Reduction, formed a collaborative team representing Institut Teknologi Bandung, Indonesian Institute of Science (LIPI), BPPT, Badan Geologi, BMKG, TDMRC and Geoscience Australia to conduct an advanced and rigorous national tsunami hazard assessment.

Tsunami hazard maps are based on a probabilistic tsunami hazard assessment methodology, which allows the probability of tsunamis of different heights to be quantified. Maps produced allow disaster managers to:

- Understand the chance of a tsunami reaching the coastline that would trigger an orange ('tsunami') or red ('major tsunami') tsunami warning;
- Understand the maximum tsunami height over different return periods;
- Rank the tsunami potential for each district in Indonesia to prioritise communities for tsunami mitigation activities;
- Assess tsunami potential for each district to plan tsunami mitigation activities;
- Determine earthquake fault lines that may have an impact on each district.

The assessment highlights that the West coast of Sumatra, the South coast of Java and Nusa Tenggara have the highest tsunami hazard (Figure 3.11).

**Figure 3.11** Tsunami hazard in Indonesia (500 year return period)



## Notes

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**i** Urban produced capital is the produced capital in urban areas with more than 2,000 inhabitants.

**ii** Countries and territories for which no data on urban produced capital is available could not be included in the risk modelling exercise. These include: American Samoa, Andorra, Ashmore and Cartier Islands, Azores Islands, Baker Island, Bassas da India, Bird Island, Bouvet Island, British Indian Ocean Territory, Christmas Island, Clipperton Island, Cocos (Keeling) Islands, Cook Islands, Dhekelia and Akrotiri SBA, Europa Island, French Guernsey, Glorioso Island, Guam, Heard Island and McDonald Islands, Holy See, Howland Island, Isle of Man, Jarvis Island, Jersey, Johnston Atoll, Juan de Nova Island, Kingman Reef, Liancourt Rock, Madeira Islands, Midway Island, Nauru, Navassa Island, Netherlands Antilles, Niue, Norfolk Island, Northern Mariana Islands, Palmyra Atoll, Paracel Islands, Pitcairn, Romania, Saint Helena, Saint Pierre et Miquelon, Scarborough Reef, Senkaku Islands, South Georgia and the South Sandwich Islands, Southern and Antarctic Territories, Spratly Islands, Svalbard and Jan Mayen Islands, Timor-Leste, Tokelau, Tromelin Island, Wake Island, Wallis and Futuna.

**iii** [www.unitar.org/unosat/maps/tha](http://www.unitar.org/unosat/maps/tha).

**iv** In countries where only a small proportion of urban produced capital is at risk, there is less chance of business and supply chain interruption and a greater likelihood of rapid recovery. In contrast, where a significant proportion of the urban produced capital is at risk, it is more likely that business will be interrupted owing to infrastructure damage and supply chain disruption and that recovery of the economy as a whole will be slower.

**v** Exposure is here estimated overlapping the urban produced capital with the cyclonic wind hazard for a return period of 250 years, with wind speed higher than 50 Km/h.

**vi** Capital exposed to cyclonic wind speed higher than 150 km/h for 250 year return period. This is a proxy for the exposure as it does not take into account flooding owing to tropical cyclones.

**vii** Data are as of 5 Dec. 2012 by National Police Agency, Japanese Government (<http://www.npa.go.jp/archive/keibi/biki/higaijokyo.pdf>).

**viii** 1USD=JPY81.84. The estimate was reported in June 2011 by Cabinet Office, Japanese Government (<http://www.bousai.go.jp/oshirase/h23/110624-1kisyu.pdf>).

**ix** See Annex 1 for more detail on the methodology.

**x** The return period attributed for the model needs to be considered as an estimate, and some events might have a slightly lower or higher return period than 500 years.

**xi** All data related to nuclear power plants and airports at risk from Norwegian Geological Institute and UNEP-GRID.

**xii** In this graph, (urban) produced capital is used as a reference point for relative risk (rather than gross fixed capital formation) as the total exposure of produced capital needs to be compared with the total stock of produced capital.

**xiii** 'Exposure' here is calculated by overlapping the potential area inundated by an extreme tsunami (return period approximately 500 years) with the population or stock in the area.

**xiv** Information for this box provided directly to UNISDR by GeoScience Australia.





## Chapter 4

# Invisible Risks



Extensive risk is **associated with localised**, mainly weather-related **hazards** with short return periods. These highly localised, yet **frequent hazards** include surface water and flash flooding, landslides, fires and both **agricultural and hydrological drought**. They are **exacerbated by** badly managed urban development, environmental degradation and **poverty**.

An **analysis of the scale of economic losses** shows that extensive risk continues to be underestimated. The **real cost** of these largely human produced risks is **rarely highlighted**. Although **extensive risk events** cause only 13 percent of total mortality, they are **responsible for 42 percent or more of total economic losses**.

These losses are **hidden in largely invisible risk layers** that no insurance covers. And yet they can **amount to more than 10 percent or more of annual capital formation**.

## 4.1 The production of extensive risk

**In-depth analysis of new national disaster loss data confirms a previously recognised and yet regularly ignored truth: accumulated losses from small-scale, highly frequent and localised disaster events approach in magnitude those of major disasters and contribute to declines in social welfare, economic growth and ecosystems. Urban and rural areas alike, particularly in low and middle-income countries, experience regular small disasters that undermine local development as well as national competitiveness.**

GAR09 (UNISDR, 2009) highlighted four underlying risk drivers that characterise the accumulation of extensive risks. (1) Badly planned and managed urban development, for example, can generate flooding, through factors such as increased run-off from a growing area of impermeable surfaces, inadequate investment in drainage and water management and the development of low-lying flood prone areas. (2) The decline of regulatory ecosystem services, such as wetlands, aquifers, forests, floodplains and mangroves, exacerbate and magnify hazard levels. (3) Low-income households are often unable to participate in the formal market to land and housing and urbanise hazard prone areas, through informal mechanisms. (4) Cities and regions with weak governance may either lose control

over the above processes or contribute to them. Given that not only exposure and vulnerability but also hazards are produced through these underlying drivers, extensive risk is endogenous to and produced by urban and economic development.

Wealthier, better-governed city regions are likely, over time, to successfully manage the processes that generate extensive risk. Rapid urban growth often reflects economic success and major inflows of capital into infrastructure and productive development (Mitlin and Satterthwaite, 2012). In fact, in high-income and in many middle-income countries, the growth in GDP per capita has outpaced growth in urban population (UN-HABITAT, 2012). Although exposure and intensive risk increase over time, these cities and countries reduce their extensive risk, for example, through investments in protective infrastructure, environmental management and upgrading of informal settlements.

In contrast, in many low-income countries, growth in urban population has outstripped growth in GDP per capita (Ibid.) in part from population migration owing to declining rural economies and crises. In these cities, a greater proportion of low-income households participate in urbanisation through informal mechanisms of land acquisition (Johnson et al., 2012; Hamdan, 2012). Governments have little capacity to reduce risks over time, and both extensive and intensive risks lead to

**Box 4.1** Extensive risks in urban centres in Kenya and Tanzania

A recent survey of disaster risk reduction in the towns of Kisumu in Kenya and Moshi in Tanzania depicts similar pictures. Administrative capacities in Kisumu and Moshi are challenged as local governments try to maintain basic infrastructure—such as storm drains—the disrepair of which leads to frequent flooding. The lack of waste management systems means that drains are frequently blocked with garbage and sewage, increasing flood risk and compromising water quality. The impact on low-income households, who frequently live in the most flood-prone areas, is devastating. Land-use planning is ineffective and disaster reduction planning non-existent. Local governments have no budget to dedicate to reduce risks and have little influence over environmental degradation in surrounding areas that increase risks in these towns.

(Source: UNISDR, 2012)

higher rates of mortality. Almost by definition, informal settlements (and a significant proportion of social housing) occupy areas of low land value, such as low-lying flood-prone areas or on landslide-prone hillsides.

In the case of Cape Verde and Senegal, for example, in their capitals Praia and Dakar, flooding has intensified over the years (DARA, 2013). New studies at the local level in West Africa highlight that underlying drivers of flood risks are poor drainage systems related to land-use and newly built environments, and limited access to land. The studies point to West Africa's continuous problems in expanding urban centres and the need for urban planning and sufficient public or private investments in adequate infrastructure. Local data of these studies were backed by national data that indicated similar problems in urban areas in Cape Verde, Ghana and Senegal (Ibid.).

In addition, the health of millions is threatened (Mitlin and Satterthwaite, 2012). For example, in Maputo, Mozambique, the limited coverage of the city's sewage system is a serious cholera threat even in normal times, which becomes a major challenge for authorities during annual flooding (Thompson, 2004).

As Box 4.1 shows, investments in protective infrastructure, such as drainage and slope stabilisation, are often inadequate. Low-income households are also more likely to live in makeshift or poor quality

constructions, further increasing their vulnerability. Disaster risks in rural areas may be particularly invisible, given the low density of produced capital and declining population. As Box 4.2 highlights, in the case of Colombia, rural populations<sup>i</sup> with unsatisfied basic needs experienced the largest relative losses during the 2010–2011 La Niña episode.

Indirect losses and the wider effects of disaster loss for low-income households and communities are rarely accounted for. However, GAR09 (UNISDR, 2009) highlighted, through a set of microeconomic studies, negative welfare outcomes, including declines in school attendance, nutrition, health, productivity and increases in inequality and unemployment. Some of these outcomes can be transmitted across generations (Ole MoiYoi, 2012). GAR11 (UNISDR, 2011) also showed how extensive disasters negatively affect children and their future.

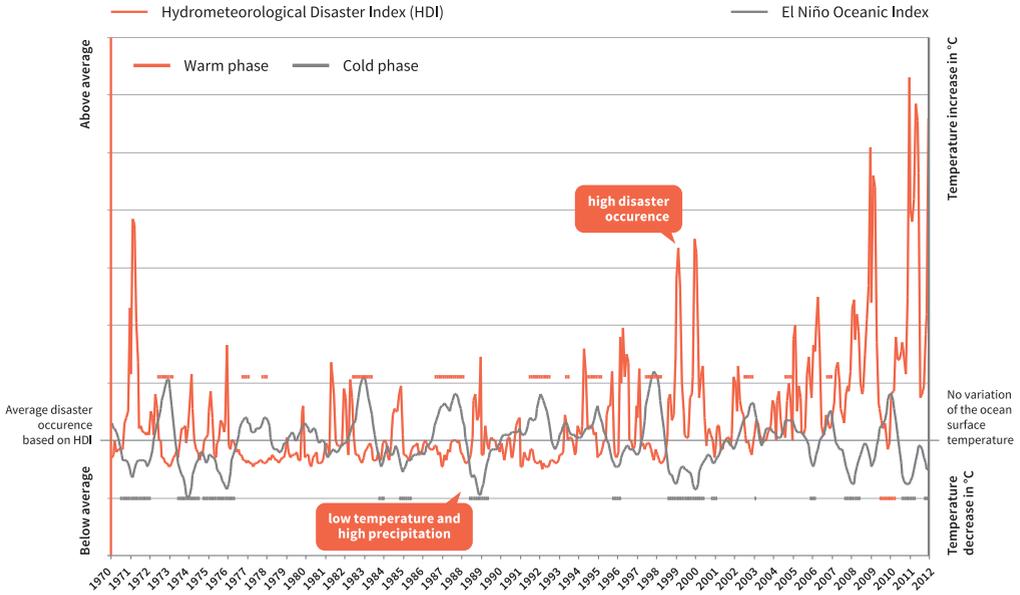
The social costs of extensive risk are not accounted for by either governments or business and are largely absorbed by low-income households and communities, undermining their potential for development and eroding resilience.



**Box 4.2** Extensive risks in rural areas

In Colombia, weather-related disasters are strongly correlated with ENSO episodes. But while the 2010–2011 La Niña was no stronger than others that had occurred in 1973–1976, 1998–2001 and 1988–89, the losses in terms of people affected and damage to housing were far greater (see Figure 4.1).

**Figure 4.1** Hydrometeorological disasters and losses in Colombia, 1970–2011



(Source: Adapted from Osso, 2012a)

Most importantly, as Figure 4.2 shows, the proportion of the population affected in rural municipalities (rural index between 50 and 75) and with over 56 percent of unsatisfied basic needs was approximately 35 times greater than in the case of urban centres (rural index between 1 and 25) and with less than 27 percent of unsatisfied basic needs).

**Figure 4.2** Proportion of disaster-affected inhabitants in urban and rural areas (expressed by rural index) and with unsatisfied basic needs (expressed by UBN index) during the 2010–2011 ENSO episode in Colombia



Unsatisfied Basic Needs (UBN)		<=27%	27 < UBN <=41	41 < UBN <=56	> 56%
Rural index					
Urban	1-25	144.05	976.17	314.12	0
	25-50	607.91	772.63	1,926.43	2,718.05
	50-75	724.18	1,082.00	1,686.34	5,086.53
Rural	75-100	0	150.98	34.73	794.80
<b>Total</b>		<b>288.7</b>	<b>823.64</b>	<b>1,764.16</b>	<b>3,626.45</b>

Values per 10,000 inhabitants 2010–2011

(Source: UNISDR, adapted from Osso, 2012c)

## 4.2 Visualising the invisible

**More than 50 countries are now recording local disaster losses, enabling them to visualize the real impact their society and economy is facing. This information is now available for governments, affected communities and businesses interested in investing in these markets.**

Localised hazards can be modelled if the necessary data is available. For example, Figure 4.3 highlights the results of a study of landslide hazard in El Salvador.

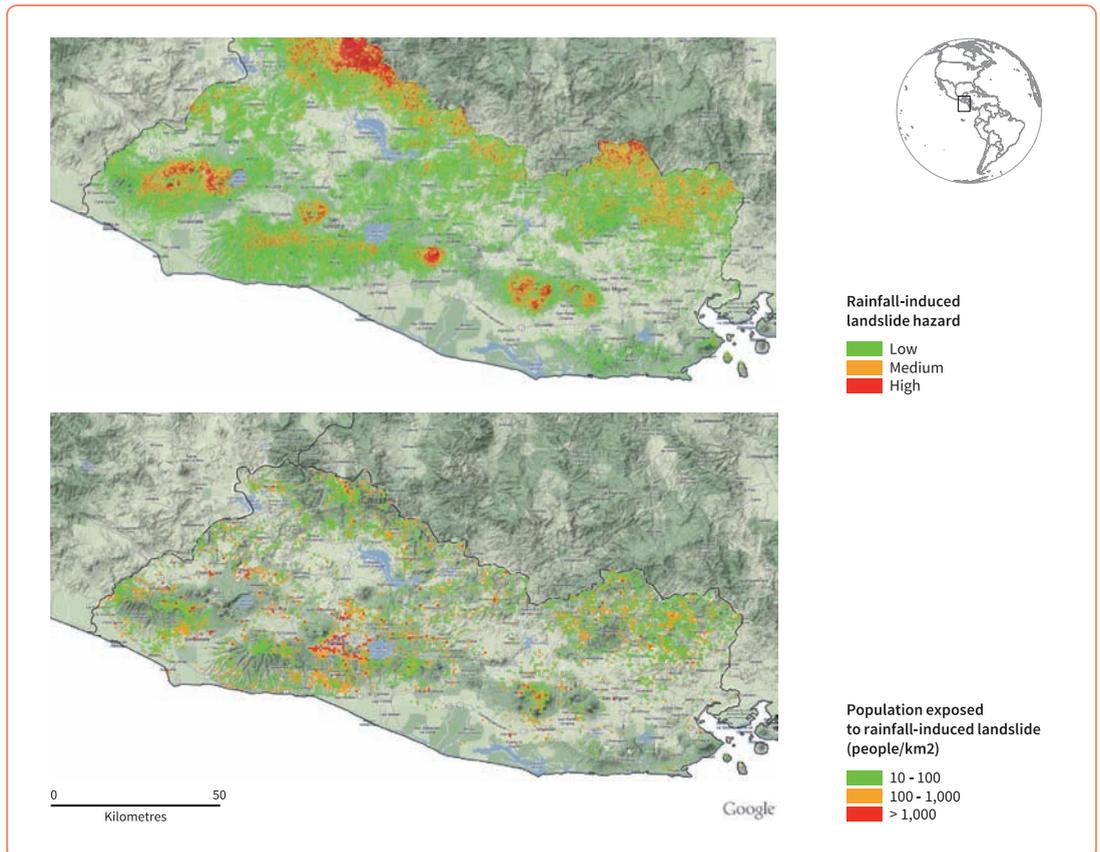
However, given that extensive risks are characterised by short return periods, the analysis of historical loss data provides a valid approach to modelling

risk patterns and trends. It is still not possible to provide a global vision of extensive risk. Box 4.3, however, highlights that a growing number of countries are developing detailed disaster loss databases that allow extensive risks to be modelled.

For businesses and governments that want to know more about these risks, a complete analysis of extensive risk patterns and trends is provided in Annex 2. Analysis on the selected set of more than 270,000 records of disaster impacts from 56 countries confirms the trends and patterns previously identified in smaller subsets of 22 and 11 countries (UNISDR, 2011 and UNISDR, 2009).

Table 4.1 shows that, although extensive disasters cause only 13 percent of total mortality, they are responsible for 42 percent of the total economic

**Figure 4.3** Hazard (top) and exposure (bottom) to landslides induced by rainfall in El Salvador



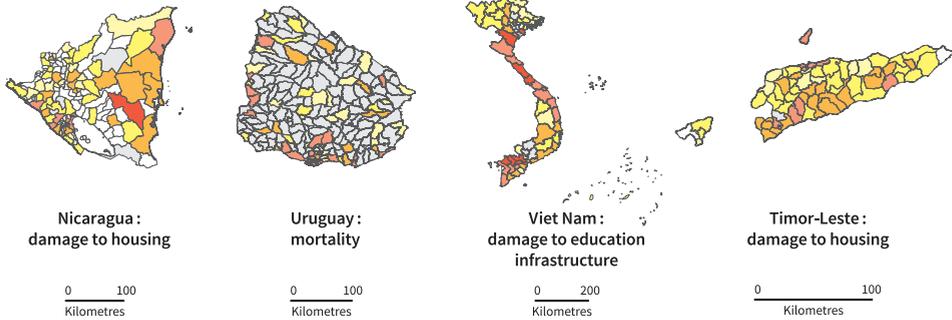
(Source: UNISDR, adapted from NGI, 2013b)



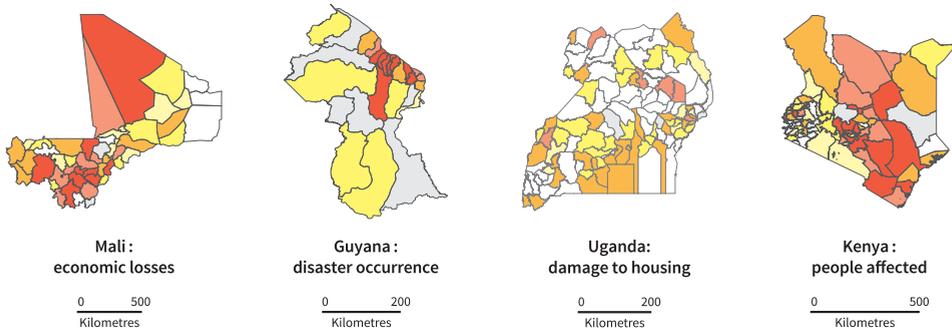


**Box 4.3** Progress in recording local disaster losses and impacts

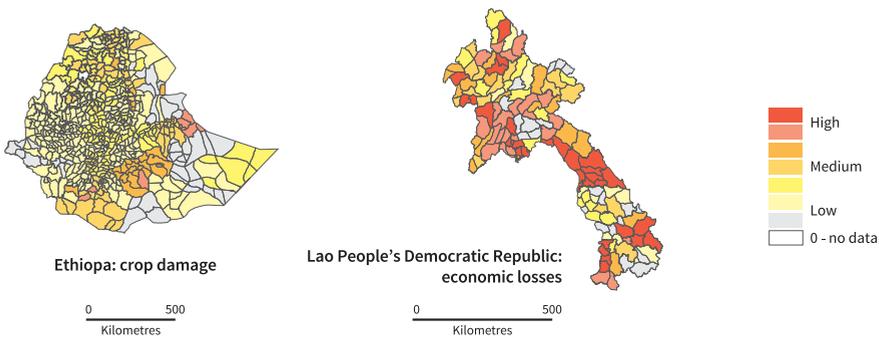
As part of a process that aims at a global vision of local disaster losses, UNISDR, UNDP, the World Bank, Corporacion OSSO and other partners are supporting national governments to build information systems that systematically account for disaster losses and impact. Currently 56 countries engage in this effort.



In Latin America and the Caribbean, Guyana, Honduras, Jamaica, Nicaragua and Uruguay have all recently published disaster databases.



In Africa, Ethiopia, Kenya, Mali and Uganda have completed initial datasets that allow a more realistic view of disaster losses in countries where global datasets have little coverage. In the Arab states, new databases have been published in Djibouti and Lebanon.



In Asia, Lao People's Democratic Republic, Timor-Leste and Viet Nam have completed disaster databases; in the Pacific Islands, a regional dataset covers 22 Small Island Developing States (SIDS). The Lao People's Democratic Republic disaster database has been used for a National Assessment Report (Lao People's Democratic Republic, 2012).

(Source: UNISDR)

losses recorded in the datasets. In countries that do not experience large-scale disasters, this figure may be much higher.

Losses associated with extensive risk, as in the example for Honduras and Uganda below, are spread over the entire country, affecting all municipalities (Figure 4.4).

The agricultural sector is one of the most affected by extensive risks, as initially highlighted by GAR11

with data from Mozambique. These impacts are further confirmed in the case of Lao People's Democratic Republic (Government of Lao People's Democratic Republic, 2012) and Lebanon (Figure 4.5).

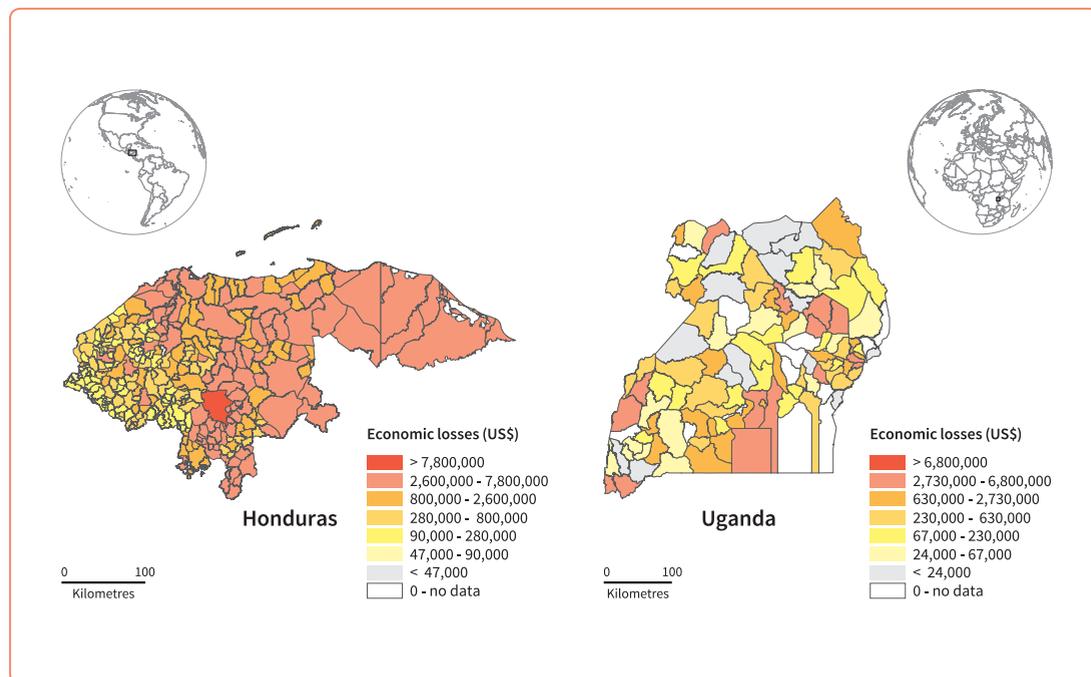
Economic losses associated with extensive risk are also increasing rapidly in the 34 new country datasets included in this report<sup>ii</sup> and are consistent with the findings of GAR09 and GAR11 (Figure 4.6). Damage to educational facilities in particular is rising rapidly.

**Table 4.1** Extensive and intensive risk impacts summary for 56 countries and 2 Indian states (1981–2011)

Risk Type	Records	%	Deaths	%	Economic Loss (billion US\$)	%
Extensive	243,614	99%	75,115	13%	115,44	42%
Intensive	1,877	1%	525,429	87%	159,94	58%
<b>TOTAL</b>	<b>245,491</b>		<b>600,544</b>		<b>275,38</b>	

(Source: UNISDR)

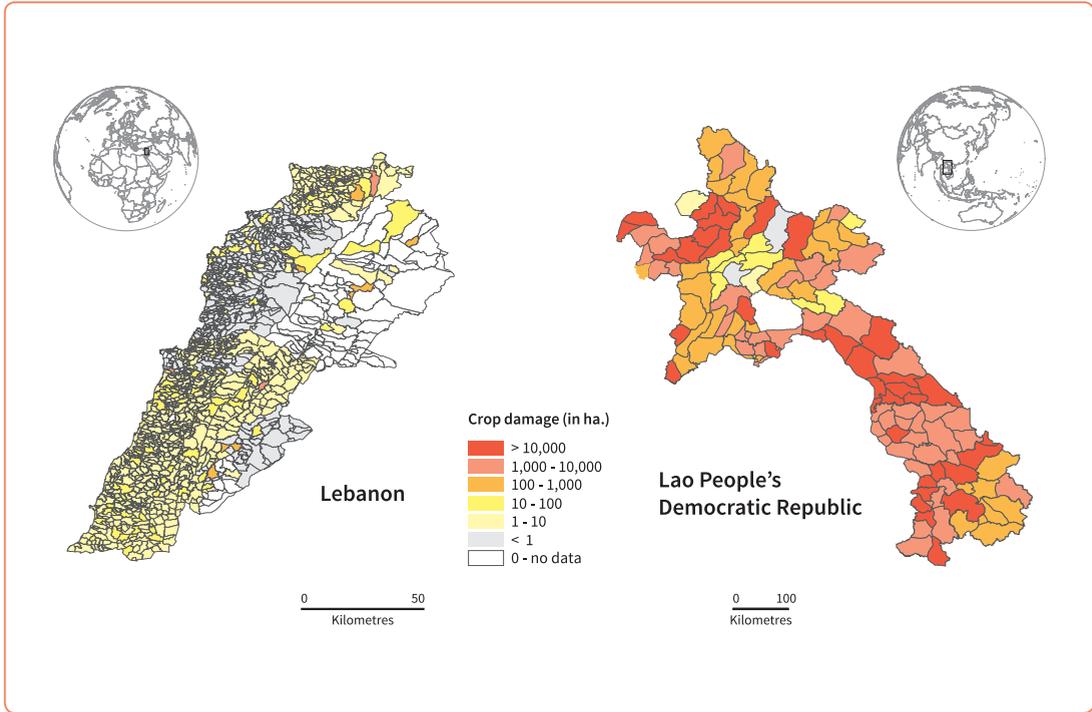
**Figure 4.4** Extensive risk direct economic losses per municipality, in Honduras (left, 1981–2011) and in Uganda (right, 1991–2011)



(Source: UNISDR)

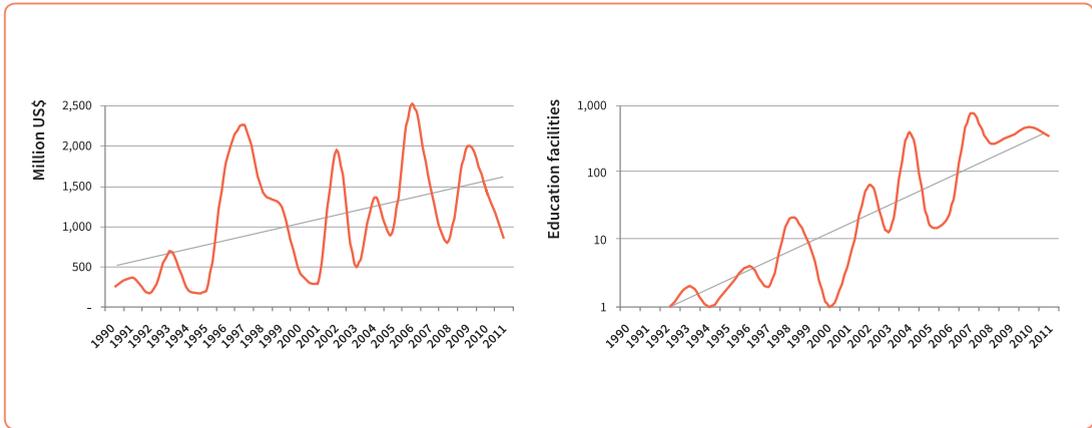


**Figure 4.5** Extensive risk, number of hectares of agricultural crops affected in Lebanon (left, 1981-2011) and Lao People's Democratic Republic (right, 1991-2011)



(Source: UNISDR, based on DesInventar)

**Figure 4.6** Loss trends over time (1990–2011) in 34 countries not presented in previous GAR analysis (left: economic losses; right: education facilities)



(Source: UNISDR, based on DesInventar)

## 4.3 Hidden risk layers

A newly applied methodology to evaluate direct loss and damage from extensive disaster events allows extensive risk to be expressed as a loss exceedance curve. This enables countries to develop a more complete analysis of risk and of their contingent liabilities associated with disasters.

Extensive risks are rarely recorded, and therefore not taken into account in national risk assessments, which usually only focus on intensive risks. GAR11 (UNISDR, 2011) presented a new hybrid loss exceedance curve as a way of combining and measuring both extensive and intensive risks at the country level. Additional hybrid curves have now been developed for eight Latin American countries.<sup>iii</sup>

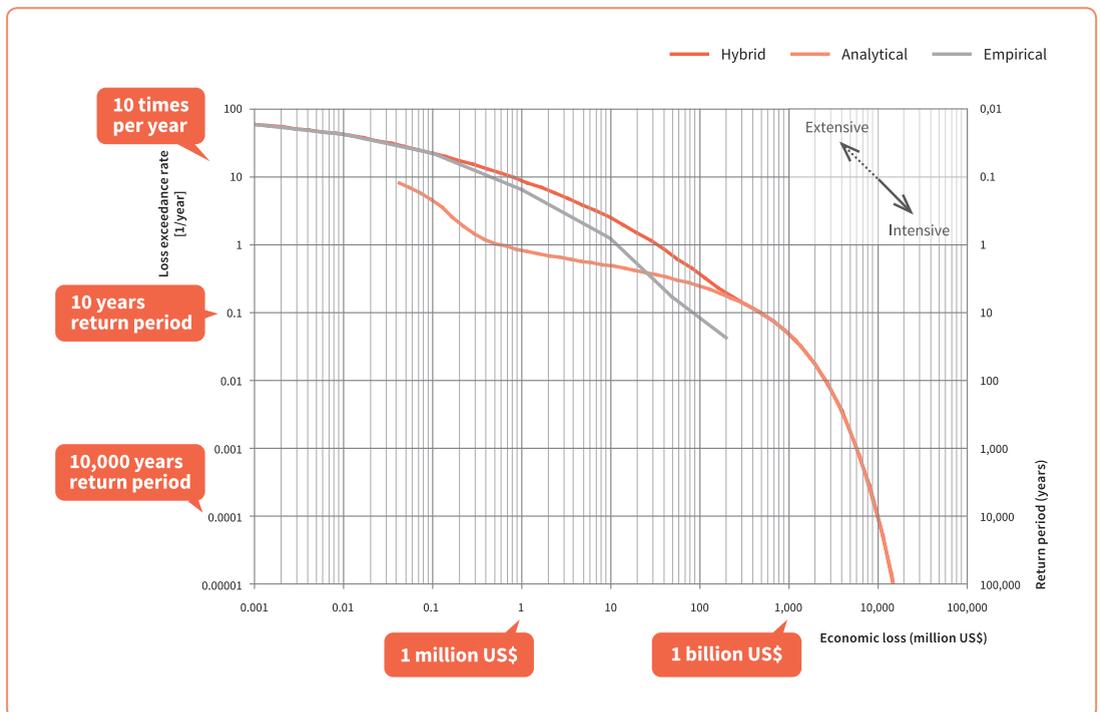
Figure 4.7 shows the hybrid curve for Guatemala. The empirical curve, based on historical loss data,

provides information on largely extensive risks with return periods of up to approximately 30 years but does not capture intensive risks with longer return periods. Similarly, the analytical curve estimated using a probabilistic risk model does not capture much of the extensive risk with shorter return periods. The hybrid curve captures both.

Figure 4.8, based on hybrid loss exceedance curves for ten Latin American countries (CIMNE et al., 2013b ; ERN-AL, 2011), highlights the annual average loss (AAL) that would be expected from all disasters, intensive and extensive, both in absolute terms and expressed as a percentage of gross fixed capital formation (GFCF). Although Mexico has the highest probable AAL in absolute terms, in relative terms, Honduras stands to lose more than 12 percent of its gross fixed capital formation every year owing to direct disaster losses.

This kind of information is valuable to inform investments in disaster risk reduction. Often, the costs of

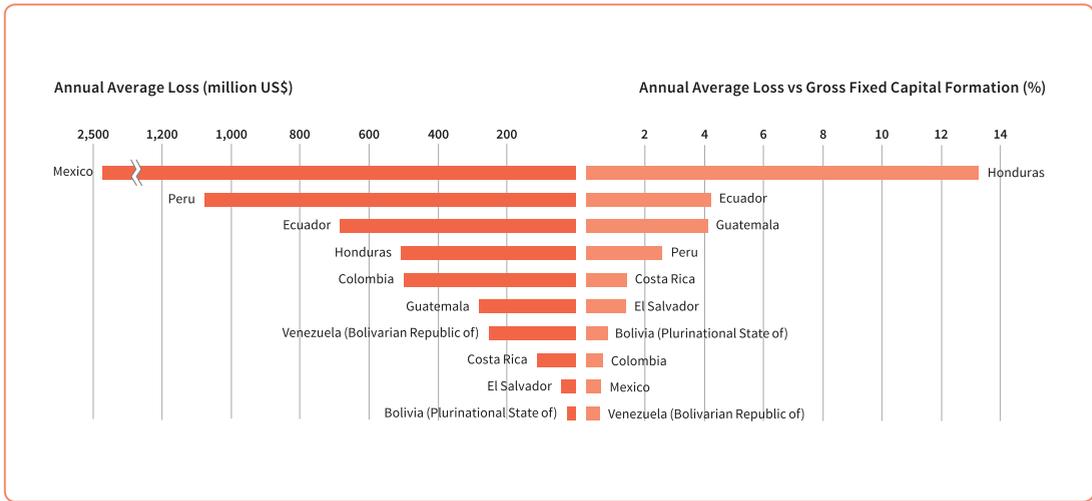
Figure 4.7 Hybrid loss exceedance curve for Guatemala



(Source: UNISDR, adapted from CIMNE et al., 2013b)



**Figure 4.8** Absolute AAL (left) and AAL relative to GFCF (right), both calculated from the hybrid risk models of selected countries



(Source: UNISDR, adapted from CIMNE et al., 2013b)

extensive disasters are not fully absorbed by government, insurance or international assistance. Parts of these losses are absorbed directly by low-income rural and urban households but also by SMEs and businesses in the informal sector. Unless these losses are made visible and their fiscal impact understood, it is difficult to justify increased public sector investments in safe and resilient infrastructure. If indirect losses to business from extensive risks could be measured, then the private sector may become a key advocate for increased public sector investment.

### Notes

- i** Rural populations are defined here using an Index of Rurality based on population density and the distance between smaller rural and larger urban centres (UNDP, 2011: Colombia Human Development Report).
- ii** The new countries are Djibouti, East Timor, Ethiopia, Guyana, Jamaica, Kenya, Lao People’s Democratic Republic, Lebanon, Mali, Nicaragua, Sri Lanka, Uganda, Uruguay, Viet Nam, plus 22 countries that have developed a joint Pacific islands regional loss database: American Samoa; Cook Islands; Fiji; French Polynesia; Guam; Kiribati; Marshall Islands; Micronesia, Federated States of; Nauru; New Caledonia; Niue; Northern Mariana Islands; Palau; Papua New Guinea; Pitcairn Islands; Samoa; Solomon Islands; Tokelau; Tonga; Tuvalu; Vanuatu; Wallis and Futuna Islands.
- iii** Bolivia (Plurinational State of), Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Peru and Venezuela (Bolivarian Republic of).

## Chapter 5

# The Resilience Challenge



Business investments are made taking into account a variety of risks, including disaster risk. However, while **immediate risks to assets** and operations may be considered, it is **equally important** for investors to be aware of the **economic resilience of the country** they are investing in.

Businesses are **more likely to recover** faster in a country where governments have the **capacity to invest** in recovery or where they have **risk financing measures** in place that cover most contingencies.

Major losses can **challenge the macroeconomic stability of even high-income countries**. Given that macroeconomic stability is considered a basic requirement of a country's competitiveness, **countries need to recognise** the potential macroeconomic implications of disasters. Currently, some countries that **can least afford to lose investment** stand to **suffer the highest disaster losses**.

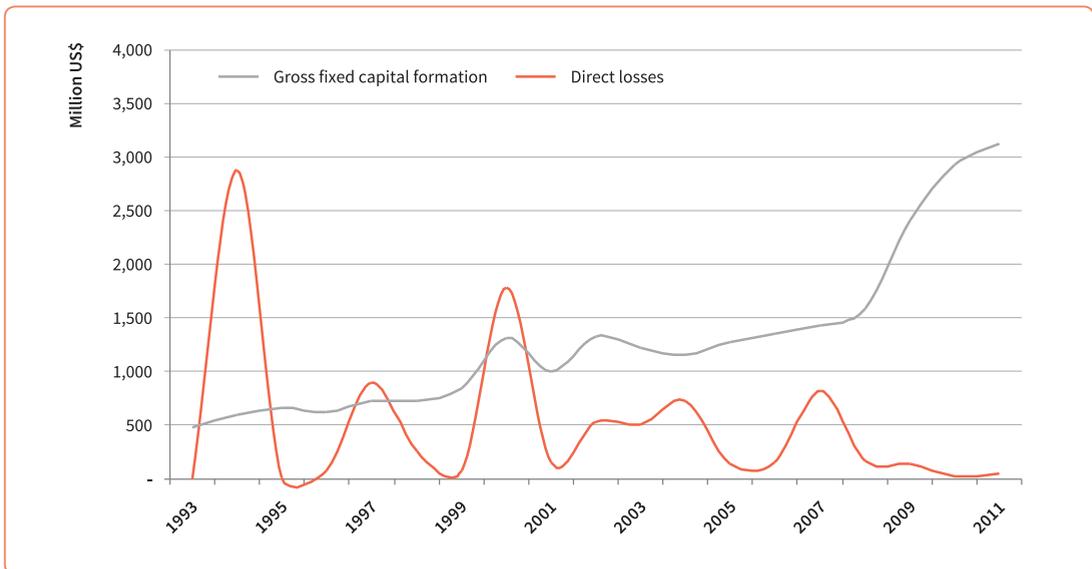
High losses and potential fiscal gaps can result in **cumulative macroeconomic effects** over time with severe implications for a country's **long-term economic and fiscal resilience**.

## 5.1 Threats to economic resilience

Direct losses from major disasters trigger indirect losses and wider impacts that can challenge the macroeconomic stability of even high-income countries. A country wishing to promote its competitiveness and strengthen economic sustainability should recognise the potentially significant macroeconomic implications of disasters.

Risk refers to the probability of a given magnitude of loss in a given period of time. Resilience refers to the capacity of a country's economy to absorb losses and recover. How quickly an economy recovers and how quickly a business recovers are clearly interrelated. But businesses are more likely to recover faster in a country where governments have the capacity to invest in recovery or where they have risk financing measures in place that cover most contingencies.

Figure 5.1 Reported disaster losses and GFCF in Mozambique, 1993–2011



(Source: UNISDR, based on national disaster loss data bases, EMDAT and World Bank indicators)

**Figure 5.2** Annual average losses from earthquakes (top) and cyclonic winds (bottom) compared with gross fixed capital formation



**1 = 10 - 30%**  
Philippines, Solomon Islands, Tonga, Trinidad and Tobago



**2 = 1 - 10%**  
Afghanistan, Antigua and Barbuda, Azerbaijan, Barbados, British Virgin Islands, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Georgia, Greece, Grenada, Guatemala, Honduras, Iran (Islamic Republic of), Japan, Kyrgyzstan, New Caledonia, Nicaragua, Pakistan, Papua New Guinea, Peru, Puerto Rico, Saint Vincent and the Grenadines, Samoa, Taiwan Province of China, Tajikistan, Turkey, Uzbekistan, Vanuatu

**3 = 0.1 - 1%**  
Albania, Algeria, Argentina, Armenia, Aruba, Austria, Bahrain, Bangladesh, Belize, Bhutan, Bolivia (Plurinational State of), Brunei Darussalam, Bulgaria, Cayman Islands, Comoros, Croatia, Cuba, Cyprus, Djibouti, Egypt, Fiji, Germany, Hungary, Iceland, Indonesia, Iraq, Israel, Italy, Jamaica, Jordan, Kazakhstan, Kuwait, Lebanon, Liechtenstein, Malaysia, Malta, Mexico, Monaco, Montenegro, Morocco, Nepal, Netherlands, New Zealand, Oman, Palau, Panama, Qatar, Republic of Moldova, Saint Lucia, San Marino, Singapore, Slovakia, Slovenia, Switzerland, Syrian Arab Republic, The former Yugoslav Republic of Macedonia, Tunisia, Turkmenistan, United Kingdom of Great Britain and Northern Ireland, United Arab Emirates, United States of America, Venezuela (Bolivarian Republic of), Yemen



**1 = 1 - 10%**  
Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Cayman Islands, Comoros, Dominica, Fiji, French Polynesia, Honduras, Hong Kong Special Administrative Region of China, Jamaica, Japan, Macao Special Administrative Region of China, Mauritius, Mexico, Micronesia (Federated States of), Palau, Philippines, Puerto Rico, Republic of Korea, Samoa, Taiwan Province of China, Tonga



**2 = 0.1 - 1%**  
Bangladesh, British Virgin Islands, Brunei Darussalam, China, Cuba, Dominican Republic, El Salvador, Grenada, Guatemala, Madagascar, Mozambique, New Caledonia, New Zealand, Nicaragua, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Solomon Islands, Trinidad and Tobago, United States of America, Vanuatu, Venezuela (Bolivarian Republic of)

**3 = 0.01 - 0.1%**  
Australia, Cambodia, Canada, Costa Rica, Guyana, Haiti, India, Indonesia, Lao People's Democratic Republic, Malawi, Malaysia, Nepal, Oman, Pakistan, Panama, Papua New Guinea, South Africa, Sri Lanka, Suriname, Swaziland, Viet Nam, Zimbabwe

(Source: UNISDR, based on GAR global risk model)

**Box 5.1** Estimating a government’s direct burden

The GAR13 model also takes into account losses to produced capital stock under government responsibility. These include government buildings and public structures as well as housing for low-income communities. These types of losses are here defined as ‘fiscal losses’, as they represent the sovereign or fiscal risk of a government in case of a disaster. They are calculated as part of total annual average losses to buildings, both public and private<sup>ii</sup>.

As infrastructure replacement costs are likely to constitute an important part of a government’s direct burden, fiscal losses presented here are likely to be underestimated. Nevertheless, they provide an important reference for governments. For example, fiscal losses from a 1 in 250 years return period earthquake can amount to more than US\$9 billion for the Philippines and US\$3 billion for Colombia. China and Mexico both face fiscal losses from earthquakes of about US\$4 billion, whereas fiscal losses from cyclonic wind damage would amount to US\$17 billion for China and more than US\$13 billion for Mexico.

The scale of these losses is better understood when comparing them with national or government revenue, i.e. a country’s income from taxes and non-tax sources. National revenue can be seen as a proxy for a country’s ability to buffer losses. Figure 5.3 shows probable maximum fiscal losses from earthquakes compared with national revenue. In the case of the Philippines, losses amount to about 27 percent of government revenue, whereas for the Dominican Republic and Bhutan, probable maximum fiscal losses may exceed 13 percent of their revenue. The Philippines displays an equally significant fiscal vulnerability to wind damage, highlighting how losses can easily exceed government revenue, potentially resulting in an increased debt burden.

**Figure 5.3** Fiscal probable maximum losses (PML) from earthquakes with a 250 years return period compared with national revenue



- 1 = 20 - 40%**  
Philippines
- 2 = 10 - 20 %**  
Afghanistan, Bhutan, Dominican Republic
- 3 = 1 - 10 %**  
Armenia, Azerbaijan, Bangladesh, Bulgaria, Barbados, Colombia, Costa Rica, Fiji, Jamaica, Jordan, Japan, Kazakhstan, Kyrgyzstan, Lebanon, Morocco, Pakistan, Peru, Republic of Moldova, Saint Vincent and the Grenadines, Trinidad and Tobago, Zambia
- 3 = less than 1 %**  
Austria, Benin, Burkina Faso, Bahrain, Bahamas, Belarus, Bosnia and Herzegovina, Canada, Chile, China, Cyprus, Denmark, Egypt, Estonia, Finland, France, Croatia, Hungary, India, Ireland, Iceland, Israel, Kenya, Cambodia, Kuwait, Liberia, Lesotho, Macao Special Administrative Region of China, Madagascar, Maldives, Malta, Mauritius, Nigeria, Netherlands, Norway, New Zealand, Poland, Portugal, Qatar, Republic of Korea, Saint Kitts and Nevis, Seychelles, Singapore, Sierra Leone, Slovakia, Slovenia, South Africa, Sri Lanka, Thailand, The former Yugoslav Republic of Macedonia, Togo, Uganda

(Source: UNISDR, based on GAR global risk model and World Bank data<sup>iii</sup>)

(Source: UNISDR)

A first approach to resilience is to look at a country's capacity to invest. Gross fixed capital formation (GFCF) is a metric that represents annual public and private investment in a country.<sup>i</sup>

Some countries that can least afford to lose investment are losing the most. For example, in Mozambique, the value of annual reported disaster losses surpassed GFCF three times during the period 1993–2011. In each episode, investment not only slowed down in the country but actually reversed. In 2011, this value represented 12 percent of Mozambique's capital formation, in El Salvador, 8 percent; and in both Honduras and Nicaragua, about 6 percent.

Figure 5.2 below highlights the proportion of GFCF at risk from both earthquakes and cyclonic winds. When annual average losses (AAL) represent a high proportion of GFCF, this implies that it will take longer for lost capital to be replaced by new investment and thus recovery slower.

For example, Japan not only has a high absolute AAL, this also represents a high proportion of its total GFCF. This means that losses cannot be easily replaced by the formation of new capital stock. In general, countries with sluggish growth and investment will find it more difficult to replace lost capital stock. In these countries, to protect economic growth, investment in disaster risk reduction is extremely important.

In contrast, countries such as the United States of America or China, which also have high absolute levels of AAL, have much higher rates of capital formation. This means that they will be able to replace lost capital more quickly and have a shorter recovery time.

A second approach to economic resilience is to estimate fiscal losses, which are disaster losses that governments are responsible for. As Box 5.1 shows, these losses can challenge the macroeconomic stability of even high-income countries. Macroeconomic stability is considered a basic requirement of a country's competitiveness (WEF, 2012); countries

**Table 5.1** Estimated contingent liabilities for the Government of Colombia

Contingent liability	% of GDP
Legal action	14.04
Infrastructure project	0.26
Public credit operation	0.22
<b>NATURAL DISASTER*</b>	
Fiscal Portfolio (Contingent Liability)	1.40
Public and Private Portfolio	11.3

Sources: MHCP 2011.

\*Contingent liability associated with natural disasters is calculated from PML estimated by UNISDR (2011). The contingent liability is 1.40% GDP (US\$4.417 billion - Return period 250 years) and the PML public (contingent liability) and private is 11.3% (US\$35.615 billion (Return period 250 years))

(Source: Government of Mexico and World Bank, 2012)

therefore need to recognise the potential macro-economic implications of disasters.

## 5.2 The financing gap

**A country's economic resilience depends to an important extent on whether a government is able to absorb losses. Assessing the fiscal capacity of a country is therefore critical to knowing whether it will be in the position to provide timely relief, invest in the required reconstruction and buffer economic downturns to avoid major and long-term macroeconomic impacts.**

Economic resilience also depends on whether a government is able to finance recovery and reconstruction through a broad array of public and private mechanisms, including budget reallocations, tax increases, reserves, domestic or external borrowing, international assistance, insurance and reinsurance payouts, and market mechanisms such as catastrophe-linked securities (Mechler et al., 2006).



The scale of a government’s fiscal deficit or financing gap following a disaster depends on how explicit and implicit the liabilities of governments are defined. The Government of Colombia, for example, has recognised this, and has embarked on an ambitious effort to fully assess contingent liabilities arising from disaster risk (see Chapter 15 of this report)—this initiative is part of its overall management strategy for government contingent liabilities (Government of Mexico and World Bank, 2012).

Basing its analysis of liability on GAR11’s examination of Colombia’s probable maximum losses from

disasters (UNISDR, 2011), the government has found that disasters associated with natural hazards are the second most important source of its contingent liabilities, after those associated with legal proceedings (see Table 5.1).

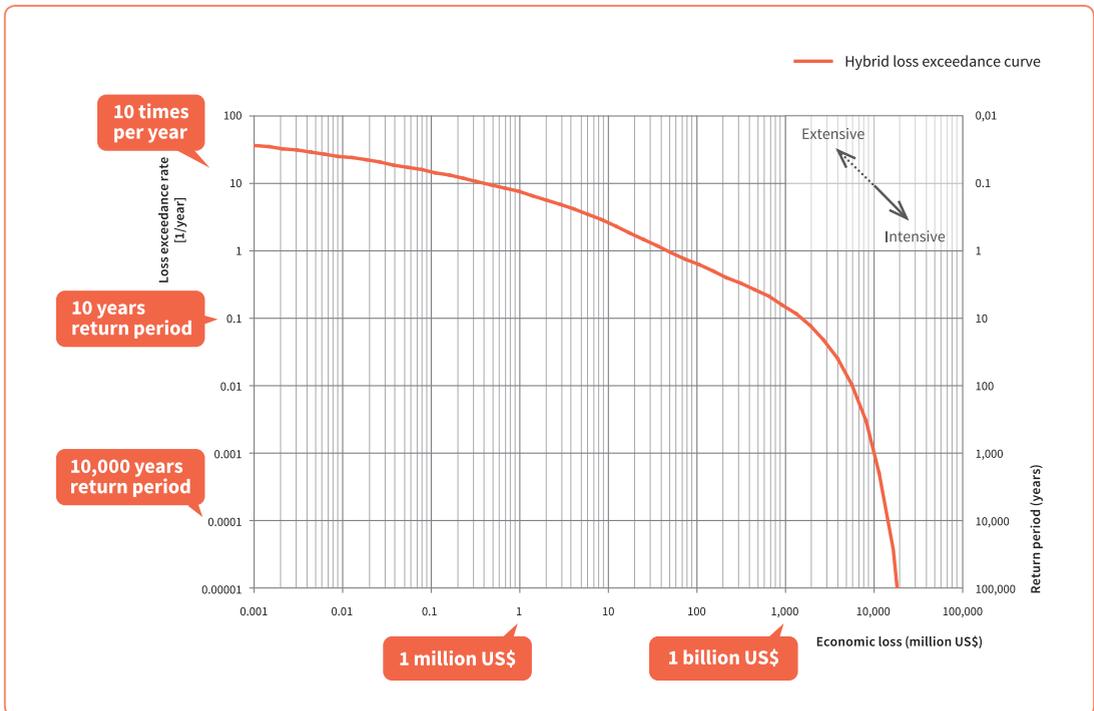
Based on this analysis, the Colombian Government’s new disaster risk financing strategy will include risk transfer solutions for potentially affected infrastructure and low-income housing as well as a strong retention strategy via reserve funds (Government of Mexico and World Bank, 2012).

**Table 5.2** Liabilities of a national government (items that can be related to risk from physical hazard appear in red)

Liabilities	Direct: obligation in any event	Contingent: obligation if a particular event occurs
<b>Explicit: Government liability recognized by law or contract</b>	Foreign and domestic sovereign borrowing, expenditures by budget law and budget expenditures	State guarantees for non-sovereign borrowing and public and private sector entities, <b>reconstruction of public infrastructure</b>
<b>Implicit: A “moral” obligation of the government</b>	Future recurrent costs of public investment projects, pension and health care expenditure	Default of subnational government and public or private entities, <b>disaster relief</b>

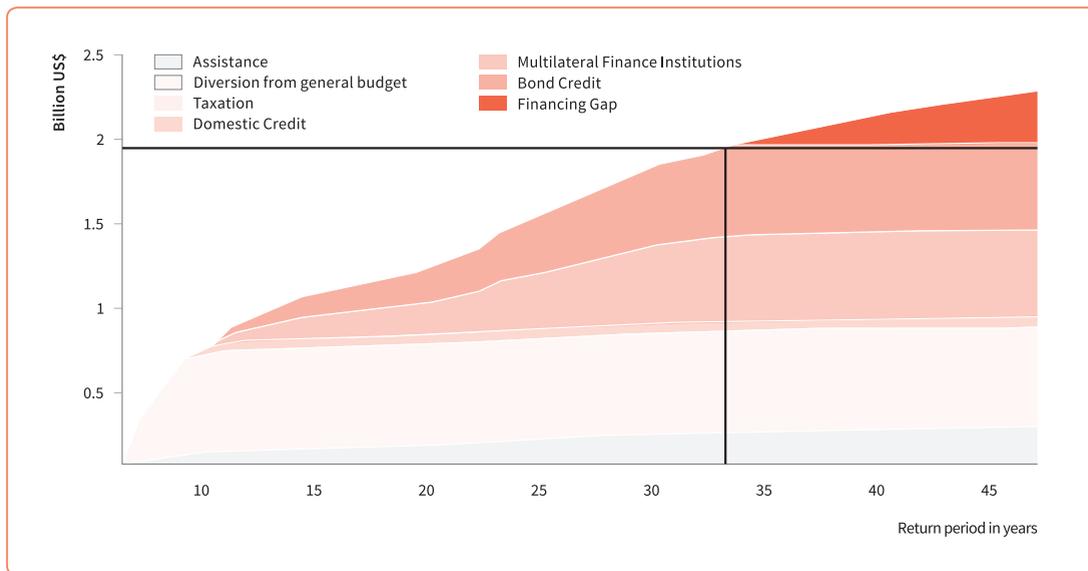
(Source: Mechler et al., 2009)

**Figure 5.4** Loss exceedance curve for Honduras



(Source: UNISDR, adapted from CIMNE et al., 2013b)

**Figure 5.5** Fiscal vulnerability of Honduras to disaster loss



(Source: Hochrainer et al., 2013)

In many countries, following a disaster, implicit liabilities bring uncertainty to the national account when reconstruction and disaster relief expenditure have to be accommodated (see highlights in Table 5.2). For example, many governments act implicitly as ‘insurers of last resort’ for low-income households even if this responsibility is rarely enshrined in law.

This kind of ad hoc compensation provides disincentives for risk reduction. Worse, ‘compensation inflation’ can occur when households expect at least the same level of compensation as provided in previous disasters, which increases the government’s fiscal burden (World Bank, 2012b). Establishing an ex-ante legal framework is needed to decrease the level of fiscal uncertainty and ensure clear incentives for risk reduction.

Based on different risk metrics and criteria for measuring government fiscal capacity, a number of examples illustrate the potential scale of these financing gaps.

In Honduras, analysis based on results from a hybrid loss exceedance curve (see Chapter 4 of this

report) shows significant losses even from frequently recurring events (Figure 5.4).

These results enabled an analysis of anticipated relief obligations of the government and its available sources of funding, illustrating the financial vulnerability of the Honduran Government to disaster risk (Figure 5.5).

The analysis shows that the government depends largely on traditional sources to cover for losses from frequently occurring small to medium-sized floods and storms (Hochrainer et al., 2013). However, for events with a relatively low return period of one-in-33 years, the government would still face a significant financing gap with potentially significant economic development setbacks, rendering it unable to provide timely relief and reconstruction efforts (Ibid.).

Another case in point is Madagascar, where a financing gap would appear from any event more severe than a one-in-23 year cyclone (Figure 5.6). And losses from one-in 100 year events could cause financing gaps of almost US\$1 billion (Hochrainer, 2012). These estimations were based on



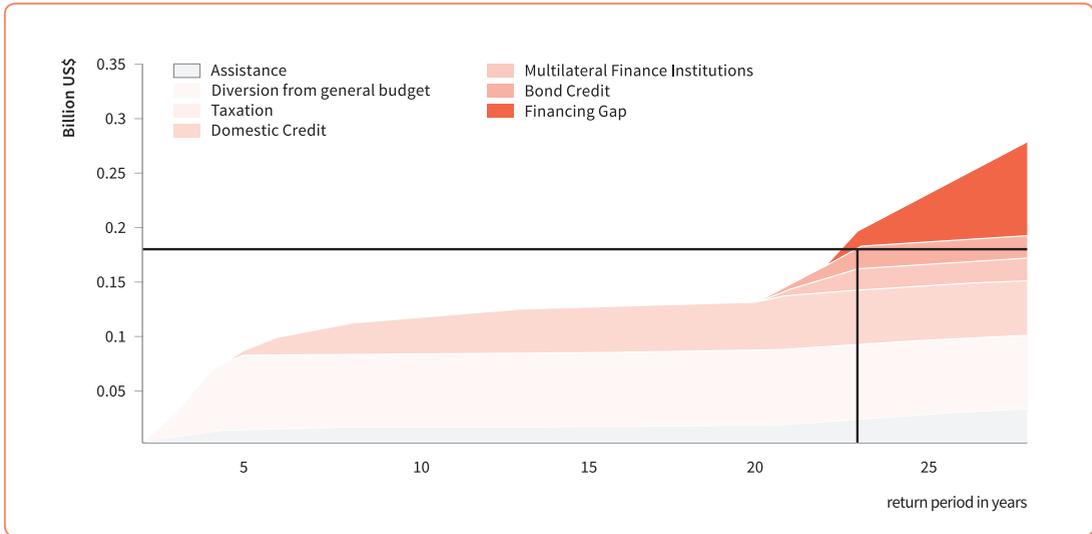
optimistic scenarios of resource availability; other scenarios showed that the Government of Madagascar would be challenged to cover losses from even annual events (Ibid.).

This information is useful in two ways. First, it indicates what scale of disaster would exhaust and exceed a country's domestic resources (taxes and budget diversion) and external resources (largely

new debt). Second, based on the analysis of impacts from disasters for selected return periods, such as a one-in-100 year event, information on the monetary scale of resources and gaps can be used to develop risk financing instruments and negotiate appropriate premiums.

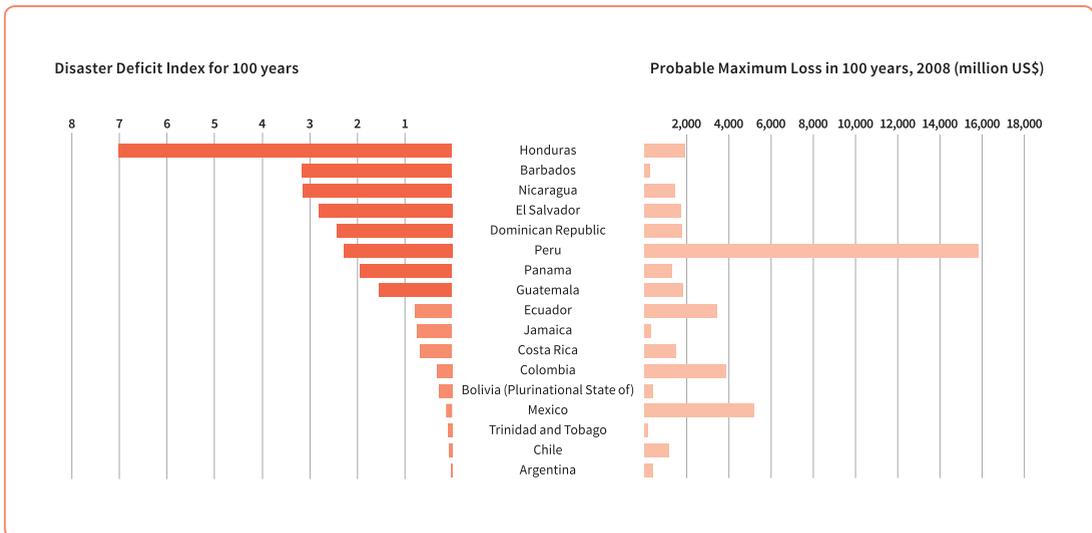
The Inter-American Development Bank's disaster deficit index (DDI) highlights resource implications

**Figure 5.6** The fiscal gap for cyclone exposure in Madagascar



(Source: Hochrainer, 2012)

**Figure 5.7** Countries' ability to absorb the losses of a one-in-100 year event (2008 data)



(Source: UNISDR, based on IADB, 2010 ERN-AL, 2011 and CIMNE et al., 2013b)

**Figure 5.8** Financing the deficit from disasters in the Philippines (in billions of Pesos)



(Source: Jose, 2012)

of major disasters in eight countries in Latin America and the Caribbean. The DDI captures the ratio of resource demands incurred by disasters to a country’s availability of funds to cover these demands.

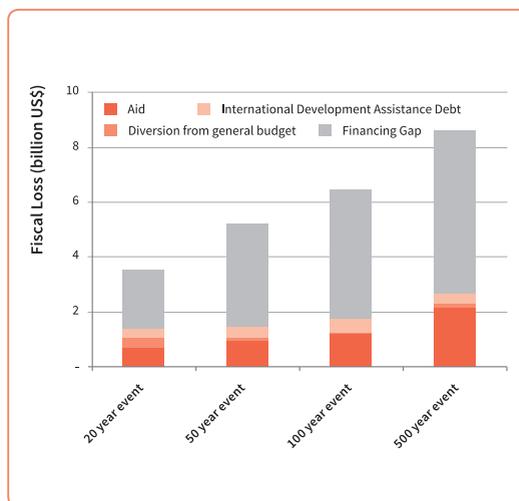
Figure 5.7 shows the results in the case of a one-in-100 year disaster, with any value above 1 on the DDI indicating a financing gap. For example, the DDI indicates that despite an estimated PML of more than US\$4 billion, Mexico is well positioned to cover these losses with available resources. In contrast, Honduras would be seriously challenged in spite of a much smaller PML.

The Philippines also has consistently experienced financing gaps owing to disasters since 2000 (Figure 5.8). Although the Philippines has financed part of those gap by domestic and foreign credit, in many countries, sovereign risks are likely to limit borrowing capacity.

The fiscal gap may be even greater in the case of low-income countries and others with high debts and a constrained fiscal space. Nepal, for example, would be unable to finance the costs of even a

one-in-20 year event, and that gap would be greater than US\$2 billion (Figure 5.9).

**Figure 5.9** Fiscal vulnerability and financing gap for earthquake and flood risk in Nepal



(Source: Mechler et al., 2013)



## 5.3 Macroeconomic effects

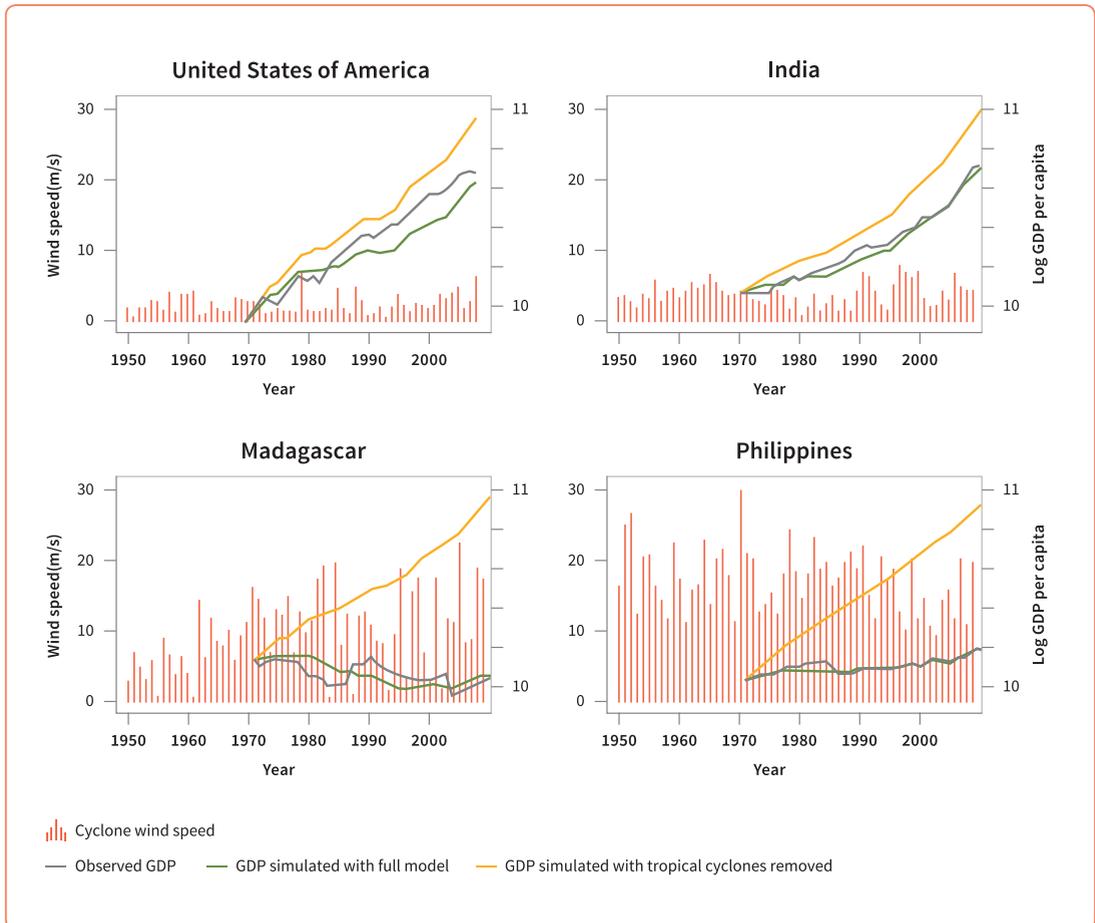
**Disasters can negatively impact the economic development of any country, but for smaller economies that are heavily dependent on single economic sectors, these impacts are likely pervasive. Direct and indirect losses can result in macroeconomic effects that cumulate over time.**

Although countries with fiscal gaps may have more difficulty recovering after a disaster, there is less certainty regarding longer-term macroeconomic impacts (World Bank, 2011). Some studies show that disasters have no long-term effect on economic performance or, on the contrary, either owing to

inflows of resources for reconstruction or to the creative destruction of obsolete capital, may even contribute positively to the economy (Albala-Bertrand, 1993 and 2006; Skidmore and Toya, 2002). Reconstruction spending may give demand-lacking economies a temporary boost.

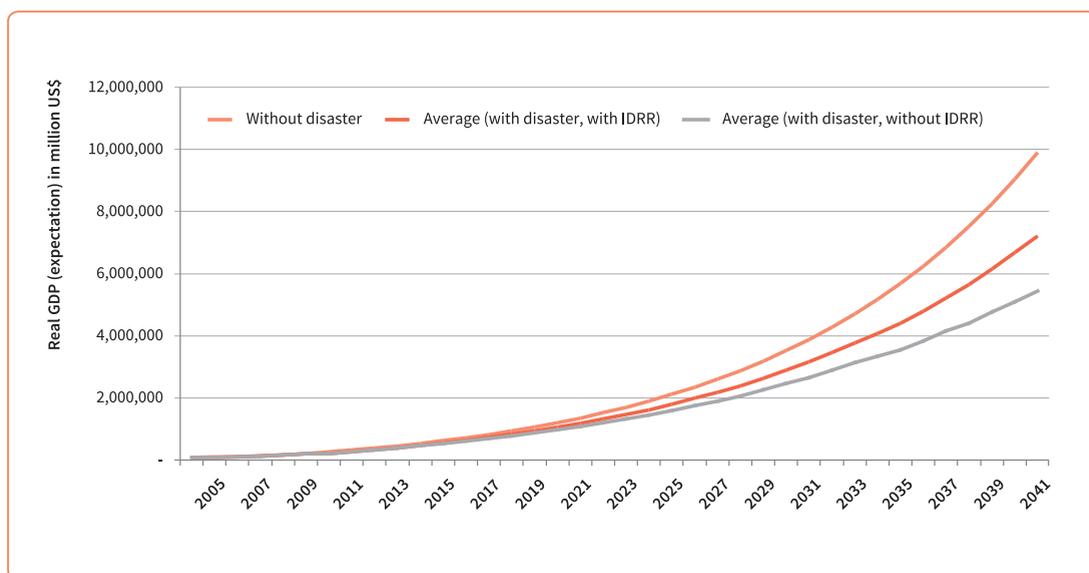
However, while these positive effects may be possible in competitive and resilient economies with high levels of GFCF and without financing gaps, this is less likely in countries with low levels of GFCF and with large gaps. Numerous studies indicate that disasters tend to impact negatively on economic development (Mechler 2004; Hochrainer, 2009; Crespo Cuaresma et al., 2008; Noy, 2009). In general, larger and more diversified economies are likely to be

**Figure 5.10** Simulations of GDP growth and tropical cyclone exposure



(Source: Hsiang and Jina, 2012)

**Figure 5.11** Simulation for Pakistan (IDRR = investment in disaster risk reduction)



(Source: Japan International Cooperation Agency (JICA))\*

more resilient than smaller economies, heavily dependent on single economic sectors (UNISDR, 2009 and 2011; Gencer, 2012). In less resilient economies, the wider impacts of disasters are more likely to be pervasive.

Although further research is required to reconcile the results from different economic models, recent studies show that in the medium (Hochrainer, 2009) or long term (Hsiang and Jina, 2012), countries that have experienced intensive disasters may never recover this lost growth. For example, countries affected by tropical cyclones experience lower GDP growth in the 15 years that follow compared with the estimated growth that would have occurred without cyclone impacts. In countries with frequent severe cyclones—such as Madagascar and the Philippines—and large fiscal gaps, growth will be lower over several decades (see Figure 5.10). Countries with less frequent and severe cyclones—such as India or the United States of America—also experience lower growth, but the divergence is far less.

New simulations of the impact of disaster risk reduction measures on economic growth also show useful results. In Pakistan, for example, an analysis

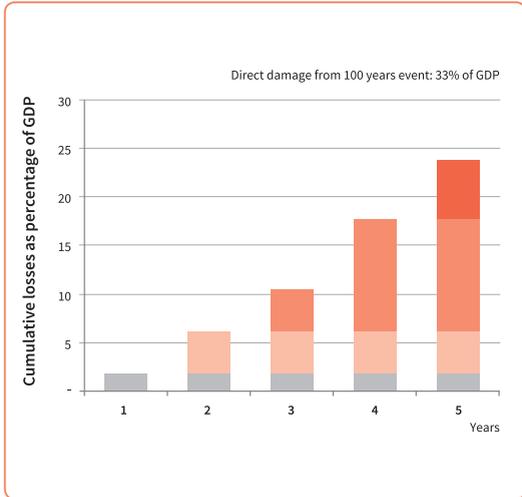
of economic growth projections shows that although real GDP growth would be impacted by a major disaster event, investments in disaster risk reduction could significantly curtail this impact (Figure 5.11).

The impacts of disasters on economic growth over time can be understood when assessing potential mid- to long-term macroeconomic impacts. In Honduras, a one-in 100 year event could produce direct losses amounting to 33 percent of its GDP. Given its limited ability to finance this loss, the government also would have to prepare for further cumulative consequences over time, estimated at up to almost 24 percent of GDP over a period of 5 years (Figure 5.12).

Currently, national accounting does not adequately measure disaster impacts. On the contrary, accounting systems usually report reconstruction and relief spending, adding to GDP figures. Disaster risk may be included in new approaches to wealth accounting at the national level such as adjusted savings,<sup>y</sup> to improve risk management and financing strategies in the future (Mechler, 2009).



**Figure 5.12** Modelled cumulative macroeconomic effects of disasters in Honduras



(Source: Hochrainer et al., 2013)

Businesses should be a strong proponent of such efforts as they promise a first step towards addressing hidden fiscal risks that can directly impact on their environment, as witnessed since the global economic crisis began in 2007. Businesses have begun to recognise this in accounting for natural capital<sup>vi</sup> (WAVES, 2012), which—as discussed in the next chapter—is critical to national wealth, but are yet to fully embrace this as an opportunity.

## Notes

**i** Countries for which no data on gross fixed capital formation is available, and which were therefore not included in the following analysis, are: Anguilla, Democratic People’s Republic of Korea, French Guiana, Guadeloupe, Martinique, Mayotte, Myanmar, Réunion, Turks and Caicos Islands, United States Virgin Islands.

**ii** Losses to other types of assets such as road or water infrastructure are not included.

**iii** World Bank data on national revenue from: <http://data.worldbank.org/indicator/GC.REV.XGRT.GD.ZS?page=1>

Countries for which no data on revenue is available, and which were therefore not included in the analysis, are: Aruba, Angola, Anguilla, Albania, Algeria, Argentina, Antigua and Barbuda, Australia, Belgium, Belize, Bolivia (Plurinational State of), Brazil, Botswana, British Virgin Islands, Brunei Darussalam, Burundi, Central African Republic, Cameroon, Cape Verde, Cayman Islands, Chad, Comoros, Congo, Cote d’Ivoire, Cuba, Czech Republic, Democratic Republic of the Congo, Democratic People’s Republic of Korea, Djibouti, Dominica, Ecuador, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Faeroe Islands, French Guiana, French Polynesia, Gabon, Germany, Gibraltar, Guinea, Guadeloupe, Grenada, Guyana, Haiti, Iraq, Liechtenstein, Mauritania, Martinique, Mayotte, Micronesia (Feder-

ated States of), Monaco, Montenegro, Myanmar, Georgia, Ghana, Gambia, Guinea-Bissau, Greece, Guatemala, Hong Kong Special Administrative Region of China, Honduras, Indonesia, Iran (Islamic Republic of), Italy, Lao People’s Democratic Republic, Libya, Lithuania, Luxembourg, Latvia, Mexico, Mali, Mongolia, Mozambique, Malawi, Malaysia, Namibia, New Caledonia, Niger, Nicaragua, Nepal, Oman, Panama, Palau, Papua New Guinea, Puerto Rico, Paraguay, Réunion, Russian Federation, Rwanda, Saint Lucia, Samoa, Senegal, San Marino, Sao Tome and Principe, Saudi Arabia, Solomon Islands, Somalia, Serbia, Spain, Sudan, Suriname, Sweden, Swaziland, Switzerland, Syrian Arab Republic, Tajikistan, Turks and Caicos Islands, Turkmenistan, Tonga, Tunisia, Turkey, Taiwan Province of China, Ukraine, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, United States Virgin Islands, Uruguay, Uzbekistan, Venezuela (Bolivarian Republic of), Vanuatu, Viet Nam, Western Sahara, Yemen, Zimbabwe.

**iv** Information directly provided to UNISDR by JICA in support of the 2013 Global Assessment Report on Disaster Risk Reduction. The simulations were made using JICA’s “DR2AD Model”, an economic model that measures the social and economic impacts of disaster risk reduction investments and allows policy-makers to evaluate multi-index effects of these investments.

**v** See for example World Bank Indicators’ adjusted savings data: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTEEL/0,,contentMDK:20502388~menuPK:1187778~pagePK:148956~piPK:216618~theSitePK:408050,00.html>.

**vi** <http://www.wavespartnership.org/waves/private-sector%E2%80%99s-role-recognizing-value-natural-capital-focus>.

## Chapter 6

# Natural capital risk



A country's **wealth is determined** to a significant extent **by its stock of natural capital**. Disaster risks include the loss and erosion of natural capital with potentially serious consequences for business, households and a country's wealth.

**Globalisation is not only modifying risk patterns** through increasing hazard exposure and vulnerability, but also **through climate change**. Along with climate change, environmental degradation, deforestation and the over-exploitation of natural resources all result in **increased risks to natural capital**. For example, **wild-land fires now affect all continents** with the **cost of damage** to tropical ecosystem services alone potentially **exceeding US\$3 trillion per year**.

**Land degradation is a key driver of agricultural drought risk**. Large areas of Africa, the Arab and Mediterranean regions are experiencing both land degradation and high levels of soil moisture deficit leading to a potentially **irreversible loss of natural capital**. The scale of direct losses and indirect impacts from **agricultural drought is still poorly understood** but potentially significant. But **innovative new probabilistic models of agricultural drought risk** are now providing a clearer picture of **potential crop losses at the country level** and can be related to relevant economic indicators.

## 6.1 Natural wealth

**A country's wealth is also dependent on its stock of natural capital. A country with a declining base of natural capital is unlikely to achieve a sustainable increase in wealth.**

Natural capital is understood as a set of renewable and non-renewable natural resources, including agricultural land, fisheries, fossil fuels, forest resources, water, biodiversity and minerals. Apart from flows into produced capital, business investment also flows into other sectors, such as agribusiness, forestry and mining, in countries with abundant natural capital. Whether these investments pose risks to natural capital needs to be assessed and understood.

Risks associated with natural capital may affect businesses as well as other social sectors in the same way as disaster risks associated with produced capital. With natural capital, many risks generated through business investments are externalised and transferred through mechanisms such as climate change, land degradation and the over-exploitation of water resources; in the long term, these become shared risks not only in space but in

time because the exhaustion of natural capital compromises the wealth of future generations.

However, although risks to produced capital are now modelled with increasing accuracy, the estimation of natural capital risks is still in its infancy. As such, both costs to business as well as shared risks are rarely factored into investment decisions. The sections that follow will explore some of the drivers of natural capital risk, including climate change, land degradation, and the impact of wild-land fires and agricultural droughts. Chapter 10 in Part II of this report will build on this analysis and explore the role of agribusiness in food security risk.

Global warming



## 6.2 The ultimate risk transfer: global climate change

**Globalisation is not only modifying risk patterns through increasing hazard exposure and vulnerability, but also through climate change.**

Since the beginning of the industrial revolution in 1750, the atmospheric abundance of the three

principal greenhouse gases—carbon dioxide, methane and nitrous oxide—have increased by 39 percent, 158 percent and 20 percent, respectively (WMO, 2011).

As Box 6.1 shows, increasing greenhouse gas concentrations in the atmosphere modifies climate, although uncertainties remain regarding the repercussions in weather and climate-related hazards in different regions (IPCC, 2012).

Increased combustion of fossil fuels, deforestation and land-use changes are directly linked to the capital flows and investment decisions of the past and to growing greenhouse gas emissions in the present and future. Industry contributes directly and indirectly about 37 percent of global greenhouse gas emissions, and these have increased by 65 percent since 1971 (Worrell et al., 2009). Production of energy-intensive industrial goods, in particular, has increased dramatically since 1970 (cement, by 336 percent; aluminium, by 252 percent; steel, by 95 percent; ammonia, by 353 percent; and paper, by 190 percent) (Ibid.). But emissions from

energy production, transport, agriculture and urbanisation are also critical. And as this chapter highlights, other factors such as wild-land fires, which are often associated with deforestation, also make critical contributions.

For more than a century, high-income countries have been contributing to these emissions. However, as a consequence of economic globalisation, many low and middle-income countries are now becoming large greenhouse gas (GHG) emitters. Given that climate change modifies climate and weather-related hazards, it becomes the ultimate mechanism of global risk transfer and of generating shared risks. It represents the privatisation of benefits that accrue from present investment at the expense of future losses that will surface from climate change later in this century. It also represents a transfer or export of disaster risk from countries responsible for the majority of emissions to those that have fewer emissions but will see their disaster risks increase. Figure 6.1 compares the ratio of GHG emissions with expected losses from cyclonic wind damage. Many countries with

**Box 6.1** Special IPCC Report appraises and addresses future climate extremes

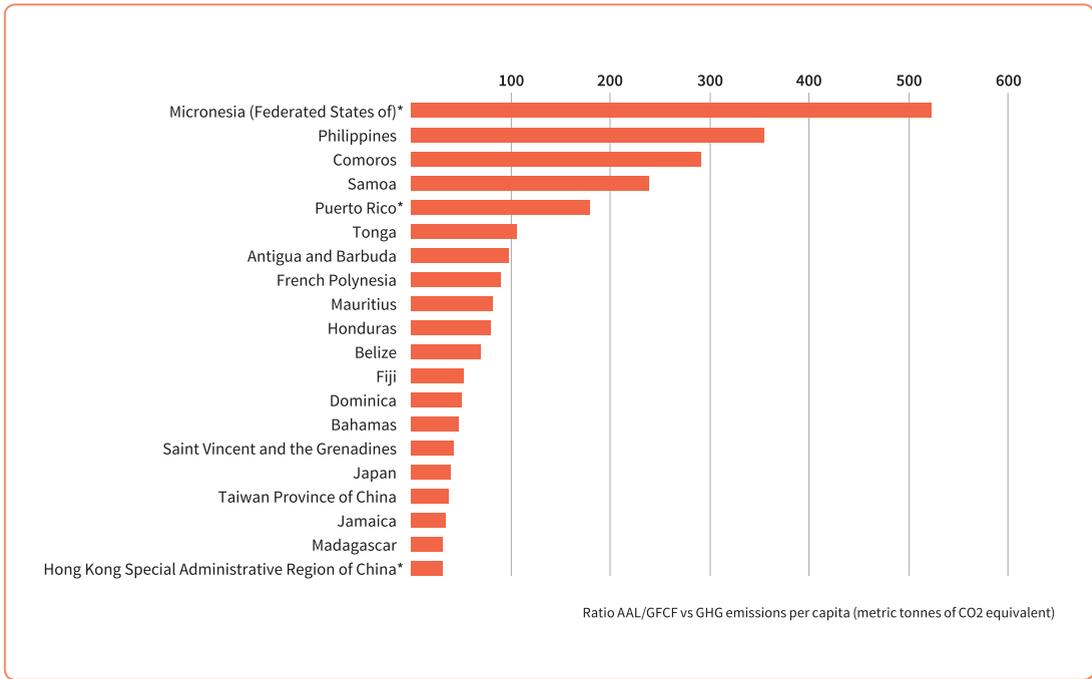
The Special Report of the Intergovernmental Panel on Climate Change presented the latest results from current research on climate change. The more science progresses in the field, the more it is possible to produce analysis that can delineate future climate patterns with higher degrees of confidence. Main conclusions of the report include the following:

- Virtually certain** Substantial warming in temperature extremes by the end of the 21st century.
- Very likely** Mean sea level rise will contribute to upward trends in extreme coastal, high water levels.
- Likely** Increased frequency of heavy precipitation or the proportion of total rainfall from heavy falls will increase in the 21st century over many areas of the globe.  
Increase in tropical cyclone maximum wind speed, though not in all ocean basins.
- High confidence** Changes in heat waves, glacial retreat and/or permafrost degradation will affect high mountain phenomena such as slope instabilities, movements of mass and glacial lake outburst floods. Many glacier- and snow-fed rivers will experience increased run-off and earlier spring peak discharge.
- Medium confidence** Reduction in the number of extra-tropical cyclones averaged over each hemisphere. Droughts will intensify in some regions, including southern Europe and the Mediterranean, central Europe, Central North America, Central America, Mexico, north-east Brazil and southern Africa.

(Source: IPCC, 2012)



**Figure 6.1** Losses from cyclonic wind compared with greenhouse gas emissions



(Source: UNISDR, based on World Resources Institute (\*))

low emissions will also face high costs from sea level rise.

Today, a familiar tendency is to assign the causality of all weather-related impacts to climate change. In reality, at least over the next two to three decades, increasing hazard exposure and vulnerability associated with economic and urban development will have a greater influence on disaster risk than climate change (IPCC, 2012; UNISDR, 2009 and 2011; Nicholls et al., 2008; Swiss Re., 2011a). Climate change will have a disproportionate influence on economies most susceptible to weather-related risks, however (IPCC, 2007). Many of these countries depend heavily on climate-sensitive natural capital, such as land, water and forests.

One climate change outcome, which the IPCC has agreed is certain, is increased warming. In regions that may also experience decreased precipitation, warming will increase the likelihood of wild-land fires and agricultural drought, which feed back into climate change.

## 6.3 Unsustainable risks

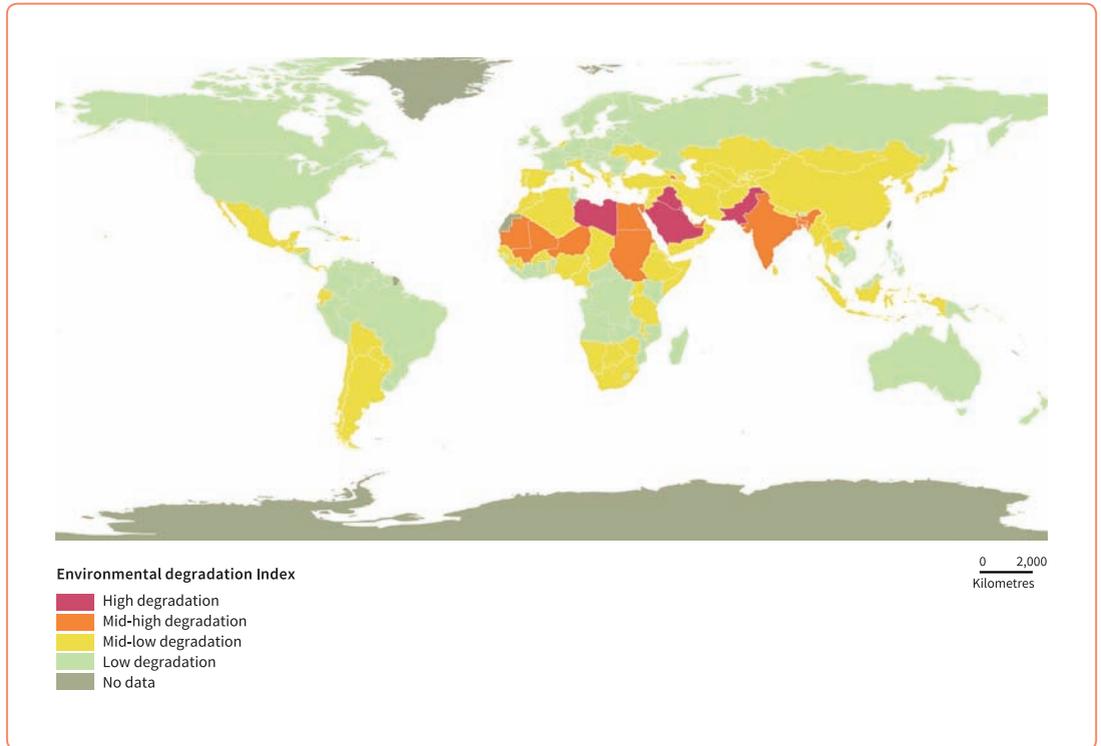
**Environmental degradation, deforestation and overexploitation of natural resources all result in increased risks to natural capital. The negative impacts of weather-related disasters further erode the natural capital base of nations, reducing their overall wealth and competitiveness.**

There is growing interest in quantifying the value of natural capital and the consequences of its loss to national economies.<sup>11</sup> The wealth of a country is the sum of produced, human and natural capital. As human capital increases, although total wealth increases, natural capital is likely to be depleted and thus wealth per capita can decrease. The persistence of environmental degradation and natural resource depletion, therefore, is an environmental as well as a social and economic concern. Figure 6.2 highlights countries that are challenged to address environmental degradation.

Loss of natural capital owing to environmental degradation and other factors is particularly critical in countries whose natural resources provide a higher contribution to the overall wealth than their produced capital (UNU-IHDP and UNEP, 2012). In Nigeria, for example, the value of natural capital is

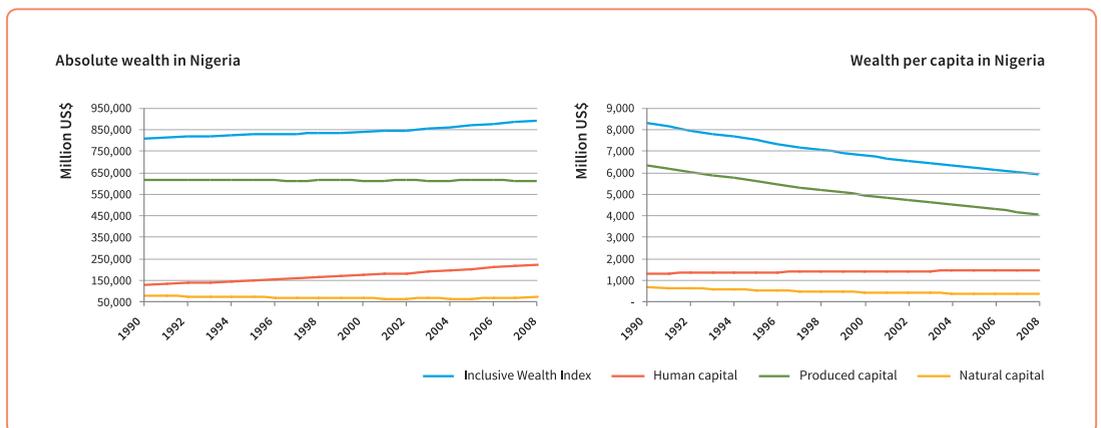
estimated to be more than 10 times that of produced capital.<sup>iv</sup> Between 1990 and 2008, Nigeria's population increased by 74 percent while its natural capital decreased by about 1 percent. As a result, total wealth per capita fell by about 30 percent (Figure 6.3).

**Figure 6.2** State of global environmental degradation based on the Risk Reduction Index 2012<sup>iii</sup>



(Source: DARA, 2012)

**Figure 6.3** Role of natural capital (purple line) in Nigerian wealth, represented by the inclusive wealth index, absolute (left) and per capita (right)



(Source: UNISDR, based on data from UNU-IHDP and UNEP, 2012)



**Table 6.1** Changes in land-use in Colombia between 1995 and 2009 (in ha)

	1995	2009	Variation	% variation
Agriculture	4,216,409	3,354,349	-862,060	-20.45
Rangeland	30,308,867	39,196,059	8,887,192	29.32
Forest	8,862,306	7,425,041	-1,437,265	-16.22
Other	1,537,403	966,294	-607,109	-38.59
Total	44,960,985	50,941,743	5,980,758	13.30

(Source: OSSO, 2012c)

In the same period, the value of natural capital in Australia fell by 8 percent in absolute terms and by 72 percent per capita. Given that produced capital per capita increased by 73 percent during this period, the depletion of natural capital did not affect total wealth, which increased by 2 percent per capita. However, the capacity of produced capital growth to absorb the loss in natural capital may not be sustainable in the longer term (UNU-IHDP and UNEP, 2012).

The depletion of natural capital may be accelerated by business investments into extractive activities—such as mining, gas and oil extraction—and agribusiness; driven by demand for raw materials and energy by rapidly expanding and urbanising economies and for food supply by a growing urban population.

In the case of Colombia, for example, Table 6.1 shows that between 1995 and 2009, Colombia lost about 20 percent of its agricultural land and 16 percent of its forests, but rangelands increased by 29 percent (OSSO, 2012c). Only 53 percent of rangelands are considered apt for grazing. At the same time, between 2002 and 2010, mining concessions increased from 1.13 million hectares to 8.5 million hectares, an area now greater than that dedicated to either agriculture or forests.

Business investments in areas such as bio-fuels, timber and agribusiness, and those involving the clearing of tropical forest, may increase wild-land fire hazard. These fires lead to a major depletion of natural capital and the loss of critical shared

ecosystem services as discussed below. Agribusiness investments in drought-prone areas may similarly contribute to increased land degradation and over-exploitation of water resources—an issue explored in more detail in Chapter 10 of this report.



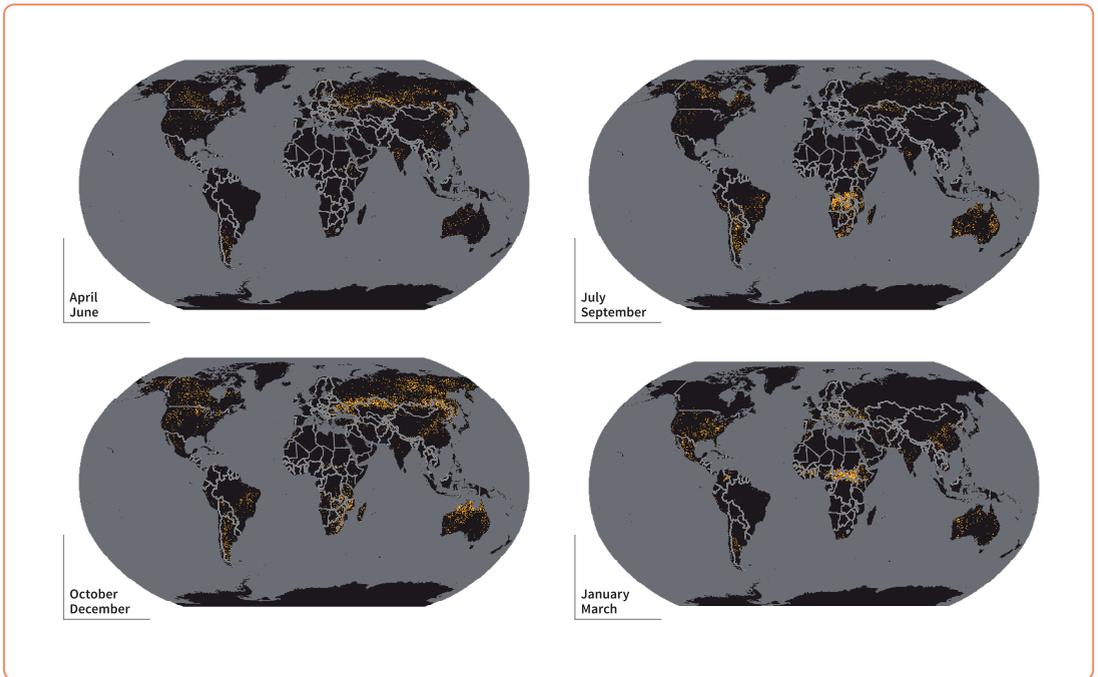
## 6.4 Wild-land fires

**Wild-land fires are both a driver and a result of the degradation of natural capital. The risk of wild-land fires affects all continents with increasing occurrence particularly in the western United States of America, south-east Australia and southern Europe. The global cost of damage to ecosystems services may reach US\$190 billion per year, in the case of tropical ecosystems alone.**

In many ecosystems, wild-land fires are a natural and essential force in maintaining ecosystem structure and productivity or an important land management tool. However, wild-land fires can be highly damaging events, and are associated with a range of drivers, both physical and artificial.

Using two different global datasets<sup>9</sup>, the average global burnt area as detected by satellite sensors fluctuates between 3 million km<sup>2</sup> and 4.5 million km<sup>2</sup>, an area equivalent to the size of India and Pakistan combined (Chatenoux and Peduzzi, 2013). Figure 6.4 shows that wild-land fires affect all continents seasonally. In recent years the extent of burnt

**Figure 6.4** Wild-land fire seasons, 2000–2006



(Source: Chatenoux and Peduzzi, 2013)

areas in regions such as the western United States of America, south-east Australia and southern Europe has risen dramatically (GFMC, 2012).

Physical factors, such as climate variability and topography, influence the patterns and variability of wild-land fires in regions. These factors include temperatures, precipitation levels and distribution as well as length of dry periods (Aldersley et al., 2011). Wild-land fire hazard is influenced by climatic extremes—in 2012, the northern hemisphere was hit by a heat wave that contributed substantially to wild-fires, especially in Europe and the United States of America.

As with other hazards, however, social and economic drivers have as much or more influence, especially on the initiation and extension of wild-land fires: for example, land-use changes such as the abandonment of agricultural land owing to rural to urban migration or the conversion of forests to rangeland. Other factors, such as fire-suppression policies, reduce fire activity in the short term but may lead to a

greater incidence of catastrophic fire in the long term. These factors vary from region to region.

In equatorial Asia, for example, fire is widely employed to convert land covered by primary or secondary forests to other uses, especially for bio-fuel crops. This practice, exacerbated by extended dry periods associated with ENSO episodes, favours the uncontrolled spread of wild-land fires (Goldammer, 2009).

Fires have traditionally been used to clear forests in tropical regions. However, as population density has increased, this practice has become an increasing source of uncontrolled wild-land fires. In addition, uncontrolled selective logging, in which only some species are removed, leave the remaining forest highly susceptible to fire (Chocraïne, 2003).

In southern Europe, the hot and dry summer climate, characterised by strong seasonal winds, exacerbates human-induced fires initiated for different reasons. Contributing factors include the



**Box 6.2** Methodology to quantify economic losses to ecosystem services from wild-land fires

This first estimation, developed using the TEEB methodology, is based on an evaluation of ecosystem services that includes: carbon storage, production of oxygen (O2), production of biomass (used for timber, fire wood, building, and so on), recreational value, intrinsic and support to biodiversity, protection of water sources, reduction of soil erosion, production of pharmaceutical products, beauty (landscape) and spiritual values. Forests also contribute to the local climate.

Not all ecosystem services were evaluated. Furthermore, while the value of a tonne of carbon storage is comparable across the globe, this is not the case for recreational values. Finally, it is difficult to include benefits of wild-land fires into the equation as well as to differentiate wild-land fires that are natural from human cause.

(Source: Chatenoux and Peduzzi, 2013)

**Table 6.2** Loss of natural capital (2002-2006) and wealth of countries (1995-2005)

Top 10 Countries	Estimated economic losses in Natural Capital for tropical forests in billion US\$ (from satellite sensor)	Natural Capital as % Total Wealth	Wealth Growth rate
Democratic Republic of Congo	538	70%	1.03%
Angola	543	96%	N/A
Zambia	321	22%	2.38%
Mozambique	224	23%	9.48%
Sudan	192	57%	5.51%
United Republic of Tanzania	200	N/A	N/A
Australia	205	8%	4.02%
Brazil	93	19%	2.64%
Chad	63	93%	-0.36%

(Source: Rank and economical losses (Chatenoux and Peduzzi, 2013); natural capital and wealth growth rate (World Bank, 2011))

abandonment of agricultural land (leaving the land populated with highly inflammable species of vegetation), lack of forest management and growth of urban areas in proximity of forests and in fire-prone areas (Bassi and Kettunen, 2008).

Average annual internationally reported losses generated by wild-land fires over the past decade (2002–2011) were US\$2.4 billion (EM-DAT<sup>m</sup>). Individual fires may cause substantial losses. For example, in Bosnia and Herzegovina, a single fire in September 2012 caused about US\$83 million in damages (WMO, 2012). However, globally, wild-land fires represent only 0.1 percent of internationally reported disaster mortality and less than 1.9 percent of economic losses.

Wild-land fires, however, have a devastating impact on natural capital, which has not been quantified or

adequately accounted for. Fires affect numerous ecosystem services including carbon storage, support to biodiversity, protection of water sources, reduction of soil erosion and land degradation and climate regulation. At the same time, in some ecosystems, wild-land fires provide benefits; for instance, there are species that need fires for their reproduction and seeding. Fires of natural origins, for example, ignited by lightning, are an integral part of certain ecosystems such as boreal forests.

Economists and scientists today agree that qualifying and quantifying ecosystem services lost and their economic value is still an incipient issue fraught with calculation uncertainties. As Box 6.2 highlights, despite gaps in knowledge and data and methodological challenges, a first estimation for tropical ecosystems based on an evaluation of different ecosystem services was developed using the

methodology proposed by TEEB (The Economics of Ecosystems and Biodiversity; TEEB, 2010).

Fires do not belong naturally to tropical forest ecosystems. However, wild-land fires may now be leading to a loss of ecosystem services in the range of US\$146–US\$191 billion per year.<sup>vii</sup> Given that tropical ecosystem services may take 40 or more years to recover, cumulative annual losses could be as high as US\$2.9–US\$3.8 trillion. These losses—between US\$2.5 and US\$3.5 trillion a year—are concentrated in Africa (Chatenoux and Peduzzi, 2013). These figures should be treated with caution given the uncertainties involved in their assessment, but they highlight a potential and critical depletion of natural capital from wild-land fires in tropical forest ecosystems.

As Table 6.2 shows, many of the countries with the highest losses in ecosystem services rely on natural capital for most of their total wealth. Similarly, some

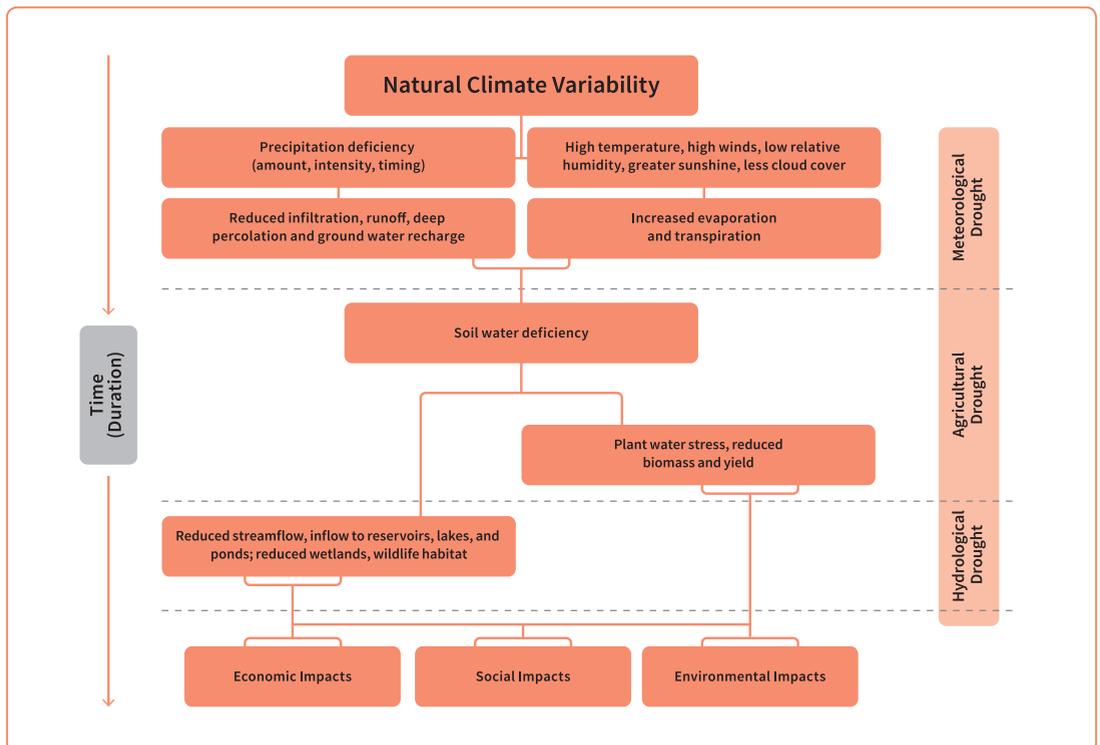
had slow rates of wealth growth between 1995 and 2005 (World Bank, 2011). These losses to natural capital are rarely taken into account when investment decisions are made.

## 6.5 Agricultural drought: the case of Africa, the Arab states and the Mediterranean

**Observed and predicted changes in rainfall and temperature have important implications for agriculture. In central Kenya, decreases in rainfall could reach up to 150 mm per year. Combined with increasing temperature, agricultural drought hazard is predicted to increase, which will reduce the area of arable land.**

As highlighted in GAR11, agricultural drought hazard is not only due to lack of rainfall. Estimations of meteorological drought, therefore, are a poor

**Figure 6.5** Drought typologies and cascading impacts



(Source: National Drought Mitigation Center, University of Nebraska-Lincoln, United States of America<sup>35</sup>)



guide to drought impacts on agriculture.

As Figure 6.5 shows, agricultural drought refers to the availability of sufficient water in the soil to satisfy the needs of crops.<sup>viii</sup> Agricultural drought, therefore, is mediated by other factors such as temperature and wind, which influence evaporation and transpiration and the capacity of the soil to hold moisture.

In Africa, the Arab states and the Mediterranean, agricultural drought is a major hazard. Without taking into account its potential impact on natural capital and on economies in the region, any estimation of disaster risk is fundamentally incomplete.

Box 6.3 presents two different but complementary approaches being pursued to improve the characterisation of agricultural drought risk (Erian et al., 2012; Jayanthi and Husak, 2012). The models include crop losses and economic environmental impacts. But the impacts on welfare and livelihoods have not been estimated at this time.

Analysis of changes in vegetation cover<sup>x</sup> between 2000 and 2010 highlights that a large area of Africa, the Arab states and the Mediterranean has experienced drought (Erian et al., 2012). Figure 6.6, for example, illustrates agricultural drought intensity in the Horn of Africa

and the Sahel, measured through an index that also takes into account drought frequency, extent and persistence in that 10-year period.<sup>xi</sup>

Mediterranean countries have been particularly affected between 2000 and 2010. In Turkey, about 25 percent of total rain-fed cropland (which constitutes about 15 percent of total country territory) has been affected by severe drought; in Italy, Serbia and Macedonia, 20 percent of total rain-fed cropland has been affected. In Portugal, Spain and Greece, more than 25 percent of the rangeland is heavily affected by drought. This corresponds, respectively, to 15 percent, 10 percent, and 8 percent of total land in these countries (Erian et al., 2012).

Scientific literature (IPCC, 2007 and 2012) agrees that all categories of drought hazard in the Mediterranean region will get worse as the region gets drier and warmer. However, in Africa, there is only medium to low confidence owing to a lack of documented evidence and data (IPCC, 2012).

In Eastern Africa, other studies highlight long-term decline in rainfall and increasing temperature, such as in parts of Ethiopia, Kenya, Sudan and Uganda, which will increase agricultural drought hazard (Funk et al., 2010; 2012a; 2012b). Figure 6.7,

### Box 6.3 Modelling agricultural drought risk

The Arab Centre for the Study of Arid Zones and Drylands (ACSAD) uses satellite data from the last 10 years to reconstruct past agricultural droughts. It measures month by month differences in vegetation. This allows a characterisation of the intensity, variability frequency and persistence of agricultural drought in any given area. With this information, it is possible to identify the exposure of areas of rain-fed agriculture, rangeland, individuals and cattle to agricultural drought as well as the amount of drought-affected areas experiencing land degradation (Erian et al., 2012). For GAR13, this approach was piloted in Africa, the Arab states and the Mediterranean.

FEWSNET developed a set of synthetic droughts to extrapolate the probability of specific areas being affected by agricultural droughts of differing intensity. Once calibrated with data on yield reductions in observed droughts, it becomes possible to estimate the probable crop losses for droughts of different return periods as well as expected annual average losses (Jayanthi and Husak, 2012). For GAR13, this approach was piloted in Kenya, Malawi, Mozambique and Niger.

Both approaches are complementary—one provides an assessment of agricultural drought occurrence, consequences and severity in the past; the other enables the quantification of the expected losses that are likely to affect a specific area in the future.

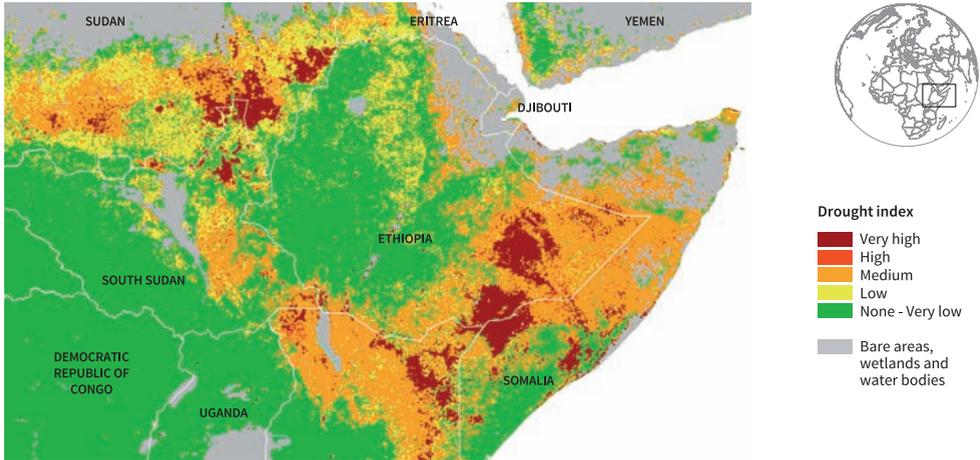
(Source: UNISDR)

for example, highlights observed and projected changes for Kenya between 1975 and 2025. For central Kenya, the projected decrease in rainfall might reach 150 mm per year, whereas temperature is estimated to increase about 0.9 degrees Celsius (Funk et al., 2010). Increasing agricultural

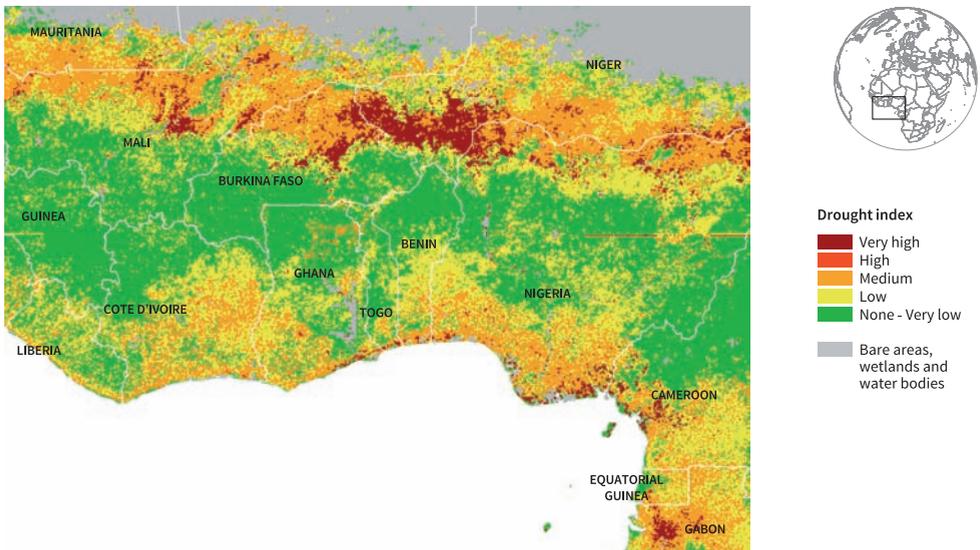
drought will reduce the areas of land to support viable agricultural livelihoods.

These changes are leading to a decline of precipitation in areas that to date received sufficient rainfall to support agriculture and a shift of rain-

**Figure 6.6** Agricultural drought intensity from 2000 to 2010 in the Horn of Africa and the Sahel



The Drought Index is calculated analysing the values of Normalised Difference Vegetation Index (NDVI) and Brightness Temperature (BT) and their variations throughout the year, taking into account agricultural seasons and land use (Erian, 2013)



The Drought Index is calculated analysing the values of Normalised Difference Vegetation Index (NDVI) and Brightness Temperature (BT) and their variations throughout the year, taking into account agricultural seasons and land use (Erian, 2013)

(Source: Erian et al., 2012) <sup>iv</sup>

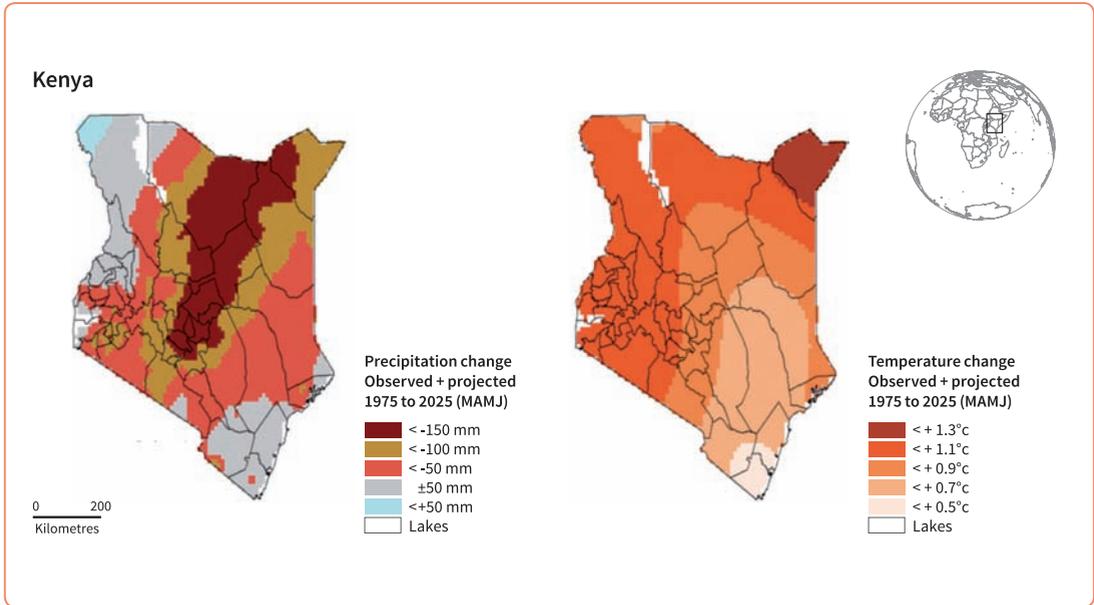


fall locations overall, as Figure 6.8 highlights.

Other studies point to potential changes in climate in Western Africa. For example, Mali is considered at risk of a ‘climate zone shift’, owing

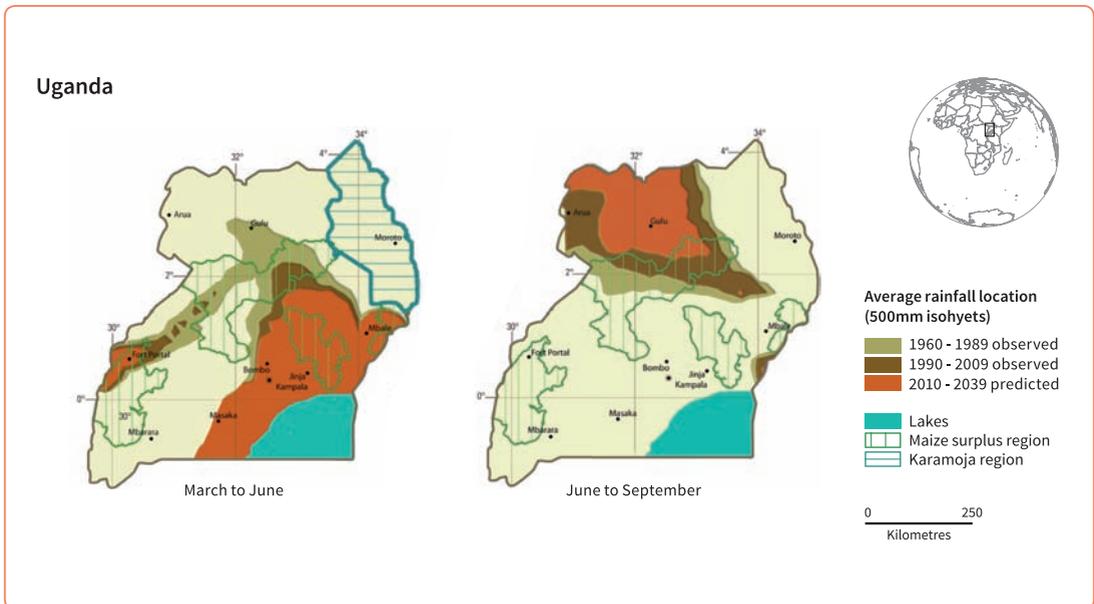
to the Sahara moving south. Because of changes in climate, in 2030, the annual value of crop and livestock production is likely to drop between 5 percent and 15 percent (ECA, 2009).

**Figure 6.7** Observed and projected changes in rainfall and temperature from 1975 to 2025 in Kenya



(Source: Funk et al., 2010)

**Figure 6.8** Climate change in Uganda<sup>48</sup>



(Source: Funk et al., 2012b)

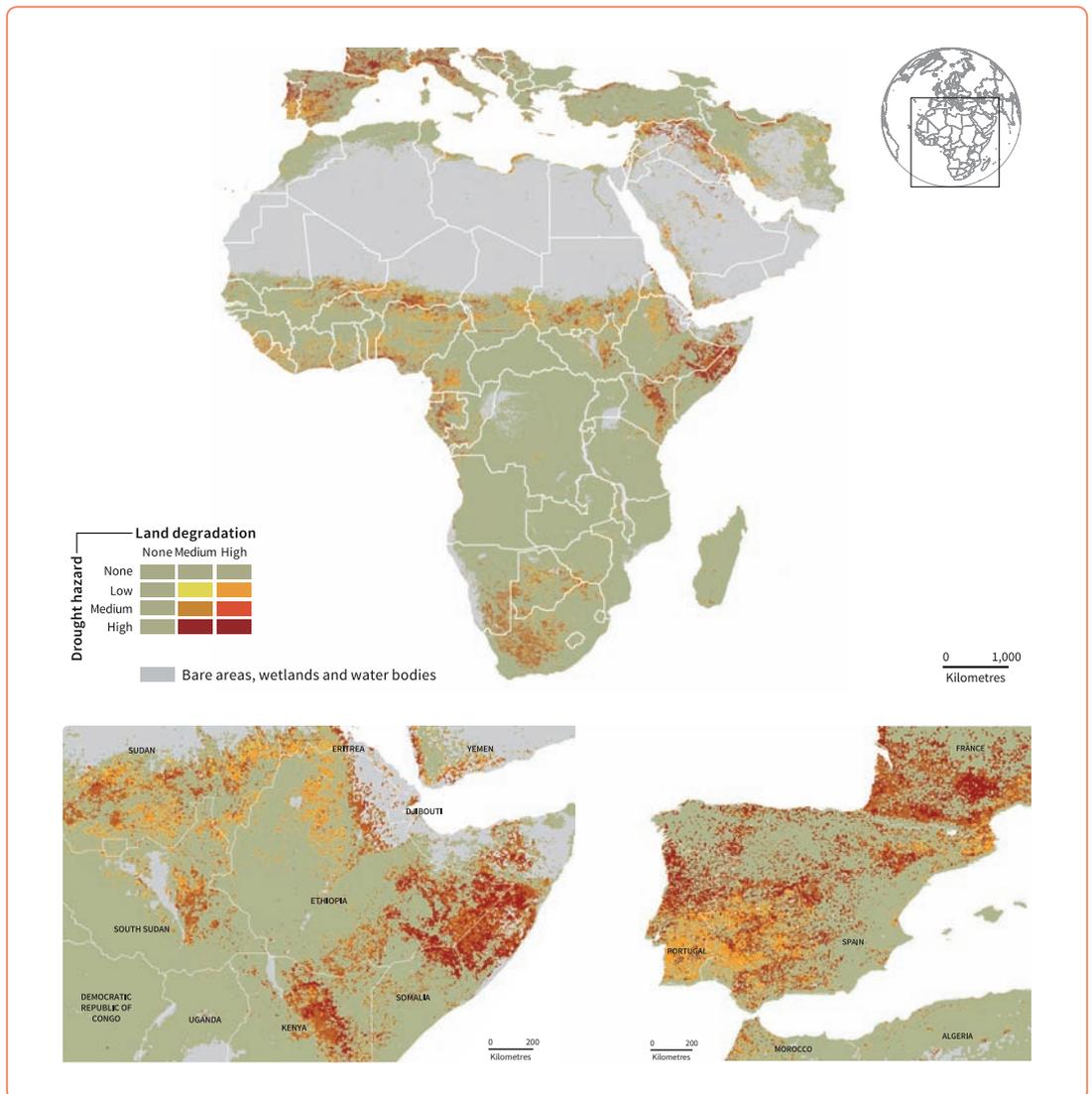
# 6.6 Land degradation

Land degradation has been recognised as a key driver of agricultural drought risk. Vast areas in Africa, the Arab and Mediterranean regions are experiencing both land degradation and high levels of agricultural drought. As a result, these areas are at risk of desertification, representing an irreversible loss of natural capital.

Land degradation is associated with intensive agriculture or overgrazing, and salinisation owing to inappropriate irrigation, deforestation and the breakdown of traditional agro-ecological systems. Climate change may interact with some of these factors, but is rarely the main driver of land degradation (WMO, 2005).

Land degradation can increase agricultural drought by reducing the moisture-carrying capacity of the

Figure 6.9 Drought hazard and land degradation in sub-Saharan Africa, the Arab region and the Mediterranean (main map); Horn of Africa and Spain highlighted (bottom maps)



(Source: Erian et al., 2012)



soil. And soil water deficiency can further increase land degradation through the loss of vegetation cover. Areas that are experiencing both land degradation and high levels of soil water deficiency are more at risk of desertification, which represents an often irreversible loss of natural capital (Erian et al., 2012; Watson et al., 2005; WMO, 2005).

As Figure 6.9 shows, large areas of Africa, the Arab states and the Mediterranean region experienced both drought hazard and land degradation between 2000 and 2010. Contrary to loss estimated from wild-land fires, the loss of natural capital and ecosystem services owing to drought and land degradation has not yet been calculated.

## 6.7 Agricultural drought losses and impacts

**The scale of direct losses and indirect impacts from agricultural droughts is still poorly understood. Estimated yield reductions, however, point to significant losses. For example, a one-in-ten year drought in Mozambique would lower the maize yield by 6 percent and the GDP by 0.3 percent. Niger has a 1 in 10 probability of suffering a loss of more than 10 percent of expected millet production.**

The contribution of agriculture to GDP is in decline (Yumkella et al., 2011), but agriculture continues to be the main source of income and employment for many households living below US\$1 per day. In sub-Saharan Africa, for example, the agricultural share of GDP has decreased from 42 percent in 1965 to 12 percent in 2008 (Ibid.). At the same time, agriculture generates two-thirds of total employment and more than 75 percent of the value of domestic trade (Ibid.). In Ethiopia, for example, although the sector contributes 44 percent of the country's GDP, 85 percent of the population is employed in agriculture (Spielman et al., 2011).

Because of its complexity, accurate and complete global data on crop losses from agricultural drought do not exist. And many losses associated with localised droughts are not documented. However, the magnitude of losses can be gauged from specific events.

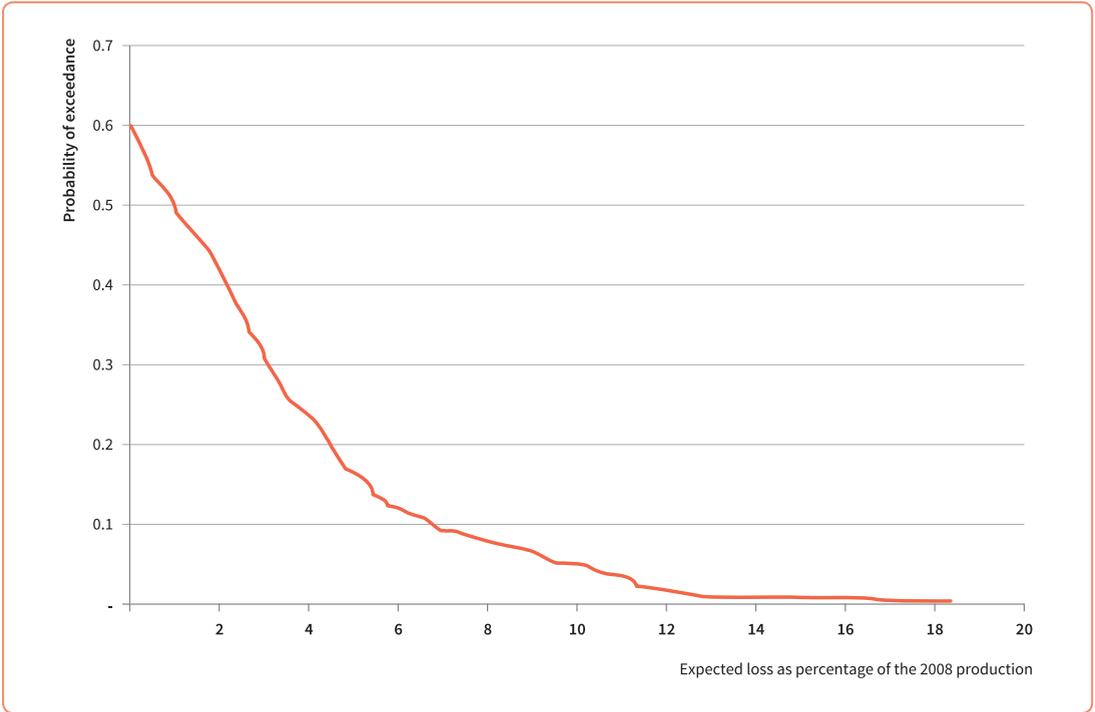
For example, direct and indirect losses from the 2008–2011 droughts in Kenya were approximately US\$12.1 billion, which are estimated to have caused a reduction of GDP of 2.8 percent per year during that period (Cabot Venton et al., 2012). Similarly, the 1998–2000 droughts are estimated to have caused a 16 percent reduction in GDP during each year of that period (Ibid.).

During the 2008–2009 drought in the Syrian Arab Republic, 75 percent of farmers suffered total crop failure (Erian et al., 2012). Between 2005 and 2009, production of barley in the region fell by 40 percent. This production failure was exacerbated by the absence of natural pasture and the doubling of feed prices. Given that barley is the primary feed for many cattle, this led to a reduction in livestock (FAO, 2009). Consequently, the estimated number of sheep dropped from 22.9 million heads in 2007 to 19.2 million heads in 2008 (NAPC, 2009).

Innovative new probabilistic models of agricultural drought risk (see Box 6.3 above) are now providing a clearer picture of potential crop losses at the country level and can be related to relevant economic indicators. As with other hazards, a probabilistic approach is required given that many droughts that could potentially occur have not yet done so.

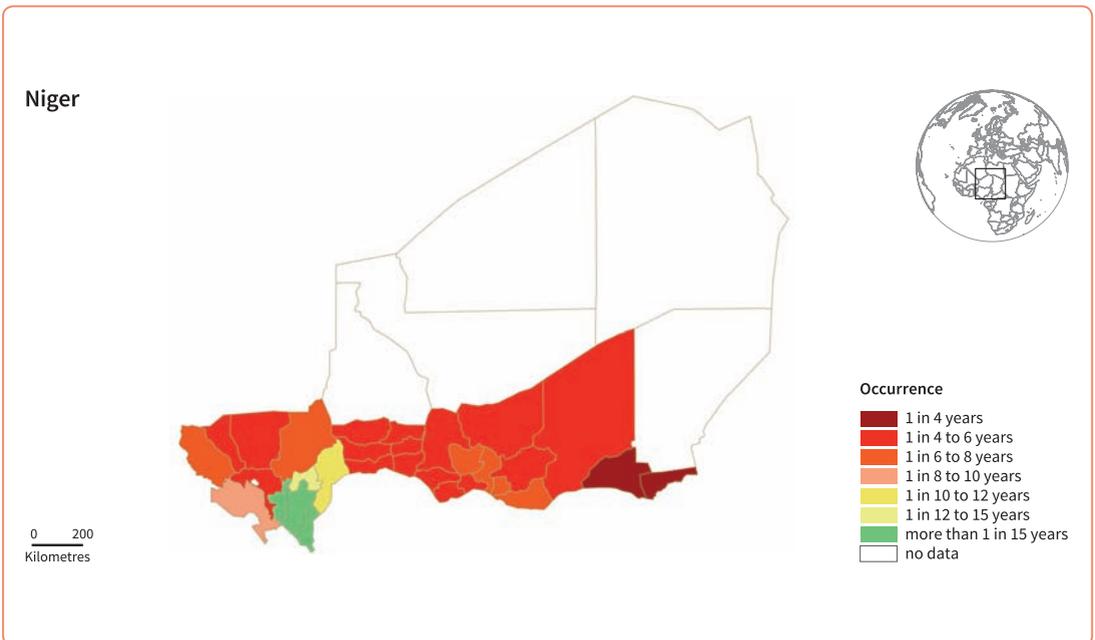
In Mozambique, agriculture contributes 25 percent of GDP (World Bank, 2011). The probabilistic model estimates that the country risks losing, on average, 0.12 percent of its GDP every year owing to the probable loss of 3 percent of its total maize production due to drought (Jayanthi and Husak, 2012). A one-in-ten year drought in Mozambique would lower the maize yield by 6 percent and GDP by 0.3 percent (Figure 6.10).

**Figure 6.10** Loss exceedance curve showing Mozambique's expected loss in maize production (in percentage) and its correspondent probability of exceedance



(Source: Jayanthi and Husak, 2012)

**Figure 6.11** Estimated likelihood of drought occurrence in Niger



(Source: Jayanthi and Husak, 2012)

In Niger, a 2009 drought caused the loss of approximately 410,000 metric tonnes (MT) of millet—about 13 percent of expected production (IRIN, 2010). The probabilistic model indicates that Niger has about a 1 in 10 probability of suffering similar crop loss or higher in any given year. Figure 6.11 represents the probability of drought frequency for different districts in Niger.

Improved modelling of agricultural drought, together with down-scaled climate scenarios put it in a framework that is consistent with risk estimates for other hazards and could reduce uncertainty regarding distribution and intensity of agricultural drought as well as its potential impacts.

A better understanding of the relationship between drought likelihood, food production losses as well as the wider risks to natural capital and social sectors would encourage informed investments by the agribusiness sector and more relevant and effective public policy decisions by governments. Together, these two players—public and private—could be one step ahead of damaging environmental change by limiting the risks associated with countries' natural capital.

## Notes

**i** Data from World Resources Institute (WRI): Per Capita Emissions: metric tonnes of CO<sub>2</sub> equivalent (mtCO<sub>2</sub>e) per person. Additional data: Puerto Rico, <http://www.epa.gov/ttnchie1/net/2008inventory.html>; Hong Kong (Special Administrative Region China), [http://www.epd.gov.hk/epd/english/climate\\_change/files/HKGGHG\\_Sectors\\_201009.pdf](http://www.epd.gov.hk/epd/english/climate_change/files/HKGGHG_Sectors_201009.pdf); Federal States of Micronesia, <http://unfccc.int/resource/docs/natc/micnc1.pdf>.

**ii** For example, the Rio+20 Natural Capital Summit (<http://www.uncsd2012.org/index.php?page=view&type=1000&nr=450&menu=126>) and the WAVES public-private partnership, involving 50 countries and 86 private companies ([www.wavespartnership.org](http://www.wavespartnership.org)).

**iii** The risk reduction index (RRI) is a composite index of underlying capacities and conditions for disaster risk reduction. The environmental degradation rankings are based on a number of proxy indicators such as air pollution, deforestation, desertification, water contamination and water scarcity. For more information on the RRI, please see: <http://daraint.org/risk-reduction-index/>.

**iv** Based on the Inclusive Wealth Index developed by UNU-IHDP and UNEP (2012).

**v** L3JRC and MODIS MCD45. Although the two global datasets are in agreement regarding the global evaluation of burnt areas, their

evaluation varies significantly depending on region and ecosystems monitored. This can be explained by the different satellite sensors and methodology used; however, it generates uncertainties and is something that needs to be improved in the future.

**vi** CRED data on: <http://www.emdat.be/database>. University of Louvain, Belgium.

**vii** Different satellite sensors provide different quantifications of burnt area.

**viii** Agricultural drought is a complex issue that not only depends on rainfall, temperature or soil conditions, but also relates to the specificity of the cultivations as well as irrigation systems. Local, or at least regional, analyses of droughts and drought risk are required to fully understand the drivers of risk as well as the impacts of drought events in each context. IPCC uses the term 'soil moisture drought' instead of 'agricultural drought' because soil moisture deficits have several additional effects besides those on agro-ecosystems, most importantly on other natural or managed ecosystems (including both forests and pastures) (Erian et al., 2012).

**ix** <http://www.drought.unl.edu/DroughtBasics/TypesofDrought.aspx>.

**x** This analysis was carried out using the normalised difference vegetation index, as explained in Erian et al., 2012.

**xi** This figure is based on the changes in the normalised difference vegetation index (NDVI) compared with the agricultural seasons (Erian et al., 2012).

**xii** The left map shows the average location of the March–June 500 mm rainfall isohyets for 1960–1989 (light brown), 1990–2009 (dark brown), and 2010–2039 (predicted, orange). The green polygons in the foreground show the main maize surplus regions; these areas produce most of Uganda's maize. The blue polygon in the upper-right shows the Karamoja region. The right map shows analogous changes for the June–September 500 mm rainfall isohyets

## Chapter 7

# Small Islands, Big Opportunities



Small Island Developing States (SIDS) face **high levels of disaster risk** and have comparatively **low economic resilience**. Most of the countries with a **large proportion of their total produced capital at risk** to earthquakes, cyclone wind damage and tsunamis are SIDS. Solomon Islands, Dominica and Vanuatu all face **losses of over 30 percent** of the value of their produced capital in the case of a one-in-250 year earthquake.

14 of the 16 countries where **wind damage from a one-in-250 year tropical cyclone** would represent **more than 60 percent of annual capital formation** are SIDS or recognised small island territories; and **10 out of 13 countries in the case of earthquakes**.

With small and undiversified economies, **many SIDS are severely constrained** to participate successfully in the global economy. But SIDS are probably the group of countries where **investments in disaster risk reduction and climate change adaptation are likely to reap the greatest benefits**. Investing in disaster risk reduction is most likely the best chance these countries have to **attract investment, strengthen resilience and improve competitiveness and sustainability**.

## 7.1 Disaster risk in SIDS

**In absolute terms, disaster risk in SIDS represents only a small proportion of global risk. However, because of their small size, often a very large proportion of their total produced capital is at risk to earthquakes, tropical cyclones and tsunamis.**

The United Nations recognises 38 Small Island Developing States (SIDS) and a further 14 non-UN member states and territories with similar characteristics in three regions: the Caribbean; the Pacific; and the Indian Ocean.<sup>i</sup>

SIDS are highly exposed to a range of hazards. A large part of their population lives in the Low Elevation Coastal Zone,<sup>ii</sup> making them highly exposed to storm surges and tsunamis. Maldives, for example, has more than 80 percent of its population in this zone (Mahon et al., 2012). Volcanic islands often feature relatively large, steep river catchment systems. These have risks of significant flash flooding and debris flows.

The GAR global risk model allows the estimation of risks for a number of these hazards, permitting a better understanding of the levels of disaster risk faced by SIDS.

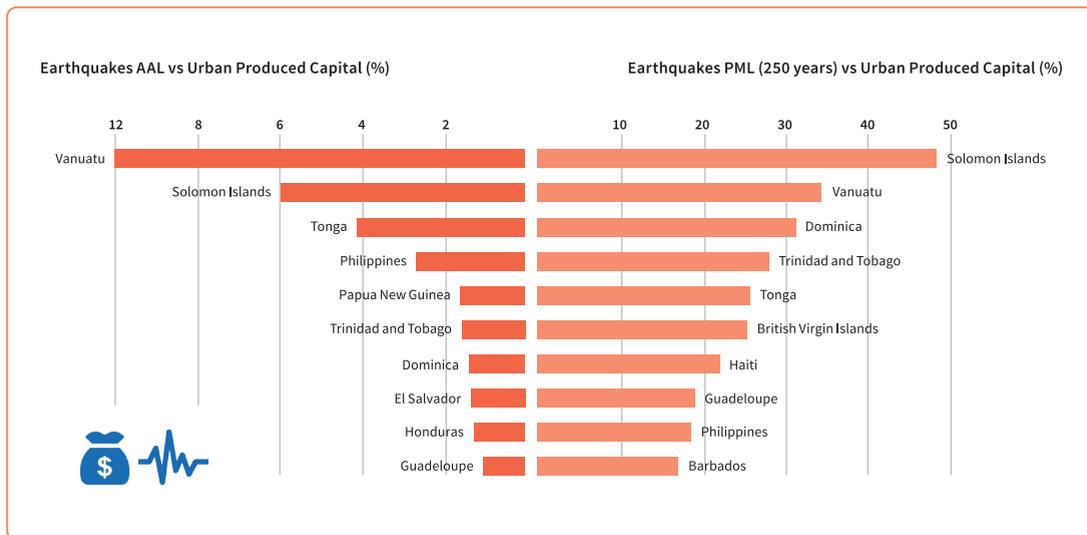
Given their small size, the expected annual average losses (AAL) from earthquakes and tropical cyclone wind damage represent respectively only 2 percent and 1.4 percent of the global total.

However, precisely because of their small size, often a very large proportion of their total produced capital is at risk. For example, as Figure 7.1 highlights, in the case of a 1-in-250 year earthquake, 8 of the 10 countries that would lose the largest proportion of the value of their urban produced capital are SIDS. In the Solomon Islands, Dominica and Vanuatu, between 30 percent and 50 percent of the value of their urban produced capital would be lost.

As Figure 7.2 shows, in the case of a catastrophic one-in-250 year cyclone, the top 10 countries in terms of losses in relation to the value of urban produced capital are all islands, 6 of which are SIDS. Turks and Caicos Islands, Cayman Islands and Guadeloupe could all expect to lose more than 30 percent of the value of their urban produced capital to wind damage.

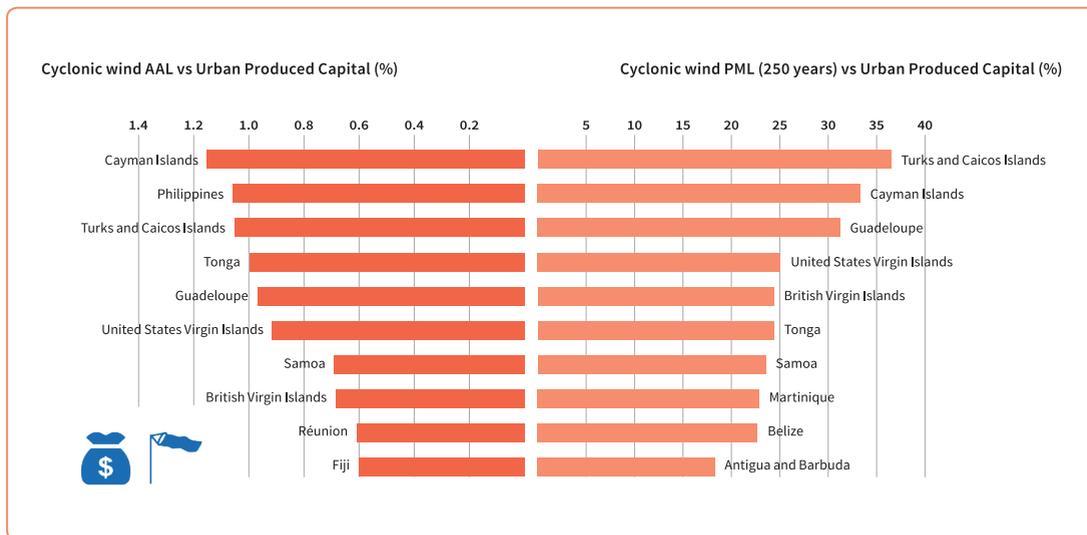
A significant proportion of their population and produced capital is also exposed to extreme tsunamis (Figure 7.3). The 2009 tsunami that affected Samoa,

**Figure 7.1** Top 10 countries in terms of AAL (left) and probable maximum loss (PML) (right) from earthquakes as a percentage of urban produced capital



(Source: UNISDR, based on GAR global risk model)

**Figure 7.2** Top 10 countries with highest AAL (left) and PML (right) from cyclonic winds

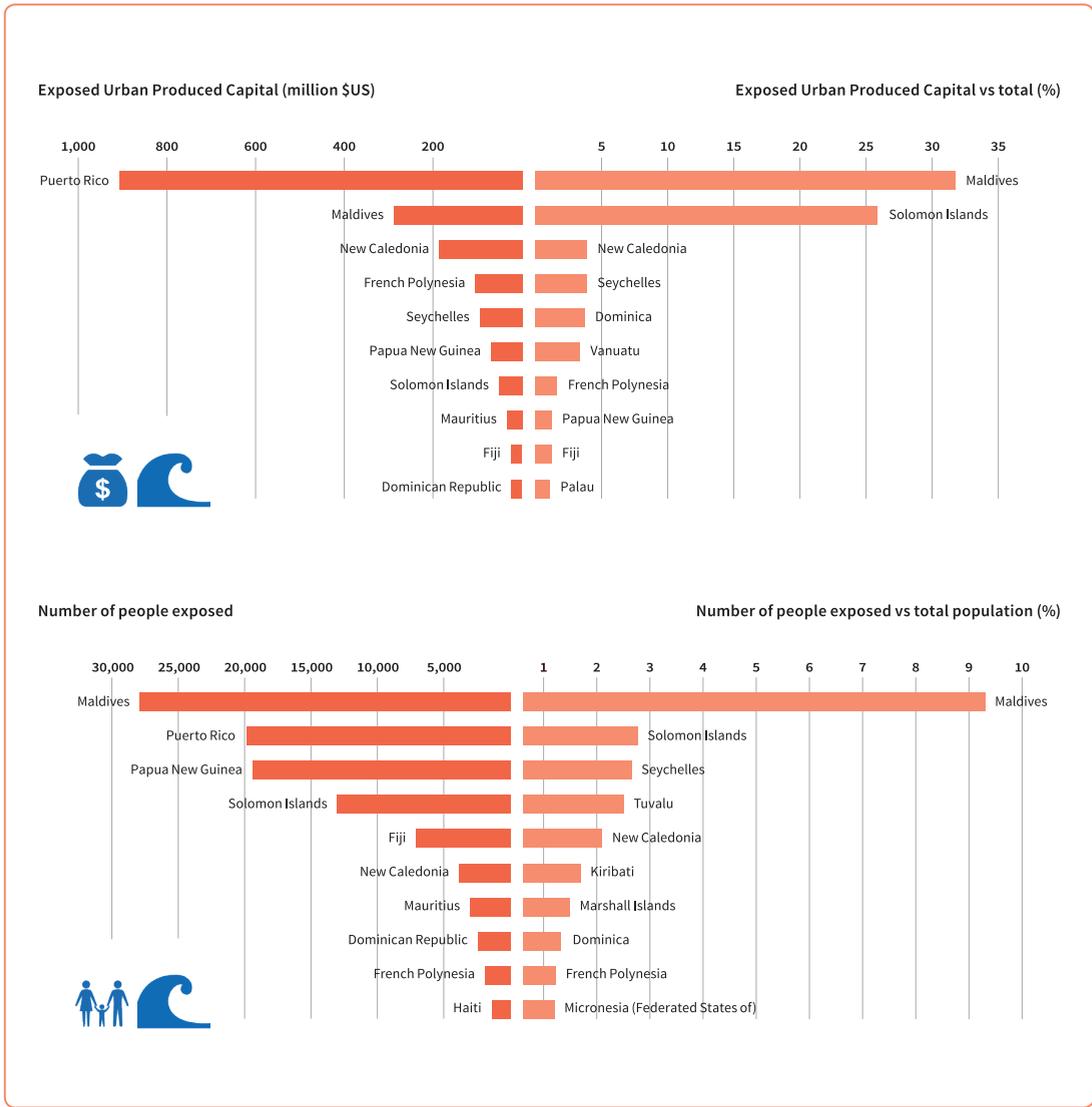


(Source: UNISDR, based on GAR global risk model)

American Samoa and Tonga in the Pacific demonstrated the kind of impacts that can be expected. Figure 7.3 shows the exposure of population and urban produced capital to a destructive one-in-500 year tsunami. Both Solomon Islands and Maldives have more than 25 percent of their urban produced capital exposed to tsunamis. And Maldives has nearly 10 percent of its population exposed.

SIDS also experience four types of flooding: flash floods,<sup>iv</sup> river floods, coastal floods and ponding floods. The island of Samoa, for example, has historically suffered coastal flooding. In 2008, it was estimated that the associated AAL could be up to US\$25 million (Economics of Climate Adaptation Working Group, 2009). Ponding flooding is a serious hazard in some Caribbean SIDS. In these countries,

**Figure 7.3** Absolute and relative urban produced capital (top) and population (bottom) exposed to tsunamis in SIDS<sup>iii</sup>



(Source: UNISDR, based on GAR global risk model)

**Table 7.1** Annual average losses and probable maximum losses (250 years return period) from ponding flooding for selected Caribbean countries

	AAL/UPC (%)	AAL/GFCF (%)	PML <sub>250</sub> /UPC (%)	PML <sub>250</sub> /GFCF (%)
Grenada	0.02	0.11	0.09	0.61
Trinidad and Tobago	0.01	0.14	0.07	0.73
Puerto Rico	0.02	0.24	0.16	2.44
Barbados	0.04	0.32	0.30	2.33
Guadeloupe	0.02	NA	0.25	NA
Martinique	0.01	NA	0.10	NA

(Source: GAR global risk model)

floods are often associated with the accumulation of rainfall in low-lying areas.

Table 7.1 highlights AAL associated with ponding flooding for six Caribbean countries. Barbados has the highest proportion of its urban produced capital at risk, followed by Puerto Rico. In most countries, wind damage represents a more significant risk than ponding floods. However, in Barbados, the AAL of ponding floods is higher than that of wind damage. This type of flooding is particularly disruptive because it can last for several days, interrupting transport and posing health risks. Thus, although direct losses might be low compared with other hazards, indirect losses for local households and businesses might be significant.

## 7.2 Climate change impacts on SIDS

**SIDS are among the countries that contribute least to climate change yet stand to suffer most from its negative impacts. Disaster losses are projected to increase, due to sea level rise, the increased severity of cyclones worsening water scarcity and drought and other factors.**

SIDS contribute less than 1 percent of total carbon dioxide emissions.<sup>v</sup> But given their high exposure to weather-related hazards, they are likely to disproportionately suffer from the magnifying effect of climate change. These effects include sea level rise and associated flood and storm surge hazard, in-

creasing cyclonic wind intensity, erosion, saltwater intrusion into coastal aquifers and worsening water scarcity and drought (CCRIF, 2010; Perch-Nielsen, 2009; UNWTO and UNEP, 2008; IPCC, 2012; Simpson et al., 2008).

For example, SIDS located in the Pacific can expect to experience extreme events such as storm surges, heavy rainfall, tropical cyclones, droughts and heat waves with significant negative impacts (Australian Bureau of Meteorology and CSIRO, 2011). In the Caribbean, changes in annual hurricane frequency and intensity could result in additional annual losses of US\$446 million by 2080—incurred mainly from business interruption to the tourism sector (Toba, 2009).

Table 7.2 highlights likely climate change impacts on SIDS identified by the IPCC (2012).

## 7.3 Disaster losses and economic resilience

**As a result of limited diversification and small market size, the economies of many SIDS are not resilient to disaster loss. Both estimated and observed losses represent a high proportion of annual capital formation and contribute to sluggish longer-term growth.**

Disaster risks pose a serious threat to SIDS economies. Figure 7.4 shows that in the case of catastrophic earthquakes with a 250 year return period, 10 out of the 13 countries where losses would be greater

**Table 7.2** Projected changes in climate extremes for SIDS

Example	Changes in climate extremes projected (to 2100)
<b>Inundation related to extreme sea levels in tropical small islands developing states</b>	<i>Very likely</i> that mean sea level rise will contribute to upward trends in extreme coastal high water levels. (Observed changes since 1950 show a <i>likely increase</i> in extreme coastal high water worldwide related to increases in mean sea level). <i>High confidence</i> that locations currently experiencing coastal erosion and inundation will continue to do so due to increasing sea level, in the absence of changes in other contributing factors.
<b>Increasing losses from cyclones</b>	<i>Likely increase</i> in average tropical cyclone maximum wind speed, although increase may not occur in all ocean basins. Coupled with the very likely sea level rise, the <i>likely increase</i> in tropical cyclone maximum wind speed is a specific issue for tropical small islands states. Heavy rainfall associated with tropical cyclones <i>likely to increase</i> .

(Source: adapted from Mahon et al., 2012 (based on IPCC, 2012))



than 60 per cent of their annual capital formation are SIDS. In the case of cyclones, 13 out of 16 countries are SIDS or recognised small island territories. Countries with low levels of investment and high AAL are in the long term less likely to be able to

absorb losses even from more frequent, less severe events. Many SIDS have annual average losses from both earthquakes and cyclonic winds above 1 percent of their annual average capital formation (Figure 7.5). For the Solomon Islands, Tonga and

**Figure 7.4** Probable maximum losses from one-in-250 year earthquakes (top) and cyclonic wind damage (bottom) as a percentage of gross fixed capital formation (SIDS highlighted in bold)



(Source: GAR global risk model)

Trinidad and Tobago, annual average losses from earthquakes exceeds one-tenth of annual produced capital.

The estimations of the risk model are confirmed in

some countries by observed losses. For example, in Jamaica, observed total average losses between 1991 and 2011 were equivalent to 2.6 percent of its gross fixed capital formation.

The effects of disaster loss are amplified in SIDS by

**Figure 7.5** Annual average losses from earthquakes (top) and cyclonic winds (bottom) compared with gross fixed capital formation, with SIDS highlighted in bold



(Source: GAR global risk model)



their small size, which means that hazard events may affect their entire territory and economy, because their economies are often concentrated in one or two sectors, and because many countries also have high levels of indebtedness and hence constrained fiscal space to invest. Additional common challenges include remoteness, narrow resource base, degradation of their marine and terrestrial environment and exposure to global environmental challenges, including climate change (UNDESA, 2010). Thirty-four SIDS have high or extreme levels of environmental vulnerability (UNEP-SOPAC, 2005).

With small and undiversified economies, many SIDS are severely constrained to participate successfully in the global economy. Geographic distance, lower trade and transport volumes and weak infrastructure generally mean that SIDS have higher overall logistics and transport costs—undermining their competitiveness. In the case of Jamaica (Figure 7.6), for example, the impact of repeated tropical cyclones may have contributed to sluggish growth over decades.

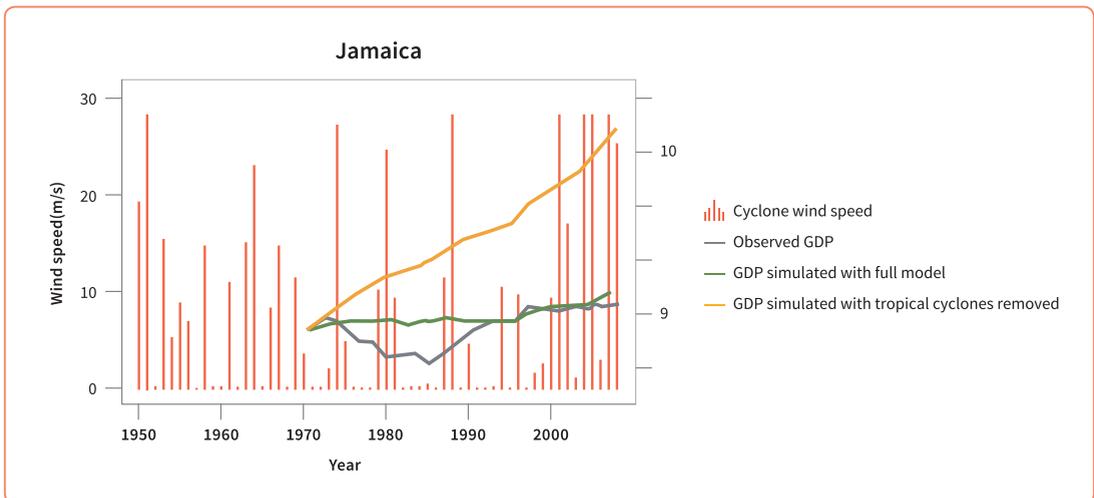
These challenges also present opportunities, however. Regional initiatives such as the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and more

recently the PCRAFI (see Box 7.1) are facilitating greater awareness of the fiscal risk posed by disasters in the Caribbean and Pacific Island SIDS; they are also providing options for countries to reduce their financing gap. To be effective and sustainable in the medium term, these programmes need to be accompanied by commensurate investments to reduce disaster risks. In providing comprehensive risk assessments, they are also providing tools to do so.

On their own, it would be difficult for many SIDS to address their high levels of disaster risk, low levels of economic resilience and challenged competitiveness and sustainability. As the PCRAFI highlights, through effective regional mechanisms, the critical mass of technical and financial resources to reduce disaster risk becomes more readily available.

If these resources can be mobilised, then the biggest challenge for SIDS can also be their best opportunity. From one perspective, disaster risk presents a serious threat to these countries’ economic competitiveness. However, precisely because of this combination of high risks and low resilience, SIDS are probably the countries where investments in disaster risk reduction and climate change adaptation are likely to reap the greatest benefits. Investing in disaster risk reduction is most likely the best chance

**Figure 7.6** Impact of tropical cyclones on GDP growth in Jamaica



(Source: Hsiang and Jina, 2012)

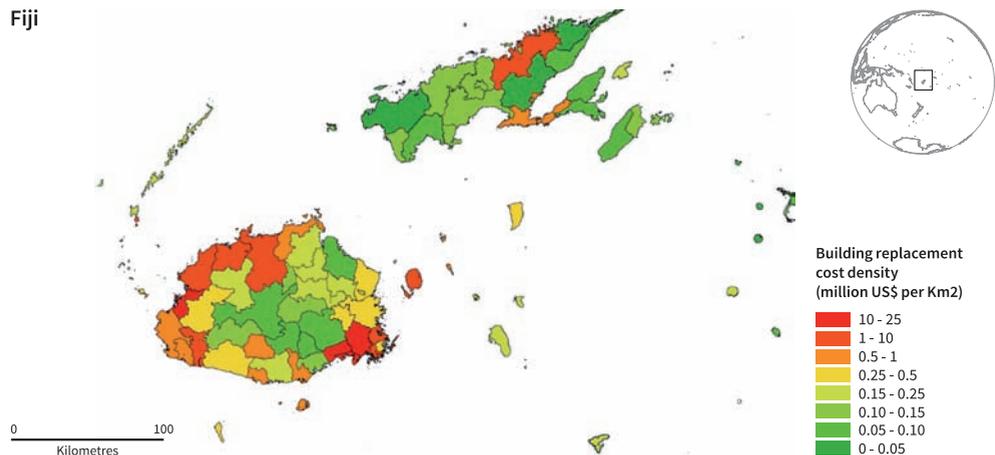
**Box 7.1** Comprehensive risk assessment in the Pacific

Based on the experience of the Caribbean Islands, the Pacific Island countries decided to set up a risk transfer facility for the region. This gave birth to the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI).<sup>vi</sup> PCRAFI provides Pacific Island countries with disaster risk modelling and assessment tools (SOPAC, 2010). It also encourages dialogue among countries on integrated financial solutions for reducing their financial vulnerability to disasters and to climate change.

Initially, PCRAFI provided 15 countries with disaster risk assessment tools (see Figure 7.7 below). Among these tools are regional historical hazard and loss databases; probabilistic hazard models for major hazards including cyclones, earthquakes and tsunamis; and a comprehensive exposure database.

**Fig 7.7** Map of annual average losses in Fiji

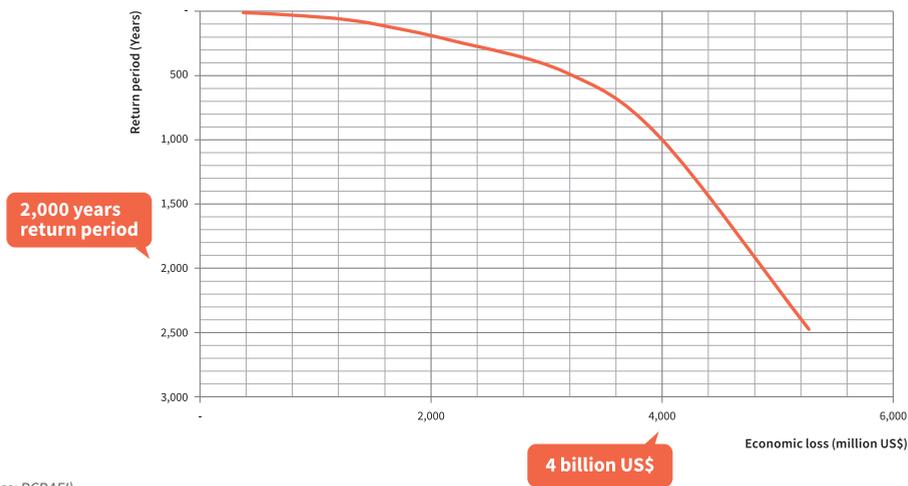
Fiji



(Source: PCRAFI)

Country-specific catastrophe risk models have been developed using these tools, along with catastrophe risk profiles (Figure 7.8).

**Figure 7.8** Loss exceedance curve for Fiji



(Source: PCRAFI)

(Source: UNISDR)



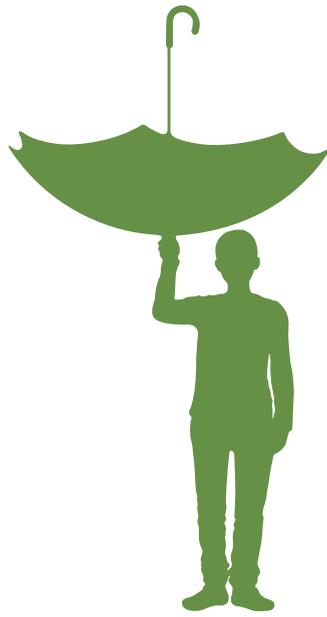
these countries have to attract investment, strengthen resilience and improve competitiveness and sustainability.

## Notes

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- i** <http://www.un.org/special-rep/ohrlls/sid/list.htm>.
- ii** Defined as the continuous area along the coast that is less than 10 metres above sea level.
- iii** Exposure here is calculated by overlapping the total capital stock and the population with the footprint of the tsunami run-up for a return period of approximately 500 years (see Chapter 2).
- iv** Ponding flood is also referred to as 'pluvial flood' as it is the type of flooding that derives from direct run-off of rainfall water and caused by the lack (or overcharge) of a natural drainage system ([www.floodsite.net](http://www.floodsite.net)).
- v** United Nations Statistics Division's Millennium Development Goals Indicators: <http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=749&crd=>.
- vi** PCRAFI is a joint initiative of the Secretariat of the Pacific Community (SPC)/Applied Geoscience and Technology Division (SOPAC), the World Bank and the Asian Development Bank (ADB).





## Part II

# Private Investment and Disaster Risk

In May 2012, earthquakes of magnitudes of up to 6.0 on the Richter scale shook the Emilia Romagna region in Italy, followed by almost 2,000 aftershocks; the economic impacts—both immediate and downstream—unexpectedly reverberated across industries as varied as agribusiness, biotechnology, real estate and tourism (see Box II.1).

In March of the same year—just two months before the earthquakes—the Emilia Romagna region had been ranked as the fifth most attractive Southern European region and the first in Italy for business by the Financial Times foreign investment specialist division.<sup>i</sup> But even if disaster risk had been considered, and had negatively affected the ranking, business activity in the region may not have been significantly lower.

Investing in hazard-prone locations rarely reflects irrational behaviour by individual business investors. On the contrary, as highlighted in Chapter 2, many such areas offer comparative advantages that translate into higher productivity, profitability and competitiveness. Multiple investments over decades, however, have accumulated high levels of disaster risk, which now negatively affect the very competitiveness that investments sought in the first place. At the same time, risks are externalised

or transferred across space and time to other locations and sectors. This ‘external risk neglect’ or shared risk affects economic sustainability as a whole (Berger et al., 2010).

Part II of this report examines whether, how and why businesses have factored disaster risk into their investment decisions and with what consequences. This is examined in three risk-sensitive sectors: urban development; tourism; and agribusiness. The three chapters reflect on the perceived trade-offs between productivity and growth, on the one hand, and internalised and externalised risks, on the other hand, which characterise investment in these sectors.

Chapter 8 examines investments in the urban development sector, in particular the role of speculative investment, public regulation and major infrastructure projects in structuring-shared urban risks and costs.

Chapter 9 focuses on the tourism sector, with particular attention to tourism in SIDS. The chapter analyses the relative dependency of small and undiversified economies on tourism investments and revenues. It also explores the potential economic value of disaster risk management for businesses and national economies invested in tourism.

#### **Box II.1** Cost to business investment in Emilia Romagna, Italy

Emilia Romagna is one of Italy's most productive regions, accounting for 10 percent of the country's GDP, and boasting one company for every ten inhabitants; most companies are small to medium-sized enterprises, but several are also large multinational corporations, including in the biomedical sector.<sup>ii</sup> Emilia's four most affected provinces provide almost 60 percent of the region's employment, spread over a range of industries including global automobile brands, pharmaceutical and biomedical plants, fashion and textiles, and construction firms (Government of Italy, 2012). Regional food production is of national importance and was significantly affected by the series of earthquakes that hit the region in 2011 and then again in 2012 when the quakes destroyed production facilities, and significantly affected the plants and investments of many multinational biomedical companies.<sup>iii</sup>

An in-depth economic study of the damage assessed direct losses, including losses suffered by public and private sectors, at US\$11.5 billion (Government of Italy, 2012).<sup>iv</sup> One month after the May 2012 quakes, several companies, in particular SMEs, had not yet reopened, and Italian officials estimated that about 20,000 workers in 3,500 companies had been temporarily laid off and their jobs at risk (Aon Benfield, 2012b). The disasters also deterred tourists from enjoying the region's 110 km of coastline, with major hubs such as Rimini and Riccione.

Chapter 10 looks at some of the key drivers of disaster risk within the agribusiness sector. It explores the impacts that the sector's vulnerability to hazards and a range of local and global pressures have on smallholders and household food security. Identifying new approaches to creating shared value along the agricultural value chain, the chapter focuses on sub-Saharan Africa and the specific vulnerabilities and opportunities of the sector in that region.

## Notes

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**i** [http://www.investinemiliaromagna.it/wcm/investiner\\_en](http://www.investinemiliaromagna.it/wcm/investiner_en) (accessed 27 February 2013).

**ii** <http://www.euronews.com/2012/06/05/italy-s-earthquakes-hit-economy>;  
<http://www.euronews.com/2012/06/07/italian-quake-damage-estimate-grows> (accessed 27 February 2013).

**iii** <http://www.guardian.co.uk/world/2012/jun/05/italy-emilia-romagna-earthquake> (accessed 27 February 2013).

**iv** In contrast, the global disaster loss database EM-DAT reported economic losses of less than US\$16 million only, once again emphasising the staggering gap in global assessments of economic losses associated with disasters (<http://www.emdat.be>).





## Chapter 8

# Urbanising Risk



**More investment in infrastructure and the built environment will be required over the next 40 years than has occurred over the last 4 millennia.** How disaster risk is addressed in the construction and real estate development sectors is therefore going to **shape the future of disaster risk reduction.**

Where investments in urban development generate new risks or exacerbate existing ones, the **cost of disasters** is often spread across communities and sectors. These **shared costs are not well accounted for and responsibilities are not well defined.** A number of disincentives work against businesses investing in reducing disaster risk in urban development, including the promise of **high profit from speculative investment and ineffective public regulation.**

Large-scale infrastructure projects and new approaches to sustainable urban development provide **opportunities for engaging private investors and the construction sector in new public-private partnerships for resilient investment.**

## 8.1 Urban development and the future of disaster risk reduction

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**Whether or not disaster risk is factored into investment decisions in urban development will have a decisive influence on the future of disaster risk reduction.**

The future of disaster risk reduction will be largely played out in city regions. As highlighted in Chapter 2, investments in real estate development and infrastructure in areas exposed to earthquakes, tropical cyclones and tsunamis have contributed to a massive increase in the hazard exposure of produced capital in some regions, particularly in Asia. However, in many cities and countries that have successfully attracted investment in transport and energy infrastructure, ports, airports, housing, industry and services, investment in disaster risk reduction and the capacities to implement have often lagged behind.

As a consequence new patterns of intensive risk have been produced. Worldwide, expected annual average losses to urban produced capital, from earthquake and cyclonic wind damage alone now represent approximately US\$180 billion per year (see Chapter 3). At the same time, the transformation of city regions, through badly planned and

managed urban development and environmental modification, has generated new hazards and extensive risks that now are responsible for comparable, additional levels of loss (see Chapter 4).

Historically, much urban growth in low and middle-income countries has occurred through informal mechanisms of land acquisition, building and infrastructure provision. Mortality and extensive risks are disproportionately concentrated in these countries, where a large proportion of low-income households lives in informal settlements in hazard-exposed areas. GAR09 and GAR11 analysed in detail the nexus between weak urban governance, the growth of informal settlements and the accumulation of disaster risk in low and middle-income countries.

This chapter complements that analysis by illustrating some of the key challenges and opportunities associated with managing disaster risk in formal processes of urban development and infrastructure development—not only in low and middle but also in high-income countries.

As this chapter will highlight, at present there are only limited incentives for businesses in the urban development sector to invest in risk reduction. However, there is evidence that this incentive structure may be changing. Investing in resilient and sus-

tainable urban development is becoming a compelling value proposition for business, particularly when it is structured through partnerships with the public sector (Global Construction Perspectives and Oxford Economics, 2011).

## 8.2 The new wave of urbanisation

**More investment in infrastructure and the built environment will be required over the next 40 years than has occurred over the last 4 millennia. Consequently, the construction and real estate development sectors are estimated to grow by almost 70 percent by 2020.**

The world is increasingly urban.<sup>i</sup> By 2050, the world's urban population (including those living in small urban centres) will represent about 70 percent of a projected global population of 9 billion.<sup>ii</sup> The proportion of the labour force in the industry and services sector, which has now reached 65 percent, has grown at approximately the same rate as the urban population (Global Construction Perspectives and Oxford Economics, 2011).

The urban population of sub-Saharan Africa is expected to grow from 298 million in 2010 to 596 million in 2030 and 1,069 million in 2050 (United Nations, 2012). The urban population of India is expected to grow from 379 million in 2010 to 606 million in 2030 and 875 million in 2050. Other regions and countries with high, expected growth include North Africa and China.

Historically, this represents a major shift in the distribution of the world's urban population and its largest cities. In 1970, the urban population of Europe represented 30.5 percent of world urban population; by 2050, this figure will have dropped to 9.5 percent. In contrast, the urban population of sub-Saharan Africa represented only 4.1 percent of world urban population in 1970; by 2050, it is expected to increase to 17.1 percent (Ibid.).

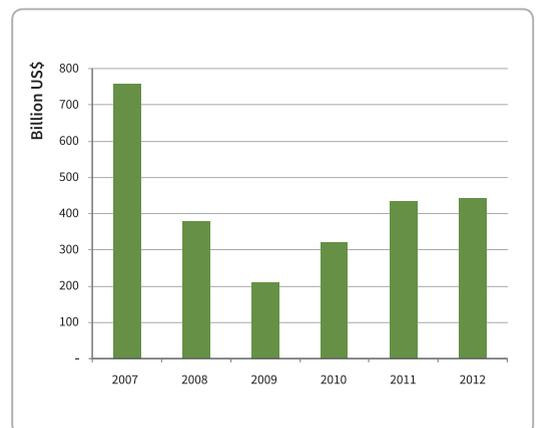
Clearly this new wave of urbanisation represents a major business opportunity. More investment in infrastructure and built environment will be required over the next 40 years than has occurred over the last 4 millennia (WEF, 2012). Consequently, the construction and real estate development sectors are estimated to grow dramatically in the next 10 years (Global Construction Perspectives and Oxford Economics, 2011).

One estimate projects investment in urban development to increase by 67 percent—from US\$7.2 trillion in 2011 to US\$12 trillion by 2020<sup>iii</sup> (Global Construction Perspectives and Oxford economics, 2011). A total of US\$97.7 trillion will be spent on construction globally during the next decade and by 2020, construction will account for 13.2 percent of world GDP (Ibid.).

Analysis of the commercial real estate sector also shows that after the financial crisis of 2007–2008, investment has bounced back to over US\$400 billion globally in 2012 (Figure 8.1).

Although a huge business opportunity, this investment represents a challenge for disaster risk reduction. Much of this new urbanisation will unfold in hazard-exposed countries such as India and in regions with weak disaster risk management capacities, as in sub-Saharan Africa.

**Figure 8.1** Direct commercial real estate investment, 2007–2012



(Source: UNISDR, based on Jones Lang LaSalle (2013))



The sheer volume of investment in urban development and infrastructure expected in the coming decades means that the future of disaster risk reduction is at stake. If this investment takes place, as it has in the past, without factoring in risk considerations, then the new wave of urbanisation will be accompanied by another wave of disaster risk accumulation. This will threaten the resilience, sustainability and competitiveness of countries, cities and businesses alike. Conversely, if incentives and regulations to encourage risk-sensitive investment are put in place, the new wave of investment may become a unique opportunity to further disaster risk reduction.

**public and private investment decisions and non-decisions taken over the long term—making it difficult to attribute responsibility.**

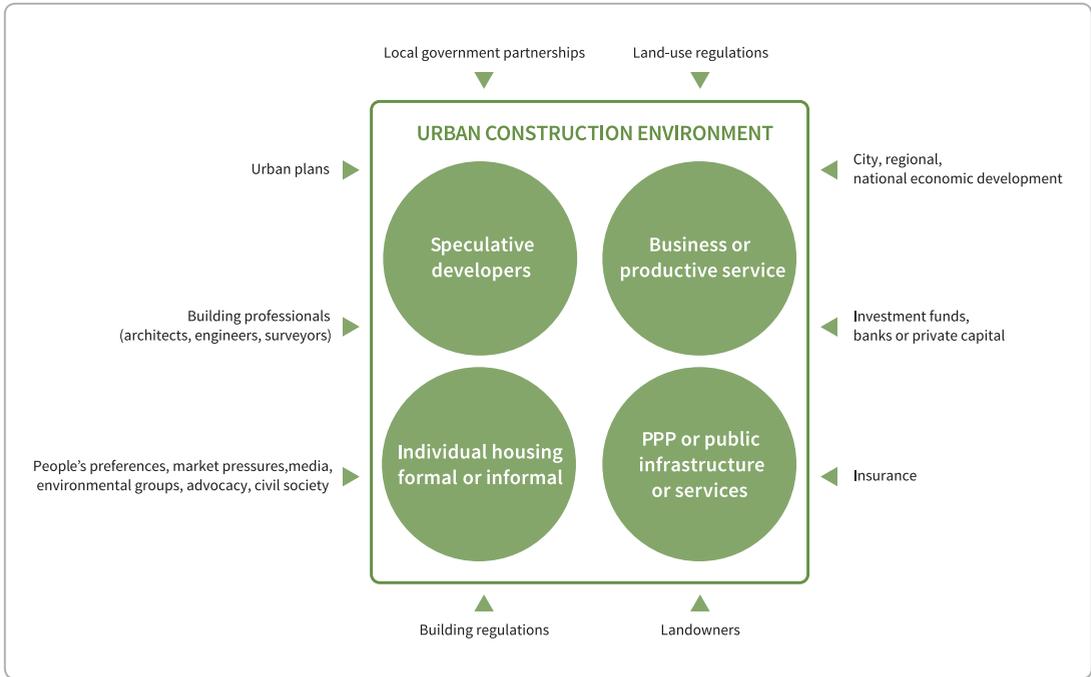
Urban development as a business sector involves a wide range of stakeholders. These include landowners and those who buy land and property for speculative development; building professions that design and supervise construction; banks, investment funds and others that finance urban development; construction and engineering businesses, which range from huge multinationals to local building companies; the insurance industry; utility and service providers; and public sector bodies that are meant to plan and regulate urban development.

### 8.3 The urban development process

**Part of the disaster risks produced through investments in urban development and infrastructure are spread across communities and sectors to become shared costs. These shared costs are produced through large numbers of individual**

As Figure 8.2 below shows, business investments in urban development are influenced by a range of factors and involve different stakeholders. The urban development process typically moves through a process that includes several stages: pre-project (developing the design brief, concept and technical

**Figure 8.2** Factors that influence the production of risk in urban construction



(Source: Johnson et al., 2012)

design of a site); pre-construction (developing proposals, tender documentation and procurement); construction; and post-completion (including operation and maintenance).

Decisions to manage disaster risk may be taken during any of these different phases and reflect the interaction between stakeholders involved and factors that influence their actions. These factors include risk awareness; pricing of insurance; the existence and enforcement of risk-sensitive land-use plans or building codes; and public policies to promote growth and investment.

But ultimately, as in any other sector, trade-offs exist between the risks and costs and potential gains and profits. For example, as discussed in Chapter 2, even risk aware businesses may decide to invest in hazard-exposed areas with other comparative advantages, reflecting the imperative of economic growth and a conscious trade-off in which high levels of return on capital are considered sufficient to offset potential risks and losses.

In urban development, identifying these trade-offs is complicated for many reasons. Many intensive risks have long-return periods, meaning that for investors in urban development, the risks have low

**Table 8.1** Types of risk-inducing construction practices and who bears the burden of risk

Types of risk-inducing construction practices	Who bears the burden of risk
<b>Building in hazard-prone locations</b>	
<ul style="list-style-type: none"> <li>- Building on flood plains</li> <li>- Building in coastal areas subject to storm surge</li> <li>- Building on seismic fault lines or areas prone to liquefaction</li> <li>- Building on steep slopes at risk of landslides</li> <li>- Building near to bushfire or forest fire areas</li> </ul>	<ul style="list-style-type: none"> <li>- Businesses and residents that are users of the buildings are directly impacted when there is a disaster event</li> <li>- Losses not covered by insurance must be covered by public sector or by individuals</li> </ul>
<b>Construction in one area exacerbates risks in neighbouring areas</b>	
<ul style="list-style-type: none"> <li>- Coastal erosion in adjacent areas caused by engineering techniques used in the project</li> <li>- Infilling of wetlands, lagoons, swamps, mangroves increases flooding in other areas</li> <li>- Flood-reducing infrastructure, ie: pumping, embankments, causes greater flooding elsewhere</li> <li>- Use of non-porous surfaces increases run-off</li> <li>- Pumping out groundwater is causing subsidence and increasing earthquake susceptibility</li> </ul>	<ul style="list-style-type: none"> <li>- Business and people located nearby who feel worse impacts (ie: more intense flooding) because of the development</li> <li>- Risks are passed onto the public sector, which often becomes responsible for recovery and risk reduction</li> <li>- Impacts felt most strongly in informal settlements lacking infrastructure</li> </ul>
<b>Building designs or construction methods that do not account for known risks and / or lack of risk reducing infrastructure</b>	
<ul style="list-style-type: none"> <li>- In seismic areas, designs or construction methods that are not earthquake-proof</li> <li>- In flood areas, buildings that are not raised, or having critical building infrastructure located in basements</li> <li>- Foundations that are not deeply set can cause buildings to move in floods</li> <li>- Inadequate site drainage</li> </ul>	<ul style="list-style-type: none"> <li>- Businesses and residents that are users or owners of the buildings are impacted when there is a disaster event</li> <li>- Losses not covered by insurance must be covered by individuals or by government</li> </ul>

(Source: Johnson et al., 2012)



visibility and are downplayed. Even when they have been assessed, the risks may be ignored given the expectation of a high short-term return on capital. At the same time, risks are produced through large numbers of individual public and private investment decisions and non-decisions taken over long periods—making it difficult to attribute responsibility, ownership or liability. While real estate development and infrastructure projects may generate new disaster risks, these are then transferred from developers to the ultimate users of urban development, reducing accountability. As Table 8.1 shows, investments in urban development and infrastructure produce shared risks and costs for the public sector and for other businesses and communities.

## 8.4 Speculative gain and public regulation: the disincentives for disaster risk management in real estate development

**In principle and in most countries, local, city or national governments regulate investments in urban development. However, even when disas-**

**ter risk considerations have been factored into planning and regulatory frameworks, there have been major challenges to implementation in practice.**

At present there are only limited incentives for businesses in the urban development sector to invest in reducing disaster risks. The short-term profitability of speculative urban development, weak or ineffective public regulatory frameworks, which rarely take disaster risk into account; and the absence of clear channels of responsibility and accountability for risks and costs generated conspire against risk-sensitive investment.

### Speculative investment

The first of these disincentives is represented by potential profits from short-term speculative investment in land and property. Historically, investment in urban development has been driven as much by the profits to be made as by demand from a growing population and productive sector (Harvey, 1985). In rapidly growing economies, land and property speculation thrives. Asset prices and rents in many economically successful urban areas have increased sharply leading to increasingly segregated

#### Box 8.1 Real incentives for investment of private capital in Dhaka's real estate

The growth of Dhaka's industry and service sectors over the last 20 years has triggered a boom in the city's real estate sector. For example, whereas only 30 garment-manufacturing companies existed in the country in 1980, in 2011, the number had risen to 5,150 with many located in Dhaka. The garments sector now represents 70 percent of Bangladesh's net exports.

However, other factors have also contributed to the real estate boom. Remittances have proved a robust source of financing and the change from multigenerational households to nuclear families has increased demand for urban housing. An increase in rents by 250 percent from 1990 to 2007 stimulated investment in real estate. Today, the construction industry employs 2.4 million in Dhaka, which in 2010–2011 contributed about 25 percent of national GDP, of which 19 percent was from private investment. These figures represent the formal real estate sector and do not include significant investment and construction in informal settlements in Dhaka and other urban centres of Bangladesh.

Regulation of real estate development is rarely effective. Developers require approvals from different authorities whose regulations and approval criteria are poorly coordinated. Combined with limited public sector capacity and temptation by developers to bypass steps in the approval process, disaster risks are rarely assessed and are transferred from poorly regulated developments to public authorities, infrastructure users and private households.

(Source: Jabeen, 2012)

cities, in which low-income households as well as small businesses find themselves pushed towards the urban periphery or onto hazard-exposed areas.

In Brazil, for example, prime urban land is held by landowners in anticipation of profits through future sales while low-income households settle in areas with limited basic infrastructure and services (Kataria and Zerjav, 2012). Perversely, these poor quality services often come at a high price and are another profit-generating stream in the informal market for water and energy (Ibid; Baker and McClain, 2009).

In Dhaka, Bangladesh, as Box 8.1 highlights, the country's sustained macroeconomic growth, low interest rates for savings, increased access to credit and a growing formal working sector have all contributed to a major flow of investment into speculative real estate development.

The short-term profitability of speculative urban development does not encourage consideration of disaster risks, which may only manifest as losses af-

ter the development has been sold. Investors or developers rarely take responsibility or accountability for the disaster risk that may be generated and sold on. In the case of the shared risks that are generated, the situation is further complicated because risks can rarely be attributed to a single investment decision, but are generated by layers of successive investments over decades.

There is now consensus that the flow of speculative financial capital into the real estate sector in the United States of America led to an over-accumulation of capital in that sector and risks in the financial sector triggered the global crisis that began in 2007–2008 (Castells et al., 2012). The evidence of an over-accumulation of disaster risk in hazard-exposed cities (see Chapter 4) has analogous causes, given that so much land and property development, particularly in housing, responds to speculative investment.

### **Ineffective public regulation**

The second disincentive is ineffective public regulatory frameworks. In most countries, local, city or

#### **Box 8.2** The build-up of risk in Lagos, Nigeria

With a recorded growth rate of more than 20 percent, construction and real estate development is one of the fastest growing sectors in Nigeria. Including the informal sector, the private sector is responsible for providing almost 90 percent of national housing stock. This growing role was actively stimulated by the government via its role in supporting development of real estate developer associations and restructuring the housing finance market (Henshaw, 2010).

However, while sound urban development policies exist, implementation of building and safety codes remains marred by corruption and limited capacity (Onakuse and Lenihan, 2007). About 80 percent of artisans engaged in the construction industry is either unskilled or uncertified owing to the absence of standardised training (Ede, 2011; Aniekwu and Ozochi, 2010; Kayode et al., 2008). Moreover, about 70 percent of Lagos' population lives in informal, poorly regulated settlements (Adelekan, 2012).

Consequently, disaster risk has been increasing. Although land zoning regulations take flood risk into account, they are not based on hazard and risk assessments. Urban development has increasingly taken place on marginal, flood-prone and unsafe lands. Coastal development has increased losses to wetlands, changes in the area's hydrology and increased flood risk, which affects the urban poor (Adelekan, 2012).

Floods in 2010 and 2011 highlighted increasing risk, with the latter event resulting in the highest claim settlement in the history of the Nigerian insurance industry and significant un-assessed costs to low and middle-income households and the public sector. In addition, hazard-mitigation measures to reduce the risk generated by uncontrolled urban development have generated huge costs to the Lagos state government.



national governments have legal responsibilities to regulate investments in urban development. A large variety of instruments are used for regulatory purposes. These include master plans or high-level planning guidelines to orient the longer-term development of a city or region; city or local level land-use and zoning plans and planning regulations; building standards and regulations as well as specific requirements for large projects, such as environmental impact assessments (EIA).

In principle, these regulatory frameworks could and should be used to discourage investments in real estate or infrastructure that contribute to increasing disaster risk. In practice, regulation alone is rarely effective in managing disaster risks, for a number of reasons.

First, the way that urban investment has been planned, regulated and implemented over past decades has changed substantially. In many higher-income countries, from the mid-1950s to the mid-1970s, there was a strong culture of public intervention and investment in government-planned and implemented urban development and land use (Kataria and Zerjav, 2012; Glesson and Low, 2000). But from the mid-1970s onward,

there was a gradual shift in focus from directly investing in urban development to facilitating increased private investment—deregulating markets and privatising state-owned land (Mukhija, 2003; Alexander, 1986).

While publicly planned urban development was not necessarily risk sensitive, this shift in focus encourages speculative development, which as highlighted above is not conducive to disaster risk management. In Serbia, for example, rapid privatisation of housing stock, including public housing estates that previously had been heavily subsidised by national and municipal government budgets, has resulted in the rapid decay of buildings and increased disaster risk (Kataria and Zerjav, 2012). In Chile, deregulation and de-zoning of urban land has also led to unregulated construction on hazard-exposed areas with inadequate overall building quality (Smolka and Sabatini, 2000).

Many low and middle-income countries also adopted legislation and planning mechanisms to regulate land use, building and urban development; or inherited inappropriate mechanisms from the colonial era, but generally with significantly weaker capacities in implementation and enforce-

**Box 8.3** Rapid growth of construction sector equals rapid growth of disaster risk in Viet Nam

Viet Nam has experienced rapid economic growth and urbanisation in recent decades. In parallel, private investors in the real estate sector have gained more power to shape urban planning and development. Increasing pressure to build in hazard-prone areas comes from migration and urbanisation, which is exacerbated by speculative real estate development driven by opportunities for short-term profits. Many areas previously zoned as subject to flood risk are being developed as residential and industrial sites, not only in large cities such as Ho Chi Minh City but also in smaller urban centres.

For example, Can Tho City, with a population of 350,000, is the demographic and economic centre of the Vietnamese Mekong Delta. Major new residential and industrial developments are planned in the Cai Rang district at the confluence of the Hau and Can Tho Rivers with high flood risk. The city district's zoning plans reflect this risk only partially; for example, future flood risk scenarios were not included.

Real estate developers heavily influence zoning plans in the city. Approval has been sought to build almost double the number of new residences allowed for in the district's master plan. While not all of these will be developed, agricultural land and floodplains will be converted to residential areas creating a patchwork of development, open spaces and fallows, which interrupts natural drainage flows in the city and aggravates flood risk. As a consequence, authorities may be forced into large public investments in flood mitigation infrastructure.

**Box 8.4** The Italian floods: shaping, building and exhausting floodplains

In Italy, damages (and often deaths) caused by flooding make it to the news almost every year. During the 20th century, Italy was recorded as Europe's second country most affected by flooding, with about 3,000 flood disasters (Llasat and Siccardi, 2010). The flood that affected the Veneto region in October 2010 was estimated to have caused €3.7 billion in damages (European Commission, 2011), and damages from events that affected Liguria and Toscana in October 2011 were valued at €722 million (European Commission, 2012). In November 2012, six people vanished during the flood affecting Toscana.<sup>iv</sup>

Although physical factors such as climate, topography and morphology contribute to flood hazard, the way river basins have been intervened (for example, canalising rivers) has been an important factor contributing to current flood risk.<sup>v</sup> In Northern Italy, excessive extraction of ground water has led to heavy subsidence in the Po Valley, reaching 0.7 cm per year (Carminati and Martinelli, 2002), which in turn increases flood hazard.

The urbanisation of floodplains has also contributed to increased flood risk, particularly since the 1960s. Different laws and policies have been adopted to regulate land use (Luino et al., 2012). But local autonomy to designate the areas that can be built up, along with the fact that flood risk assessments are not an 'exact' science, has in some cases allowed developers to keep building in floodplains (Ibid.). However, it is not only a matter of legislation—regulations are not always respected. For example, in Campania, population growth and speculative development has extended city boundaries towards flood-prone areas and also contributed to landslide risk in the area (Di Martire et al., 2012).

(UNISDR)

ment. These mechanisms were often used to structure urban space in a way that segregated higher and lower-income households and formal and informal areas of cities (Mitlin and Satterwaite, 2013). As Box 8.2 exemplifies, in some cases, this has resulted in city governments completely losing control over urban development (UN-HABITAT, 2012).

In recent years, however, a counter trend has emerged. In middle-income countries with successful economies, formerly ineffective or non-existent planning and regulatory mechanisms have been strengthened, enabling city governments to exercise some control and authority over urban development.

Second, even where regulatory mechanisms do exist and when disaster risk considerations have been factored into these mechanisms, there have been major challenges to implementation in practice. More than half of the countries reporting on progress against the HFA in 2011–2013 recognise that they lack risk-sensitive mechanisms to regulate investment in urban development.

For example, in Bangladesh, the government acknowledges that the country does not have risk-sensitive policies for land zoning and the regulation of private real estate development (Government of Bangladesh, 2012). Risks may also be generated by inaction and non-decisions, which weaken accountability and responsibility. In Turkey, construction takes place that ignores the country's relatively strong building codes (Yönder and Turkoglu, 2010; Balamir, 2012; Sengezer and Koç, 2005).

As Box 8.3 highlights, investors and developers are often able to influence and manipulate land-use zoning plans designed to regulate disaster risk.

As Box 8.4 illustrates, similar challenges are faced in high-income countries.

In the United Kingdom, where flood risk management has been debated for decades, a policy that requires local planning authorities to identify risks posed by floods to new development has existed since 2006. However, a sequential approach in the planning process allows planning permission to be granted for development on floodplains if the developer can show that no alternative sites exist.



**Box 8.5** Flood damage in the United Kingdom—what went wrong?

In the United Kingdom, 2012 was a particularly wet year, with second highest rainfall recorded in about 100 years. In November 2012, in some locations, rainfalls of a return period above 100 years were recorded (NERC (CEH), 2012). Flooding affected many parts of the country, causing losses estimated at about £1 billion, with more than 1,000 homes damaged or destroyed. Insured losses represented about half of the total cost (AON Benfield, 2012c). This was the worst damage since the 2007 floods, which in turn had triggered reforms in the United Kingdom's management of flood risk.<sup>vi</sup>

So what went wrong again in 2012? Existing regulation and guidance on required risk assessments (Government of the United Kingdom, 2006) and the new National Planning Policy Framework (Government of the United Kingdom, 2012) might not have provided the Environment Agency with enough authority to stop development (Barclay, 2012). The rate of construction in the floodplain has continued to increase (Committee on Climate Change, 2012), which increases exposure and risk (Bosher, 2012; Barclay, 2012).

But this is not the only issue. From one perspective, regulation would appear to be successful. Since 1989, 7 percent to 11 percent of new housing in the United Kingdom has been built in areas with “high flood risk” (Bosher, 2012). Between April 2008 and March 2011, the Environment Agency reported that the rate of planning permits granted against their advice was reduced from an annual rate of 4.6 percent to 0.9 percent.

However, existing flood risk ‘zoning’ only accounts for river and coastal flooding. Therefore development can still take place in areas subject to surface water and flash flooding. Insufficient drainage and culverts blocked owing to lack of maintenance were important contributors to the 2012 flooding. Substantial cuts in funding to the Environment Agency and to local flood risk management initiatives (Bennett, 2012) might have contributed further.

Also, areas protected by flood defences are not defined as ‘high risk’. Therefore, many new developments were built on areas protected by flood defences (thus, strictly speaking, not at risk of flooding). To maintain the same standard of protection for such developments, the government needs to heavily invest in the maintenance of such structures. Thus, increasing development in areas protected by flood defences, or continuing to build new defences, may be unsustainable in the long term (Committee on Climate Change, 2012).

However, public acceptance of curbing new developments in floodplains or reducing the standard of protection from floods is limited. The Humber Estuary is a case in point. Being particularly vulnerable to sea level rise, the maintenance of the current standard of protection provided by flood defences is not viable in the whole estuary. After extensive consultation with residents and local business, there was little support for proposals to ‘make space for the water’ (Government of the United Kingdom, 2008).

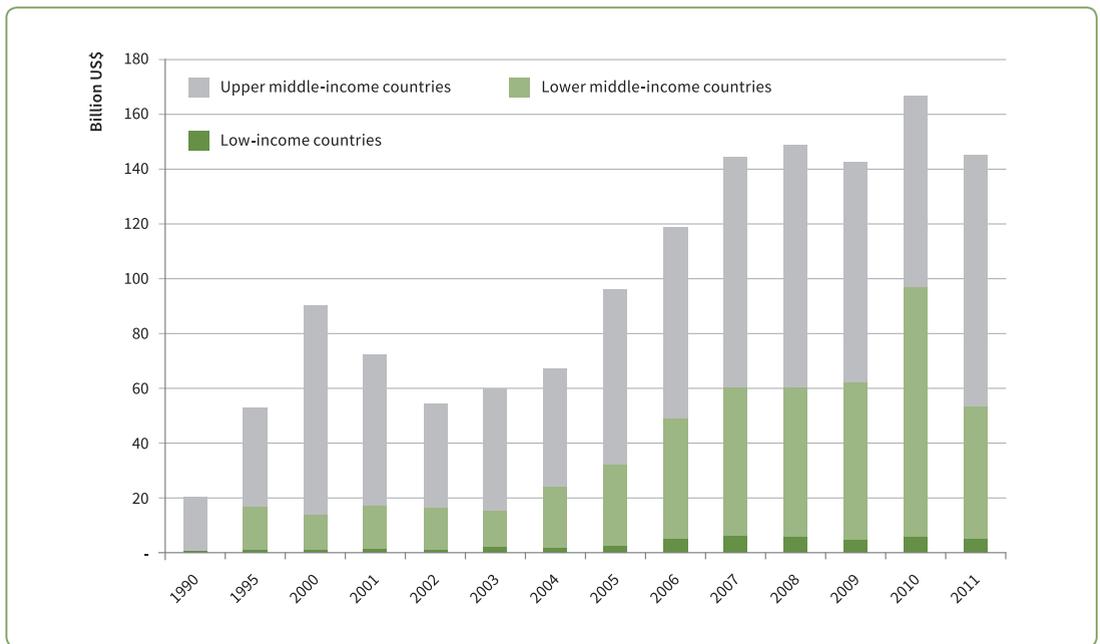
Households and businesses clearly need to be more aware of risks when deciding where to buy a house or establish a business. In the United Kingdom, information on flood risks is freely available. Despite this, a recent survey showed that in London, less than one-third of small and medium-sized businesses at risk are adequately equipped against floods.<sup>vii</sup> Currently, the government has an agreement with insurers that oblige them to provide policies to those who live in areas with a yearly probability of 1 in 75 (or lower) of being flooded (Bennett, 2012a). Although this does not protect all households (e.g. those at higher risk of flooding and those who cannot afford insurance), it provides a certain degree of security. This agreement is, however, expiring in 2013.

(Source: UNISDR)

In practice, developers have received planning permits to build on flood-prone areas, especially in densely populated areas such as Greater London (Bosher, 2012). As Box 8.5 highlights, building in flood-prone areas has had a direct and decisive influence on economic losses in the United Kingdom in recent years.

There is little evidence, therefore, to show that disaster risk in urban development can be managed by public regulation alone, even in countries with strong institutions and a high level of capacities. The attractive short-term returns on capital to be gained from speculative real estate development, the potential collusion between different stake-

**Figure 8.3** Private participation in infrastructure projects in low and middle-income countries, 1985–2011<sup>viii</sup>



(Source: UNIDR based on World Bank and PPIAF, PPI project database<sup>viii</sup>)

holders in the urban development process and loop-holes in regulation itself, all conspire against an effective management of disaster risks.

## 8.5 Infrastructure development and risk transfer

**Infrastructure investments at the scale required to meet sustainable economic and developmental goals will increasingly rely on private sector engagement, particularly in low-income countries.**

The OECD estimates that by 2030, annual investment requirements for telecommunications, road, rail, electricity (transmission and distribution) and water are likely to total about US\$53 trillion, an average of 2.5 percent of world GDP (OECD, 2007). When electricity generation and other energy-related infrastructure investments in oil, gas and coal are added, the total would be more than US\$70 trillion or 3.5 percent of world GDP (Ibid.).

The need for such investment is particularly critical in low-income countries. For example, the World Bank estimates that African countries need to

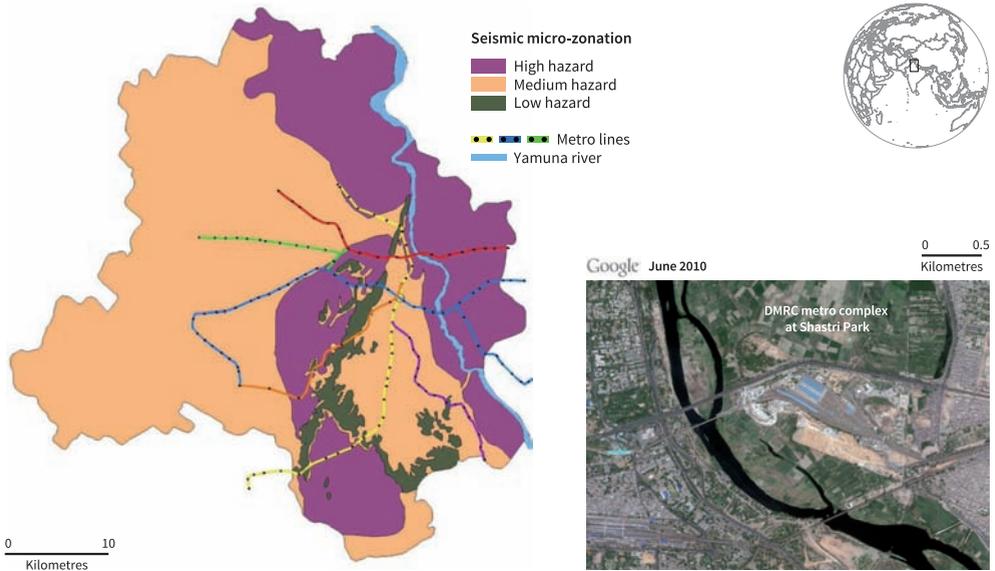
### Box 8.6 Delhi metro exposed to multiple risks

A metro line to connect Delhi, India, with a new suburb is one of the city's biggest recent infrastructure projects. This privately financed project, however, may contribute to increasing earthquake and flood risk in the city.

In terms of direct risks, more than 50 stations on this new line are located in areas of high earthquake hazard, exposing the line to earthquakes of up to a magnitude of 8 on the Richter scale (see Figure 8.4). One of the stations was also built in a high flood hazard area. In both cases, hazard information was available on municipal zoning maps. As a result, the metro line is exposed to high flood and earthquake risk even for short return periods of 1–10 years (IIHS, 2012).



**Figure 8.4** Delhi metro lines overlaid on the seismic micro-zoning map, and location of Shastri Park metro station in floodplains of the Yamuna riverbed

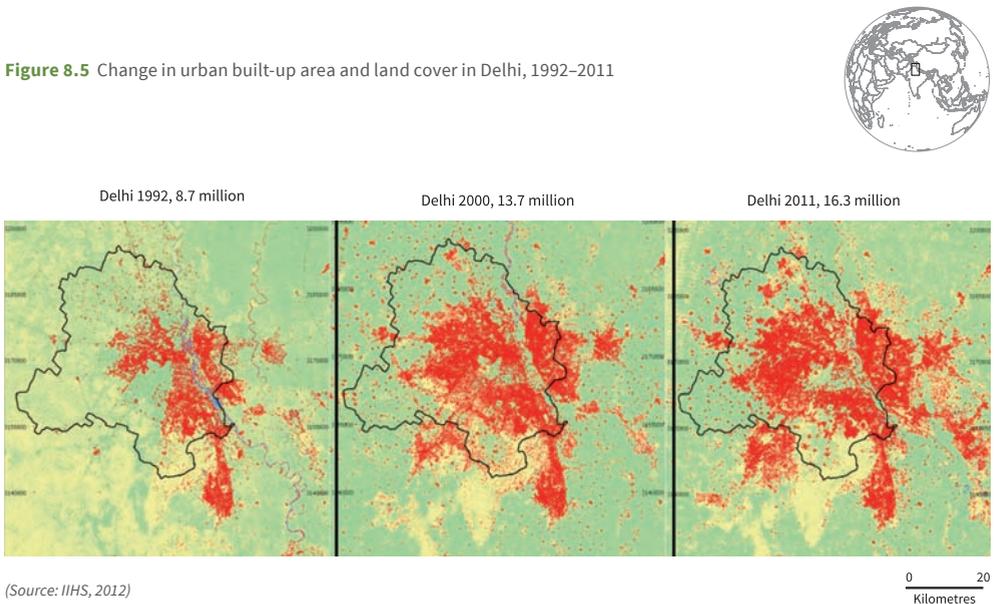


(Source: IIHS, 2012)

This direct risk to metro stations and rail line structures has been addressed and reduced owing to application of risk-sensitive building codes. However, this is not necessarily the case for new real estate developments surrounding the stations. For example, following construction of the station in the floodplains, further commercial expansion is planned in the area without consideration of risk (IIHS, 2012).

Decision-making for such large-scale infrastructure projects is a complex process in any country or city. But in planning and implementing such projects, disaster risks are constructed and then transferred to the ultimate users of the infrastructure, irrespective of zoning and risk maps (IIHS, 2012). Despite awareness of earthquake and flood risk, much of the expansion of Delhi (Figure 8.5) has taken place in highly hazard-prone areas.

**Figure 8.5** Change in urban built-up area and land cover in Delhi, 1992–2011



(Source: IIHS, 2012)

spend about 9 percent of their GDP on new as well as on the operation, maintenance and expansion of existing infrastructure to reach the Millennium Development Goals by 2015 (World Bank, 2008a). However, this has not translated into actual spending, owing to budget constraints in many countries. Actual expenditure on infrastructure in Africa has been only half of the required 9 percent over the last 40 years (Ibid.).

Private participation in the development of infrastructure, including private financing, is thus sought to bridge the gap between needs and available public resources. The World Bank's database on private engagement in infrastructure projects<sup>x</sup> shows that despite fluctuations, this has been increasing in low-income and middle-income countries since the mid-1980s (Figure 8.3).

Investment in major infrastructure projects structures how cities and their regions grow. If disaster risk considerations are not factored into their design, collapsed and damaged critical infrastructure can be a serious cause of business interruption and a source of indirect disaster loss for city regions. But even when the infrastructure itself is disaster proof, it can lead to other investments in hazard-prone areas that increase disaster risk. Infrastructure projects, therefore, have a major potential to generate shared risks and costs.

Major infrastructure projects are increasingly developed as public-private partnerships (PPPs), in which a varying proportion of the investment and risk is carried by the public sector and by private investors. Depending on how these PPPs are structured, who owns these risks may not be clear and part of

**Box 8.7** Impact of dike rupture in Colombia, the Netherlands and Japan

Over the last 40 years, construction of dikes has been the principal strategy for flood hazard mitigation in the floodplains of Colombia, particularly on the Magdalena and Cauca Rivers that cross the country from south to north. Between 1970 and 1990, 715 km of dikes were constructed along the river and 626 km in lateral canals in the Cauca river basin alone (OSSO, 2012c). Although dikes provide flood protection, they explicitly or implicitly encourage development and increased exposure on areas where flood hazard has been reduced.

During the 2010/2011 ENSO episode in Colombia, dykes failed in at least 42 percent of the country's departments, and were responsible for a significant proportion of total flood losses (OSSO, 2012c). During and following the disaster, a significant proportion of resources invested in rehabilitation and reconstruction was used to rehabilitate or reinforce dykes (US\$884 million by Colombia Humanitaria and US\$21 million by the Adaptation Fund), potentially reproducing or aggravating the risks that existed before the disasters (Ibid.).

In contrast, the Netherlands, with two-thirds of its population and 60 percent of its land below sea level, had been investing in dyke construction for decades, turning floodplains into polders<sup>xi</sup> for agricultural and urban development (Orie and Stahel, 2012). A series of floods in the 1990s, associated with dyke failures, led to a new approach that effectively "depolderises" the country (Ibid.). By deepening riverbeds and moving dykes away from the river, rivers can expand into floodplains at almost 40 locations along the major rivers.<sup>xii</sup> Although costs for this strategic shift are an estimated €2.2 billion, the social and environmental benefits are expected to be even higher (Orie and Stahel, 2012).

In Japan, the 2011 tsunami triggered a review of design concepts for levees against possible tsunami impact. The main innovation was a classification of disaster risks into two categories: extensive and intensive risk. In the revised designs, levees are required to withstand extensive risks with a return period of 10 to about 100 years (Government of Japan, 2012b). In other words, levees have to be built to protect populations from high-frequency risk. For intensive risks, which are likely to happen with a return period of more than 100 years, building levees would usually neither be a guarantee for protection nor do they show positive cost-benefit ratios. Therefore, in addition to infrastructures, the government focuses on resident evacuation and other preparedness measures for such events.



the risk may be transferred from the private to the public sector.

In India, the country's Eleventh Five Year Plan allocated more than US\$500 billion for infrastructure investment up to 2012, of which a substantial portion was earmarked for the engineering and construction sectors (PwC, 2008). Increasingly, in India, PPPs are emerging where private investment finances publicly managed construction.

As Box 8.6 shows, these partnerships do not necessarily lead to improved disaster risk assessment and management, and may underplay disaster risks or lead to their transfer as shared costs to the public sector or to city residents.

The construction of infrastructure to control floods, such as dykes, may also generate shared risks and costs, as it facilitates real estate development in flood-prone areas that appear to be protected. The consequences of dyke failure may be worse than the risks that were supposed to be addressed by the infrastructure in the first place (Box 8.7).

Unless the ownership of the risks that can be generated by large infrastructure projects is made explicit and the responsibilities of both private and public partners clarified, there may be insufficient incentive for the private partners to invest in risk reduction. At the same time, the public partners are often unaware of how much new risk they are really taking on.

## 8.6 Towards a new incentive structure: disaster risk reduction as a value proposition in urban development

**Through partnerships, businesses are able to reduce their own losses as well as support the public sector to more effectively manage and reduce disaster risks. Resilient infrastructure systems underpin resilient business and resilient business underpins prosperous cities and countries.**

On 6 July 2011, businessman Donald Trump and Panama's President Ricardo Martinelli participated in the inauguration ceremony of Trump Ocean Club, Panama, a luxury international hotel and casino.<sup>xiii</sup>

### Box 8.8 Addressing flood risk in Scotland – joint private and public action

Compared with other parts of the United Kingdom, Scotland has been comparatively successful in reducing its exposure to flood hazard. Since 1995, new construction in floodplains has been reduced to almost zero as a result of a national planning policy that prohibited the building of residential property in areas of high flood risk.

The Scottish success was the result of working closely with private real estate developers and insurers. Planners in local governments were legally obliged to set up Flood Liaison and Advice Groups (FLAG) (Crichton, 2012) as non-statutory advisory groups of public and private sector representatives with insurers playing a key role in their establishment. Between 2000 and 2003, the Association of British Insurers (ABI) was instrumental in helping to establish 19 FLAGs with 28 Scottish local authorities covering more than 90 percent of the Scottish population. These groups also brought together property developers, landowners, water departments and suppliers, emergency planners, hydrology consultants, representatives from the national rail network, the police, fire and rescue services and many more. With local government's land use planners, development control officers and neighbouring authorities, all issues related to water management were addressed on a catchment-wide basis, making available critical hydrological and flood risk information to all stakeholders. Many groups convened information sharing events and involved community groups.

The success of this initiative is undisputed. Only one local authority, Moray, did not engage and continued construction in floodplains. Consequently, it now has serious problems with flooding and access to flood insurance. In other parts of the United Kingdom (see Box 8.5 above), local communities are not directly involved in flood planning and there is no mechanism in place for planners to consult with developers, insurers and other key stakeholders across the catchment area.

(Source: Johnson et al., 2012)

Urban developers who sell properties immediately after development will have lower stakes in an integrated approach to disaster risk management. However, developers who own, lease and/or manage buildings even after construction will have a vested interest in protecting profits from losses, including those associated with disasters. Mori Building, a Japanese private developer, is such a company, and it has recognized the need to explicitly deal with earthquake risk in the construction and maintenance of its developments. It has begun to promote an urban development concept that seeks to build “a city to escape into rather than a city from which people run away”. Its biggest development includes, for example, a local power plant constructed under consideration of both earthquake risk and CO2 reduction goals. During the aftermath of the Great East Japan Earthquake, the plant had the capacity to produce and sell surplus electricity to outside areas that experienced power outages. The company has housed and trained employees with specific responsibilities for disaster management and undertakes regular emergency drills.

Mori Building has not made this investment without calculating the costs and benefits. A survey of office requirements of more than 1,000 companies in Tokyo, conducted in April 2011 just after the major disaster, revealed that the most important criteria for selection was earthquake resilience (92 percent), followed by proven disaster management by the company managing the building (55 percent), and back-up of electricity to avoid power outages (51 percent). Although the result of this survey was clearly biased by the immediate disaster experienced by companies, the success of Mori’s approach to take concerns seriously speaks for itself: its large commercial buildings with office space are fully occupied.

(Source: Mori Building (2012))

The Trump Ocean Club represented a new high-water mark in Panama’s burgeoning real estate sector.

Unfortunately, the inauguration represented a high-water mark in more ways than one. The ceremony will now mainly be remembered for the severe flooding in the Punta Pacifica area where the Club was built and for televised images of the VIPs struggling through the flood-waters.<sup>xiv</sup> While it had rained heavily, the floods were caused by inadequate drainage infrastructure that had not kept pace with the city’s growth and could no longer cope with peak run-off. The capacity of the drainage system had also been reduced due to the accumulation of cement from real estate projects in the drains themselves.<sup>xv</sup>

As this case highlights, investments in urban development may generate shared risks and costs for the city as a whole, such as increased flood hazard. But these shared risks can also boomerang back to affect businesses and investors, including through damaged reputations. As businesses are starting to understand how these shared risks and costs can affect them, a new incentive structure for risk-

sensitive urban development is beginning to emerge.

There is growing evidence of the emergence of expanded risk governance frameworks in cities. Urban governments that seek to attract investment are entering into innovative partnerships with businesses (Box 8.8) as well as with low-income communities to address climate change, improve security and effectively manage risk (Johnson et al., 2012). And new approaches to urban development that highlight environmental and social sustainability are becoming a key value proposition for the construction and real estate sector. Reducing the risks associated with flooding and other hazards fits easily into this new narrative of urban development.

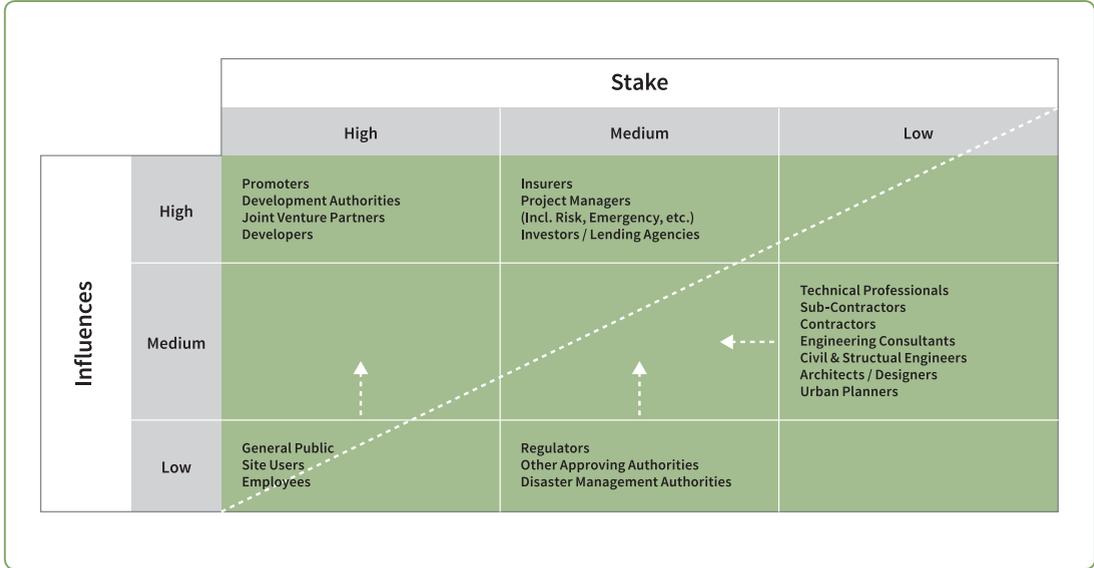
In urban environments, governments can seek to include businesses and investors in planning and decision-making instead of seeking to control private investment through regulation only (Johnson et al., 2012). The construction sector is an example where there are particularly important pre-project and pre-construction stages where disaster risk should be considered and where both private and public stakeholders can play a critical role (IIHS, 2012). Fur-



ther, incentives for private urban developers to invest in and market their disaster risk management efforts already exist and need to be articulated more clearly to promote replication (see Box 8.9). However, risk considerations are often included too

late in the process when they have limited scope to influence project design and completion. Stakeholders have varying levels of incentives for including disaster risk reduction measures in the planning process. Often whether or not they engage in the

**Figure 8.6** Overview of critical actors, their stake and influence, engaged in different project stages in construction



(Source: IIHS and UCL, based on IIHS, 2012 and Johnson et al., 2012)

**Box 8.10** Risk assessments and scenario planning for cities

In 2007, **Chicago** undertook an assessment of its exposure and vulnerability to climate change. Applying state-of-the-art climate models and risk information, the assessment focused on key infrastructure and developed a number of scenarios to evaluate the incremental costs of climate change (Oliver Wyman, 2008). Directly involved in the assessment were 18 different city departments that provided the input required for analysis of probable economic impact of climate change on the city’s capital investments, internal operations and budgets (Ibid.).

The assessment highlighted rising temperatures and higher levels of rainfall as the main future drivers of dramatically increasing energy and maintenance costs. Annual energy costs in the high emissions scenario were estimated at nearly 14 times the costs in the low scenario, meaning that efficiency gains in energy consumption would yield the highest returns (Oliver Wyman, 2008).

In July 2005, **Mumbai** experienced heavy rainfall of half of its annual average within 24 hours, which resulted in flooding of more than 60 percent of the city with poor and vulnerable populations suffered significant impact with an estimated total loss between US\$240 million and US\$250 million (Hallegatte et al., 2010). Mumbai’s disaster risk management plan of early 2005 had not anticipated the massive direct losses as well as indirect impacts after the floods in the form of epidemics from contaminated water and food. After the event, the municipal government updated its plan to include post-event impacts such as the spread of communicable diseases. Significant investments were made in flood control, both structural and non-structural (United Nations, 2010).

However, Mumbai still faces the serious challenge of flood risk owing to a high prevalence of informal and unsafe settlements, high density of construction on the shoreline and continuing land reclamation efforts that go hand-in-hand with the degradation of its coastline, including loss of mangroves and wetlands around the city.<sup>xvi</sup>

(Source: UNISDR)

process is a function of stake and influence, which may vary for each stakeholder during different phases of a project. Incentives for including safety and disaster risk reduction measures in the planning processes of the project may be increased by raising their stakes; for example, by improving public participation processes, the capacities of the implementation agencies and regulatory bodies, and enforcing Professional Acts and making professionals more liable for their practice (Figure 8.6).

As Box 8.10 shows, the first step towards developing a joint business case for urban planners and business investment is often a risk assessment that is either commissioned by the city council or the Mayor's office or by the business itself.

Similarly, regulation that ensures the carry-over of insurance policies from developers to property owners could contribute to the practice that risk assessments of investments not only focus on the construction phase of the project but take into account the lifespan of the building (IIHS, 2012).

Businesses in the real estate sector can also play a

key role in raising awareness of disaster risks. For example, in the United States of America, the Federal Alliance for Safe Homes (FLASH) has built a unique coalition of more than 100 organizations ranging from local governments to private sector enterprises, to the insurance industry and the federal government, all committed to reducing damage from natural hazards (Government of the United States of America, 2012). It has helped to educate Americans on how they can lessen the impacts of hurricanes, floods, fires, earthquakes, and other natural hazards on their homes.

Green building is increasingly being mainstreamed as a key component of this value proposition and in cities' efforts to develop more socially and environmentally sustainable living spaces (Carpenter, 2013). Green buildings attract higher rents, higher asset values and more stable tenancies (Brugmann, 2012). Real estate developers increasingly market aspects such as energy-efficiency, social space (Carpenter, 2013) and low environmental impacts as factors of competitiveness. And it is likely that disaster risk management will likewise become

**Figure 8.7** Green roofs on the building of Quito's water utility



(Source: Empresa Pública Metropolitana de Agua Potable y Saneamiento de Quito<sup>viii</sup>)



part of this value proposition.

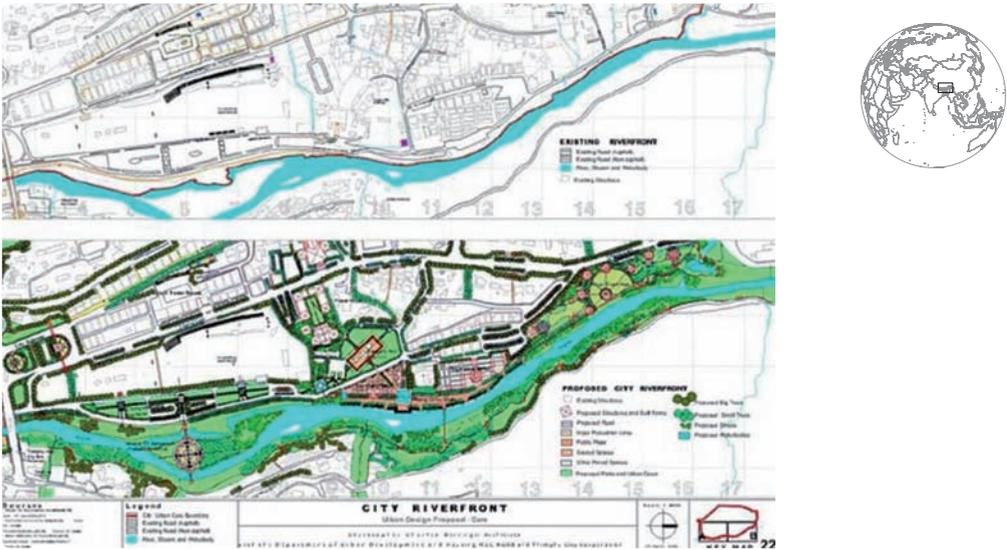
For example, in Ecuador, Quito's water utility (Empresa Pública Metropolitana de Agua Potable y Saneamiento de Quito) is encouraging sustainable

risk reduction through water conservation, environmental education and climate change adaptation. This includes the promotion of sustainable urban drainage systems, including using green roofs that reduce the risk of urban flooding by ab-

**Box 8.11** Social and green cities in low-income countries

In the city of Thimpu, Bhutan, the local government has begun to develop an urban planning process that takes account of the interrelationship between environmental sustainability, effective disaster risk management and human well-being. The Thimpu Structure Plan is based on “Principles of Intelligent Urbanism,”<sup>28viii</sup> acknowledging the needs of different occupations and lifestyles in the spatial organisation of the city. The plan is organized around 22 themes, including the achievement of a “balance with nature and tradition, conviviality and creating the ‘city of our dreams’” (Figure 8.8).

**Fig 8.8** The Thimpu Structure Plan lays out the existing river front and planned enhanced development of urban green spaces and social meeting points



(Source: Thimpu Structure Plan<sup>28</sup>)

To achieve balanced industrial and residential development, environmental management and social and individual well-being, the municipality has employed a development suitability matrix that lays out the degrees of inter-compatibility of different types of land use.<sup>29</sup> The matrix includes considerations of rainfall levels and temperature and of climate extremes, to encourage low-risk land-use planning. It supports development of multiple land uses to enhance livelihood diversification and sustainable development to strengthen the city's economic resilience. However, there has been criticism in the local press regarding the slow implementation of the plan and its increasingly outdated features, as its original timeframe ended six years ago.

In addition, Thimpu is still challenged with limited capacity in disaster risk management, including early warning and emergency funding, watershed management and access to risk information. But the municipal government's attention not only to physical safety in planning economic development within the city but also to lifestyles and a social-environmental balance in the city landscape is an approach that may well prove to build mid- to long-term resilience.

(Sources: Government of Bhutan, 2004; IIED, 2012a)

sorbing rainfall water and reducing the inflow into urban drainage systems (Figure 8.7). Green roofs are symptomatic of the new value proposition in urban development. They can reduce energy costs, improve air quality, reduce flood risks, mitigate urban heat islands and contribute aesthetic and environmental values to urban areas.

These innovations are happening as part of a renewed recognition of the role of urban design and planning to produce urban spaces that are not only attractive and functional but also social, sustainable and safe (Soja, 1996; Sassen, 2010). They are taking place not only in large global cities such as New York or Tokyo or in high-income countries, but also in low-income countries, such as in Bhutan, for example (Box 8.11).

In the Republic of Korea, the national government has developed tax policies and other financial incentives to reduce private investors' uncertainty and stimulate public-private partnerships (PPPs) for urban green growth (OECD, 2012). These were de-

veloped in its First Five-Year Action Plan for Green Growth of 2009 and include construction subsidies, compensation for base cost and infrastructure credit guarantees (Ibid.).

Such examples show that business will invest in green urban infrastructure when the right incentives, mainly associated with cost recovery and competitive pricing, are provided (Johannessen et al., 2013). Certification initiatives and agreed standards can promote this further; for example, in Sweden, collaboration between various government departments, municipalities, building and energy companies, property owners, consultants and architects is working to develop a sustainability certification for city areas (Karlsson, 2012). Although this initiative does not yet explicitly consider disaster risk, such tools can be adapted to include assessments of drainage and run-off capacity, flood risk and heat absorption, to name a few (Johannessen et al., 2013).

A good example of a certification programme is

#### **Box 8.12** PPPs in Canterbury, New Zealand

Infrastructure provides services, utilities and linkages, which allow cities to function and indeed present lifelines for business and community. Infrastructure networks are often large, complex and interdependent systems, meaning that failure in one network can compromise the entire system.

A good example of how PPPs can reduce risks to infrastructure networks was highlighted in the 4 September 2010 and 22 February 2011 earthquakes near Christchurch, New Zealand, which caused damage of US\$4 billion and US\$12 billion, respectively. The Christchurch Engineering Lifelines Study (Christchurch Engineering Lifelines Group 1997) undertaken in the 1990s, addressed a range of hazards including earthquakes, snow and wind-storms, flooding and tsunamis. A key feature of the project was the wide involvement of engineers and managers from utility organisations, including local authorities, and private and public companies. After the study, Christchurch's utility companies built disaster risk management into their daily business practices. Inter-organisational collaboration was facilitated and formalized through the Canterbury Lifeline Utilities Group.

These efforts paid off when the earthquakes struck. Thanks to investments in reinforcement before the earthquakes, the Port of Littleton was able to resume operations within days—despite heavy damages to the port and major losses owing to demolished commercial buildings. Telecommunications buildings that had also been reinforced were able to continue to operate. Most bridges had been retrofitted by Christchurch City Council and the New Zealand Transport Agency and successfully survived the quakes; and US\$6 million of investment in seismic strengthening work by Orion, the local electricity distribution company, saved more than US\$65 million in direct losses.

In contrast, residential losses were high owing to Christchurch's history of land-use decisions, which allowed development on land susceptible to liquefaction, lateral-spreading and subsidence in the event of earthquakes.



the U.S. Green Building Council's LEED Neighbourhood Development rating system, which incorporates disaster risk reduction concepts, particularly with regard to flood protection.<sup>xxi</sup> If these and other similar certification programmes can be expanded and fully include risk neutrality within their criteria, they can become another powerful incentive for businesses to invest in disaster risk reduction.

At the same time, the construction of resilient infrastructure can also be a key value contribution. As Box 8.12 shows, PPPS can be used to reduce risks and shared costs. Resilient infrastructure systems underpin resilient business and resilient business underpins prosperous cities and countries.

## Notes

**i** The urban population of Asia more than tripled between 1970 and 2011, from 506 million to 1,895 million, and is projected to increase to 2,703 million by 2030 (UNDESA, 2012). The urban population of Africa almost quintupled between 1970 and 2011, from 87 million to 414 million and is expected to reach 744 million by 2030. Latin America and the Caribbean have a far slower urban growth rate than other regions, but this is only because a very high proportion of its population already lives in urban areas.

**ii** UNDESA World Population Prospects, the 2010 revision: <http://esa.un.org/unpd/wpp/index.htm>.

**iii** Expressed in 2010 prices and exchange rates.

**iv** [www.ansa.it](http://www.ansa.it).

**v** [www.cirf.org](http://www.cirf.org).

**vi** e.g. the Flood and Water Management Act, 2010.

**vii** [www.rics.org/uk/knowledge/news-insight/news/businesses-in-the-capital-unprepared-for-flood-risk](http://www.rics.org/uk/knowledge/news-insight/news/businesses-in-the-capital-unprepared-for-flood-risk).

**viii** The value is expressed in 2005 US dollars; the GDP deflator is taken from World Development Indicators of the World Bank. Countries are classified according to GNP per capita: low-income countries = US\$1,025 or less; lower middle-income countries = US\$1,026 to US\$4,035; upper middle-income countries = US\$ 4,036 to US\$12,475.

**ix** <http://ppi.worldbank.org>.

**x** The database covers infrastructure projects in energy, telecommunications and transport and water sectors of low and middle-income countries that meet three criteria: a) projects that are owned or managed by private companies, b) projects that directly or indirectly serve the public and c) projects that reached financial closure after 1983. For the detailed database description please see: [http://ppi.worldbank.org/resources/ppi\\_methodology.aspx](http://ppi.worldbank.org/resources/ppi_methodology.aspx) (accessed 28th February 2013).

**xi** The Dutch word "polder" refers to dry land created by enclosing floodplains (or shallow waters) with dykes.

**xii** For more information on the Dutch "Room for the Rivers Programme" see: Government of Netherlands, <http://www.rijksver>

[heid.nl/ministeries/ienm#ref-verkeerenwaterstaat](http://heid.nl/ministeries/ienm#ref-verkeerenwaterstaat) and <http://www.ruimtevoorderivier.nl/meta-navigatie/english/>.

**xiii** [http://www.ticotimes.net/Current-Edition/News-Briefs/Donald-Trump-inaugurates-Latin-America-s-tallest-building-in-Panama\\_Thursday-July-07-2011](http://www.ticotimes.net/Current-Edition/News-Briefs/Donald-Trump-inaugurates-Latin-America-s-tallest-building-in-Panama_Thursday-July-07-2011).

**xiv** <http://www.youtube.com/watch?v=ivJ701fqjhM>.

**xv** <http://www.bbc.co.uk/news/world-latin-america-14152439>.

**xvi** See Government of Maharashtra: [http://www.visionmumbai.org/images/projects/Document\\_EC%2039th%20%20meeting%20minutes\\_Final\\_120412120808.pdf](http://www.visionmumbai.org/images/projects/Document_EC%2039th%20%20meeting%20minutes_Final_120412120808.pdf) (accessed 25/2/2013); <http://www.indianexpress.com/news/post1947-land-reclamation-tripled-in-mumbai-study/960419> (accessed 25/2/2013); <http://india.blogs.nytimes.com/2012/11/01/what-if-mumbai-gets-hit-by-a-storm-like-sandy> (accessed 25/2/2013).

**xvii** Information provided directly to UNISDR. For more information on Quito's water utility, see: [www.emaapq.gob.ec](http://www.emaapq.gob.ec).

**xviii** <http://www.dudh.gov.bt/Thimphustructural/Index.html>.

**xix** <http://www.dudh.gov.bt/Thimphustructural/Index.html>.

**xx** [http://www.dudh.gov.bt/Thimphustructural/maps/development\\_matrix.gif](http://www.dudh.gov.bt/Thimphustructural/maps/development_matrix.gif).

**xxi** <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=148>.

## Chapter 9

# Hazardous Leisure



Small island states that have been most **successful in attracting investment** in the tourism sector have also **experienced the highest losses** relative to GDP and damages to uninsured public and private infrastructure.

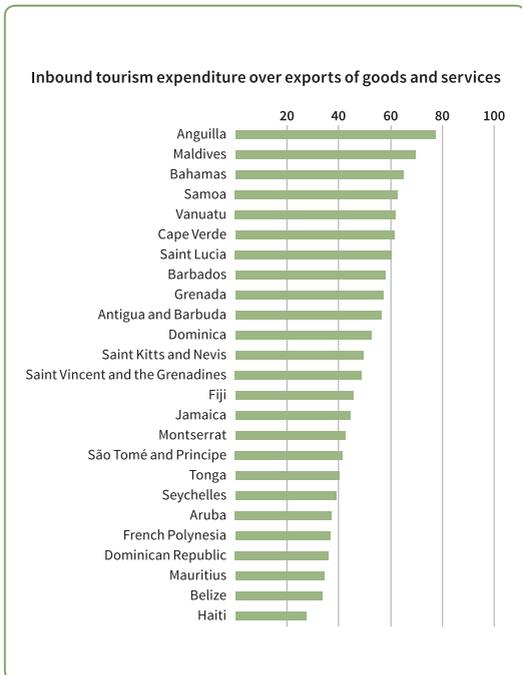
Where the **ownership of risk** is not well defined, **costs** may be borne by those that usually benefit least. In these settings, **tourism** can create new risks, but also **presents great opportunity** for risk management.

The role of **social demand** for resilient investment is currently not a **strong lever** in the tourism sector, particularly in the context of demand for beach tourism. **Value propositions** for small island holiday destinations that meet current demand and yet promote resilience **need to be articulated**.

Globally, tourism is one of the most dynamic and fastest-growing business sectors, contributing 9 percent to global GDP (WTO, 2011; WTTC, 2012). In 2011, the tourism sector was responsible for 4.6 percent of total global capital investment. The sector creates more jobs than the financial services, communications and mining industries and for every US\$1 spent on tourism and travel, US\$3.2 is generated in GDP (WTTC, 2012).

In 2012, the tourism industry was expected to grow faster than overall predicted global growth (UNWTO, 2011).<sup>i</sup> Its contribution to global GDP in the same year was estimated to be US\$2 trillion, generating more than 100 million jobs (WTTC, 2012). Most of this growth is occurring in China and India, where domestic tourism is expected to generate a sharp upturn in capital investment—contributing to an overall growth of 6.7 percent in Asia (Ibid.). This chapter, however, will focus on tourism in Small Island Developing States (SIDS), and how business investment decisions contribute to disaster risks, in turn affecting the economy of these countries.

**Figure 9.1** Contribution of tourism to exports of goods and services, annual average 2006–2010 (percent)



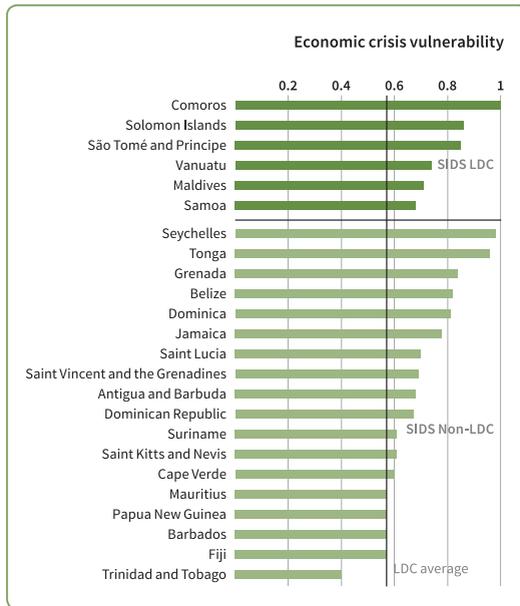
(Source: UNISDR, based on data from UNCTAD, 2011)

## 9.1 Comparative advantages but high risks

Small island states in the Caribbean, Indian Ocean and Pacific are increasingly popular tourist destinations, many of which are also highly exposed to hazards. Attracting investment in tourism development is one of the few areas where SIDS are competitive. However, it also poses risks, given their high economic vulnerability.

Many small island developing states (SIDS) are heavily dependent on tourism and a number of different tourism products along the tourism supply chain as the key source of investment (Zhang et al., 2009). Although SIDS may be uncompetitive in other economic sectors, in tourism, many of them excel (WEF, 2011).

**Figure 9.2** Economic crisis vulnerability<sup>iii</sup> of SIDS economies (LDCs and non-LDCs) compared with LDCs on average



(Source: Adapted from (UNDESA, 2010))

In many SIDS, business investment in the tourism sector is driven by attractive tropical beachfront and coastal locations, associated marine leisure opportunities as well as land-based activities, such as golfing. Several SIDS also promote business and conferencing facilities along with attractive beachfronts, targeting large national and international companies and organisations. Because of these comparative advantages, the tourism sector has been a major driving factor for economic growth, particularly between 2005 and 2010, enabling countries such as the Maldives and Cape Verde to graduate from their Least Developed Country (LDC)<sup>ii</sup> status (UNWTO, 2012).

In 2007, international tourism receipts accounted for 51 percent of total value of exports of SIDS compared with less than 10 percent in other developing countries (UNDESA, 2010). Figure 9.1 highlights the contribution made by the tourism sector to exports and GDP in 25 SIDS.

Investment in the tourism sector, however, presents SIDS with opportunities as well as challenges. Tourism

generates economic growth and employment. But this reliance on a single economic sector implies risks. As Figure 9.2 shows, all but a handful of SIDS (whether they are LDCs or not) have a higher vulnerability to shocks and crises than LDCs in general.

## 9.2 Beachfront risk

**Direct and indirect losses from disasters in SIDS can affect not only the entire tourism industry but national economies as a whole. Tourism investments both exacerbate and suffer significant impacts from weather-related disasters in these countries.**

The comparative advantage of SIDS in attracting business investment in the tourism sector is equally one of their greatest risks. For example, in the Caribbean, typical tourism development is located within 800 metres from the high water mark (World Bank, 2000). In the Commonwealth Caribbean more than 65 percent of hotel rooms are in coastal areas—in Barbados, for example, the percentage exceeded 90 percent in 2002 (Jackson, 2002).

By their very nature, these investments—particularly in beach tourism—are highly exposed to hazards such as tropical cyclones, storm surges and tsunamis. Further, coastal tourism is highly exposed and vulnerable to negative impacts from climate change (ECLAC, 2011). This may include infrastructure exposed to sea level rise, beaches that are subject to coastal erosion, diving centres that depend on healthy coral reefs, as well as sedimentation and water pollution.

As highlighted in Chapter 7, many SIDS have exceptionally high levels of disaster risk. Business investment in the SIDS tourism sector, therefore, comes with high levels of disaster risk, which, given the high dependency of local economies on tourism, becomes a shared cost for economies and societies as a whole.

Over the last decade, beach tourism destinations and island reserves in particular have experienced disasters associated with the following hazard events: Indian Ocean tsunami in 2004, Hurricanes Katrina and Wilma in 2005, and the Samoan tsunami and Fiji floods in 2009. Data on the amount of losses to the tourism sector or percentage of tourism operations and outputs exposed to hazards are not readily available. However, the few national or regional-level studies published to date all indicate significant impacts (UNEP, 2008).

In 2004, Hurricane Ivan resulted in estimated direct losses of US\$900 million in Grenada—more than twice the country's GDP. The tourism sector was particularly hard hit. Of the island's infrastructure, 70 percent was damaged, and demand for services from the tourism sector declined for several years (World Bank, 2004). Apart from hotel and restaurant infrastructure, eco-tourism and agro-tourism components suffered severe damage to their resource base (*ibid.*).

Later that year, the Maldives suffered direct losses from the Indian Ocean tsunami amounting to total estimated damages of US\$470 million, or close to 62 percent of GDP. Of this amount, about US\$100 million were losses in the tourism sector (World Bank et al., 2005). Of these losses, approximately one-half were insured. Tourism also suffered the largest indirect losses, together with the fisheries sector. With a sharp drop in tourist arrival numbers, tourism suffered the highest negative macro-economic impact (*ibid.*).

In 2009, another tsunami caused total disaster losses of US\$124 million in Samoa, the equivalent of more than 22 percent of GDP (Government of Samoa, 2009). Losses in the tourism industry accounted for almost 15 percent of direct and 56 percent of indirect losses. With tourism receipts accounting for 65 percent of all exports (in 2009), Samoa's efforts to recover from the global financial crisis at the time were further challenged (*ibid.*).

Disasters may also cause interruptions to tourist sector supply chains, as flights are cancelled and suppliers affected. Even the warning of an impending cyclone may cause cancellations and hence indirect losses. The structure of these supply chains also makes them highly susceptible to interruptions that affect airports and air traffic in the principal markets for tourism services, such as the United States of America. Storms and extreme weather that close major airport hubs, even for a few days, can lead to cancellations in tourism destinations on the other side of the globe (Hall, 2010).

Business may also be affected for many years after a disaster given that it depends on perceptions of destination safety and security and on the confidence tourists place in industry players (Mahon et al., 2012; Forster et al., 2012; Méheux and Parker, 2006). After disasters, however, tourism operators normally attempt to ensure a speedy recovery of business, playing down underlying risks, so that potential tourists see the disaster as a brief business interruption rather than a manifestation of these risks. In some cases, such as the Maldives, concerns about negative tourist perceptions have led to the withholding of disaster-related information by industry stakeholders (Becken et al., 2011).

Owing to lack of information dissemination on risks, the wider impacts of disasters on the sector have not necessarily resulted in reduced business for tourism operators. For example, in Grenada, by December 2005, just over a year after Hurricane Ivan, the tourism sector had almost completely recovered, with 96 percent of hotel rooms reopened (UNDESA, 2010).

**Box 9.1** Losing out on post-disaster recovery: micro, small and medium enterprises in Arugam Bay, Sri Lanka

The local economy of Arugam Bay in Sri Lanka, dependent to a large extent on tourism and fishing, was devastated by the 2004 Indian Ocean tsunami that wreaked havoc on the coast. The particular impact on micro and small and medium enterprises (SMEs) and those that worked in these was quickly recognised; special initiatives were designed to help those affected to recover quickly. However, interest to also boost the more formal, commercial tourism sector during reconstruction led to much of the government’s support for the sector going into large investments geared towards marketing the country’s beaches as an up-market, boutique tourism destination. As a result, small entrepreneurs and businesses as well as fishing communities were insufficiently involved in the recovery processes and their livelihood recovery was severely hampered.

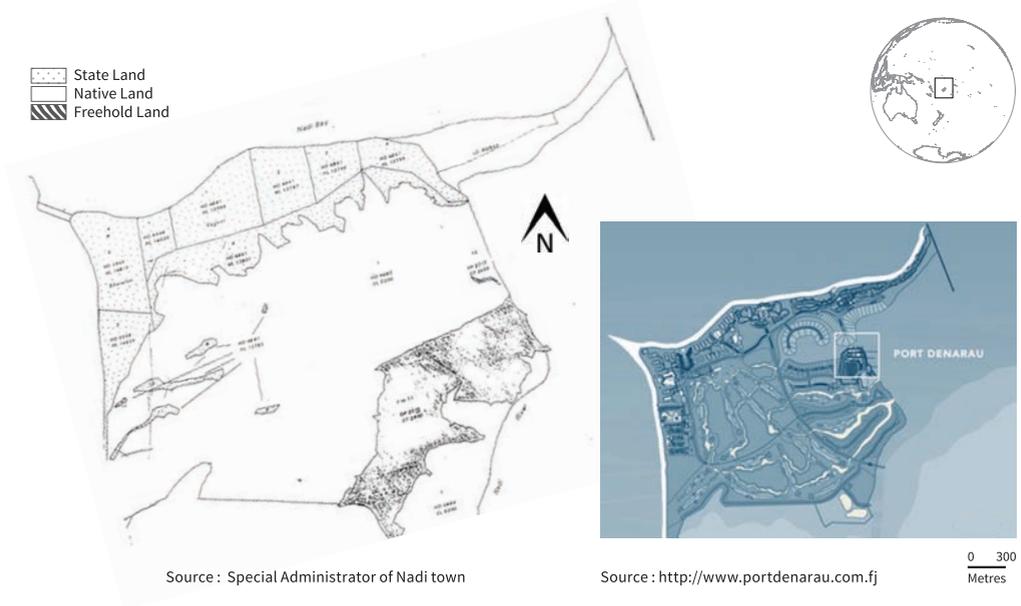
(Source: Robinson and Jarvey, 2008)

**Box 9.2** A blueprint of investment-driven risk accumulation in the tourism sector – the case of Denarau, Fiji

The 2009 floods that affected Fiji resulted in high economic costs that were borne almost exclusively by small businesses and households. About US\$143 million were lost by small businesses and another US\$7 million by households. In March 2012, more floods led to more devastation and only two months after the floods, the Nadi Chamber of Commerce reported that 46 small businesses (one-fifth of all small and medium businesses registered with the Chamber) had to close down because of damage to buildings or destruction of stock; only a handful eventually reopened.

Tourism development in Denarau has resulted in Nadi attracting more investments, people and businesses, which meant an increase in exposure of assets. The Pacific Catastrophe Risk and Financing Initiative (PCRAFI) surveyed the Nadi area, noting that financial exposure of physical infrastructure in the area could be estimated at US\$2.3 billion. The physical landscape of the island has changed dramatically over time, creating new risks and exacerbating existing exposure (Figure 9.3).

**Figure 9.3** Denarau before and after tourism development



(Source: Bernard and Cook, 2012)

# 9.3 Who pays the costs?

As tourism investment attracts further business investments, generates jobs and with it results in the build-up of housing development and road infrastructure, the ownership of risk is usually not well defined. As a result, risks from new

investment become shared costs borne often by those who benefit least from the return on this investment.

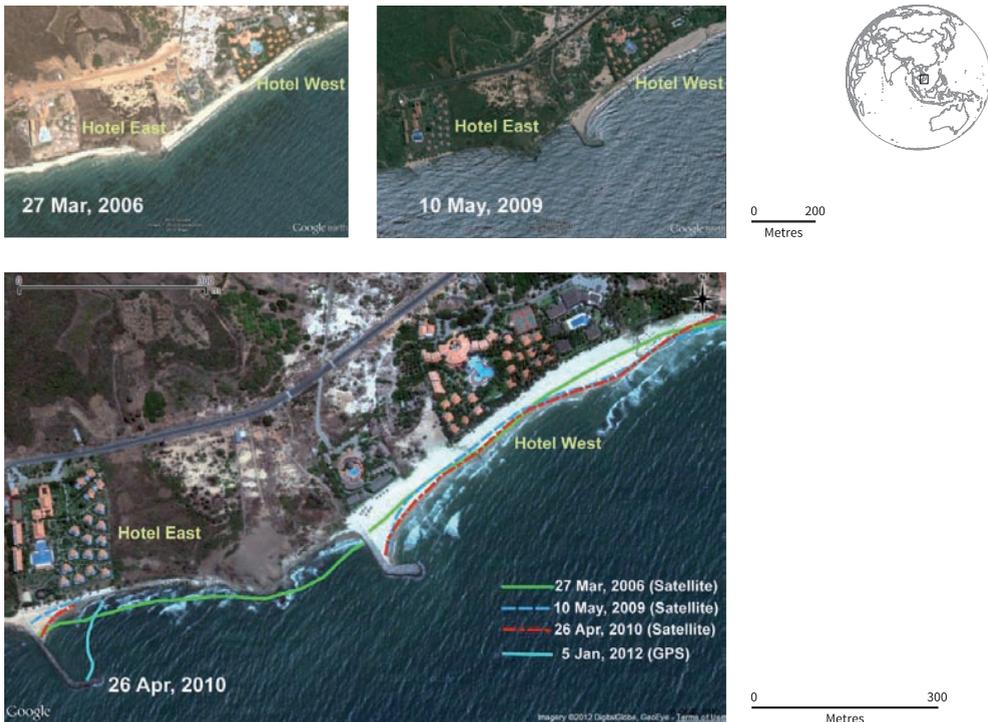
Losses in the tourism sector in SIDS can rapidly translate into impacts on employment and disproportionately affect small and medium enterprises (ECLAC, 2003). For example, after the Indian Ocean

### Box 9.3 Tourism investment, coastal erosion and rapidly increasing coastal disaster risk in Southern Viet Nam

Mui Ne is located east of Phan Thiet, the capital of Binh Thuan province in southeast Viet Nam. Increased investment in tourism infrastructure on Mui Ne's beachfront, including construction of a large jetty, seems to have resulted in coastal erosion of Phan Thiet shores with resulting increased storm surge and flood risk. Obstruction of shoreline sediment transport by the jetty may be the main reason. The first photograph of Figure 9.4 shows sandy beaches in front of two hotel developments (depicted here as Hotel West and Hotel East) as well as sand accumulation at a jetty west of the hotels towards Phan Thiet.

To retain sand at the hotel beach, Hotel East invested in the construction of a large jetty that was successful in protecting erosion and even increasing the beach area in front of the hotel. However, the lack of sediment transportation from east to west, following the construction of the jetty, resulted in loss of beach area for Hotel West and coastal erosion further along the coast to Phan Thiet (Figure 9.4, large photograph), leaving those areas more vulnerable to storm surges and floods.

Figure 9.4 Relationship between investment and erosion in coastal southern Viet Nam



(Source of data and figures: Takagi, 2012)

tsunami in 2004, many local economies based on tourism and fishing were severely damaged. Yet, in several cases, reconstruction and recovery efforts focused on large-scale investments that bypassed local businesses to accelerate overall tourism revenue (Box 9.1).

SIDS competing to attract investment in the tourism sector are, implicitly or explicitly, accepting ownership over part of the disaster risk generated by business investments in hotels and resorts. Countries that have been most successful in attracting investment in the tourism sector and have consequently increased their hazard exposure have also experienced the highest losses relative to GDP and damages to uninsured public and private infrastructure (Clayton, 2003).

Investments in tourism infrastructure also attract associated investment (housing for employees; road, water and electricity infrastructure; small businesses) to hazard-exposed areas. Risks to these assets are often not borne by the industry but transferred to households, small entrepreneurs or the public sector—as in the aftermath of major floods in Fiji in 2009 and 2011 (Box 9.2).

Investments in the tourism sector are often accompanied by associated urban and suburban real estate development and land-use change, which can also lead to shared costs and transfer of risk over time and space. For example, although not a part of SIDS, the case of Mui Ne, near Phan Thiet in Viet Nam, highlights the direct causal relationship that tourism investment has in one location and how that can increase disaster risk in another location (Box 9.3).

## 9.4 Incentives and disincentives for risk-neutral investment in the tourism sector

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**Incentive structures that address the need for risk-sensitive investment in the tourism industry need to be developed significantly.**

Despite recurrent disaster losses in SIDS, there is little disincentive to continued and increased business investment in hazard-prone beachfront locations. Between 2004 and 2007, there were sequential major disasters affecting SIDS as well as a rapid growth in their tourism sector (WTTC, 2012).

Because beach or waterfront locations represent more profitable business investments, this drives the concentration of investment into highly hazard-exposed areas. High profitability and short turnover to recover capital investments may mean that investors over discount the risk posed by intensive events with long return periods. And for SIDS governments, tourism is one of the few sectors where they are competitive.

As with other business sectors, it is unlikely that tourism investments in hazard-exposed locations reflect irrational behaviour by either businesses or governments, but rather a calculated trade-off between returns on and risk to capital. The typical tourism developer on Grenada's main tourism belt of Grand Anse, for example, will calculate the expected economic return associated with a hazard-prone, seafront location and choose this location over one that is located inland and away from the coast and which would produce lower returns (Mahon, 2007). Disaster risk is closely related to setback lines (the distance of tourism infrastructure from the shoreline). In the case of SIDS, appropriate setback lines may be unfeasible if the concerned islands are too small, as with the Maldives (Mahon et al., 2012).

However, multiple layers of investment, decision-making and ownership structures in the industry itself mean that responsibility and accountability



for disaster risk is often diffuse. For example, as in the case of one large international hotel chain, separate investors or investment funds own up to 80 percent of its global hotel business (Honey and Krantz, 2007). In such cases, the premises of resorts are usually operated by another set of investors, including local investors (Ibid.). Thus, the risk for global chains, already spread across numerous operations across regions, is further reduced and instead transferred to local investors (Mahon et al., 2012). Even a major disaster in one region would affect only a minor percentage of businesses' total global operations.

From a government perspective, the predominance of the sector in SIDS economies also implies high inter-country competition to attract investment. This in turn can potentially weaken the role of government regulation to reduce disaster risk, including through land-use planning.

For some small islands that turn down tourism investment, owing to disaster risk or environmental concerns, few other comparative advantages to attract alternative investment in other sectors remain. In contrast, large tourism investors can easily reorient their investments to other islands.

As such, stringent regulations to reduce disaster risk—for example, establishing non-building zones on coastlines—end up curbing total tourism investment and revenue and are difficult to justify or sustain from an economic or political perspective.

The tourism industry, however, is also a frequent recipient of investments made by international development and aid institutions. For example, about US\$10 billion were provided in 2005 by 12 international donor agencies to fund 370 individual tourism-related projects (Honey and Krantz, 2007). In addition, tourism and related infrastructure investments from the United States of America and Europe into the Caribbean, in particular, is substantial (Lewsey et al., 2004). Although more could be done to proactively increase the disaster resili-

ence of these investments, good examples exist, such as the Inter-American Development Bank's Tourism Sustainability Scorecard.<sup>iv</sup>

In addition, much of the produced capital in the sector was built in the 1960s and 1970s—a time of relatively weaker planning and regulation and low environmental and risk awareness. During this period, many hotels were developed extremely close to the high water mark (Honey and Krantz, 2012; Mahon, 2007; Mahon et al., 2012). Many coastal tourism belts throughout the Caribbean have developed seaward of the coastal road owing to little recognition of the impact that future sea level rise many have on properties (Mahon et al., 2012).

The imperative to attract investment in the tourism sector is not generally matched by corresponding efforts to manage and reduce resulting disaster risks (Mycoo, 2006). The lack of coordination among the different departments concerned with attracting tourism investment, on the one hand, and with managing disaster risk, on the other hand, further leads to serious policy distortions and conflicting policy objectives and instruments.

The availability and pricing of insurance has yet to act as a disincentive to investment in hazard-exposed locations. Tourism investment represents a growing source of exposure for the insurance industry. Yet, there are only a limited number of assessments available of potential insured losses and the associated implications for insurance premiums and insurability in high-risk regions (UNWTO, 2012).

Although increasing losses could make insurance unaffordable, or unavailable, in the future—particularly for smaller tourism businesses—there is little evidence that the tourism sector has begun to systematically integrate disaster risk considerations into investment and operational plans (UNWTO, 2012).

Good examples do exist, however, as with Fiji,

where the banking and insurance sectors work together to protect their investment in tourism assets (Mahon et al., 2012). A new alliance between the Insurance Council of Fiji and the Fiji Institute of Engineers has resulted in a certification programme overseen by a vetted panel of engineers. To acquire insurance and access bank loans, builders are required to go through this certification programme (Ibid.).

## 9.5 The double-edged sword of social demand

**Client demand in the tourism sector continuously undermines efforts to create incentives for more risk-sensitive investment. New and unique selling points for holiday destinations that meet the current demand and yet promote resilience should be identified.**

Up to 2,700 tourists may have died in coastal resorts in Thailand in the December 2004 tsunami (Rosa, 2012). However, this mass mortality did not diminish the enthusiasm of tourists for tsunami-prone coastal areas, in Thailand or elsewhere.

Social demand, expressed through market demand, plays an important role when changing investment behaviour in other industries. In the tourism sector, however, the demand itself is driving the risk with limited incentives to proactively reduce it. In fact, an asymmetry exists in the valuation of risk by potential tourists: destinations perceived as unsafe benefit from efforts that counter this perception, whereas places that are already perceived as relatively safe do not increase arrivals by specifically promoting this aspect (Sirakaya et al., 1997). This means that to a certain extent, although destinations may be punished for being perceived as unsafe, there is no reward for being perceived as safe (Mahon et al., 2012).

Tourists prefer proximity to the beach, which poses a challenge to coastal zoning for safe tourism

developments. A survey of 367 international visitors to the island of Tobago revealed that about 43 percent thought that it is moderately to extremely important that their hotels have disaster plans; a similar percentage found it moderately to extremely important to receive guarantees of personal safety from disasters; whereas about 40 percent of tourists thought it moderately to extremely important to receive information about disaster events at their hotel. However, more than 82 percent thought that it is moderately to extremely important that their hotel be located close to the beach (Mahon et al., 2012).

As a consequence, the tourism sector can actively distort communication of risk information. Examples from the Maldives and Thailand specifically show that the tourism industry can be reluctant to share risk information out of concern that tourists will perceive them as lacking destination safety (Becken et al., 2011; Rittichainuwat, 2012; Mahon et al., 2012).

At the same time, although tourists may place responsibility for disaster risk management on resort and facility managers, the industry assumes that responsibility lies with local and national governments (Drabek, 2000), who may not have fully assessed the risks. In Florida, for example, only about one-half of tourism businesses surveyed in 2011 had either written procedures for disaster events or evacuation plans in place (Pennington-Gray et al., 2011). Even major hotel chains do not visibly take disaster risk into account (Bouvier and Kohnold, 2011).

Yet, there are signs that in transparently managing disaster risks in the tourism sector, both businesses making investments and SIDS striving to attract those investments increase their competitiveness. Several countries that have begun to spearhead this challenge are investing in measures that move significantly beyond ‘business as usual’ response preparedness to potentially effective risk management and reduction (Wright, 2013). Varied mea-



asures have included developing new cyclone building standards (Cook Islands); coastal land-use and zoning plans that are considerate of projected tsunami and storm surge levels (Fiji); and setting back new infrastructure developments according to storm surge inundation lines for events with a 100 years return period (Anguilla).<sup>v</sup>

Although resort tourism features predominantly in beach tourism in several SIDS, such as Fiji (Scheyvens and Russell, 2012), eco-tourism is now the fastest-growing segment within the global tourism industry. Investments in resilient communities, environmental protection and local culture are already on the agenda of large hotel chains, airlines and tour operators (UNWTO, 2011).

Certification programmes and voluntary rating systems are emerging as popular tools. They are increasingly being accepted by clients and supported by governments that seek to promote the role of private enterprises in disaster risk management (Raisch, 2007; Raisch et al., 2007). One such example is Green Globe, the global travel and tourism industries' certification programme for sustainable tourism. Green Globe Members save energy and water resources, reduce operational costs, and thus positively contribute to local communities and their environment and meet the high expectations of green leisure and business travellers.<sup>vi</sup>

During interviews with small tour operators in Tonga, the main potential incentive for considering disaster risk was a quality certification programme that incorporated disaster risk reduction (Mahon et al., 2012).

By integrating risk-neutral behaviour into the agenda of tourism destinations and operators, the sustainability of both SIDS and the tourism investments that they attract could increase. Disaster risk reduction would present a triple win situation for investors in the industry, SIDS governments and communities in tourism destinations.

## Notes

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**i** Data on real growth in the sector were not available for 2012 at the time of writing.

**ii** To be categorised as a Least Developed Country by the Economic and Social Council of the United Nations, a country must satisfy three criteria: low gross national income (under US\$750 based on a three-year average estimate); low human resources (based on indicators of nutrition, health, education); and high economic vulnerability (based on a composite Economic Vulnerability Index). For more information, see: [www.un.org/special-rep/ohrlls/ldc](http://www.un.org/special-rep/ohrlls/ldc).

**iii** Vulnerability here is defined based on United Nations Environment Programme/SOPAC methodology (UNDESA, 2010) and takes into account characteristics such as size, remoteness, dependence on external demand and supply, extent of resource base, and exposure to global environmental challenges.

**iv** <http://www.iadb.org/tourismscorecard>.

**v** All these measures are described by countries in their National HFA progress reviews, 2011–2013 available on <http://www.preventionweb.net/english/hyogo/progress/reports/?pid:222>.

**vi** <http://greenglobe.com/register/green-globe-certification-standard/>.

## Chapter 10

# No Free Lunch: Agribusiness and Risks to Food Security



The agricultural sector and with it, the **agribusiness industry**, has **particularly high levels of disaster risk**. Disasters in this sector are not only disasters for businesses, large or small, but **also significantly affect rural societies**, urban households, national and **global commodity markets and food security**.

In the localities and regions where these investments are being made, already **limited access to fertile land by smallholder farmers** may be further reduced. In a context of increasingly **constrained global food markets**, the spread of agribusiness investments into regions with high but poorly understood agricultural drought and other hazards generates **risks of future and more severe food price spikes**. This poses a greater threat to the food security of households in low income areas than drought itself.

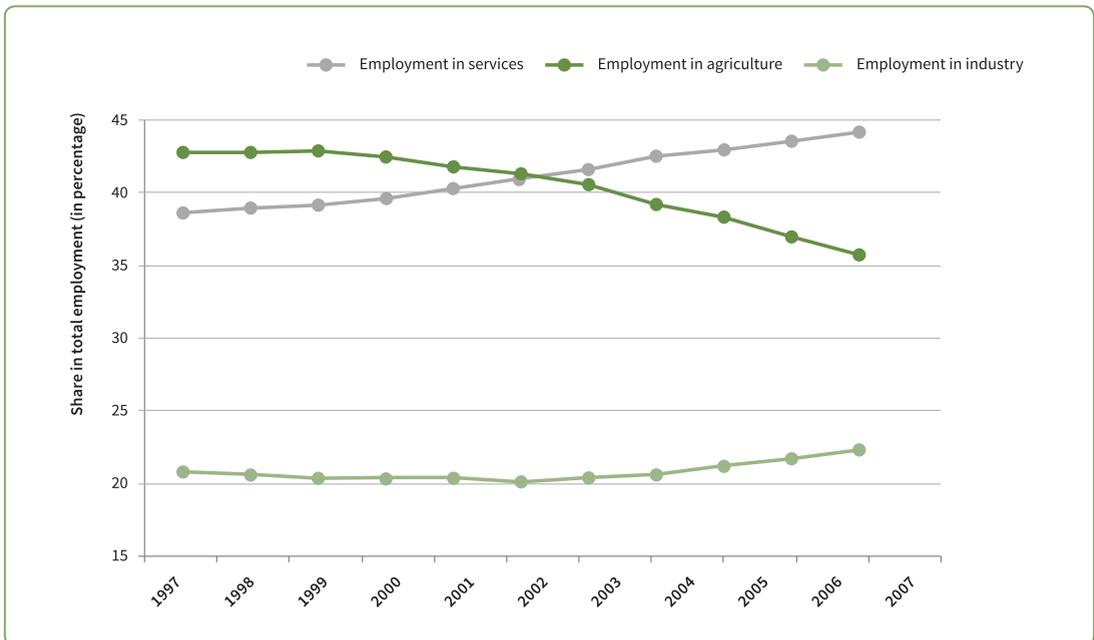
But **new practices are emerging** that match **investment opportunities** for private companies with **infrastructure and service gaps in under-developed markets**, particularly in Africa. Partnerships are developed that aim to **increase the productivity and resilience of smallholder farmers**, contributing to local and national food security.

Agriculture remains a key sector in the global economy even as industrial and service sector growth continues. Moreover, in several regions, agricultural production increases at a staggering rate—for example, in Latin America, it increased 50 percent from 2000 to 2012, and in sub-Saharan Africa, more than 40 percent (FAO, 2012a). In fact, urbanisation

is giving a boost to the role of the agribusiness industry in mediating food production, distribution and consumption.

Many low and middle-income countries significantly depend on food exports. And agribusiness' role in creating income and employment opportu-

**Figure 10.1** Contribution of agriculture to global employment (1997–2007)



(Source: ILO, 2012)

nities, particularly in those countries, is undeniable (FAO and UNIDO, 2009; ILO, 2012; World Bank, 2008b). For example, in sub-Saharan Africa, although agriculture contributes about one-fifth of GDP growth, the sector provides more than one-half of all employment and remains the largest employer in the region (IMF, 2012). Even globally, although total employment in agriculture is declining, it still provides more than one-third of total employment (Figure 10.1).

Thus, disasters in the agricultural sector are not only disasters for agribusinesses, large or small, but they also affect rural societies, urban households, national and global commodity markets and food security. And yet, only 14 percent of the 94 countries reporting on progress in implementing the HFA (see Chapter 14 and Annex 3) undertake disaster risk assessments prior to investment in agriculture. The risks associated with agribusiness investments become costs shared with all who purchase and consume food and agricultural commodities throughout the world. Therefore, decisions taken by agribusiness in factoring disaster

risk considerations into its investments will play a crucial role in global food security.

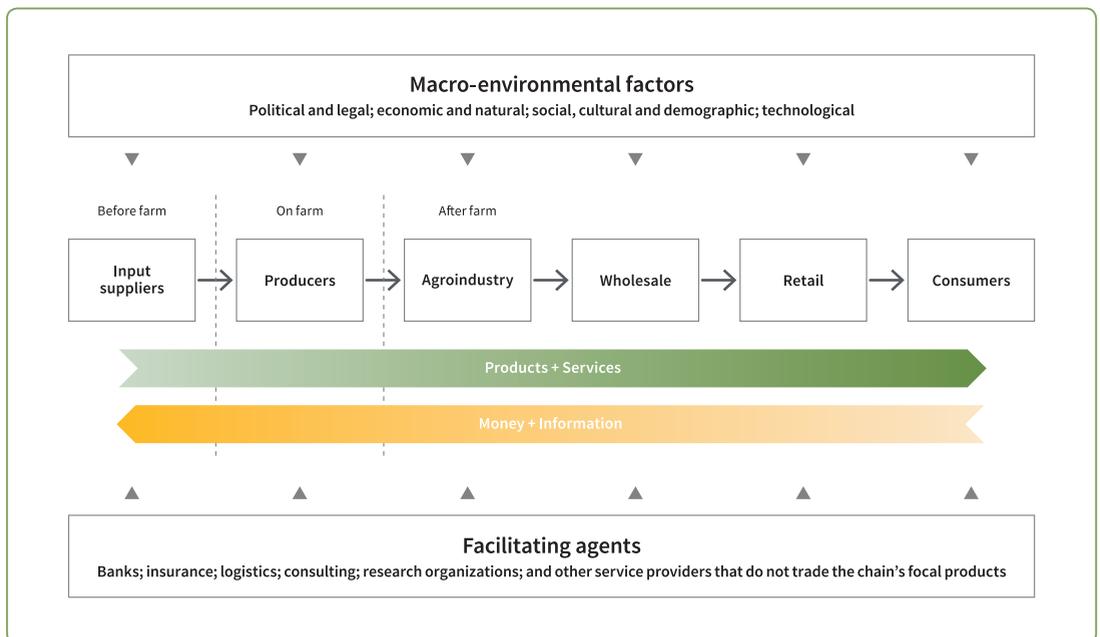
## 10.1 The agricultural value chain

**The complexity of value chains in the agribusiness sector means that interruptions at critical points or nodes can ripple through the entire supply chain.**

The agribusiness sector is organised around a complex value chain—input suppliers, producers, intermediaries, processors, marketers and consumers, mediated by a range of facilitating agents and macroenvironmental factors (Figure 10.2).

Along this value chain, size and form of businesses vary immensely; from large fertiliser companies to individual farm households that sell surplus production to local buyers at the farm gate; from local grain mill cooperatives to medium-sized processing plants; from small urban traders to multinational food chains.

**Figure 10.2** Framework of a typical agribusiness production chain



(Source: Fava Neves and Alves Pinto, 2012)



However, the myriad of agricultural producers and those that rely on the sector for their livelihood all experience different types of vulnerabilities and exposures along the value chain.

At every step of the chain, transport and associated infrastructure can be at risk of direct damage from hazard events, meaning that interruptions at critical points or nodes can ripple through the supply chain. Those investing in agricultural production, processing and trade, therefore, have a vested interest in the uninterrupted functioning of this infrastructure and in reducing damage owing to disasters.

Nevertheless, producers are usually in the supply chain’s most vulnerable position. In other sectors, producers are better able to estimate accurately output volume in relation to a desired level of production and a given set of inputs. In farming, however, production is subject to highly unpredictable and uncontrollable conditions, including weather-related hazards and pest and diseases in crop and livestock. Additionally, there is a large time gap be-

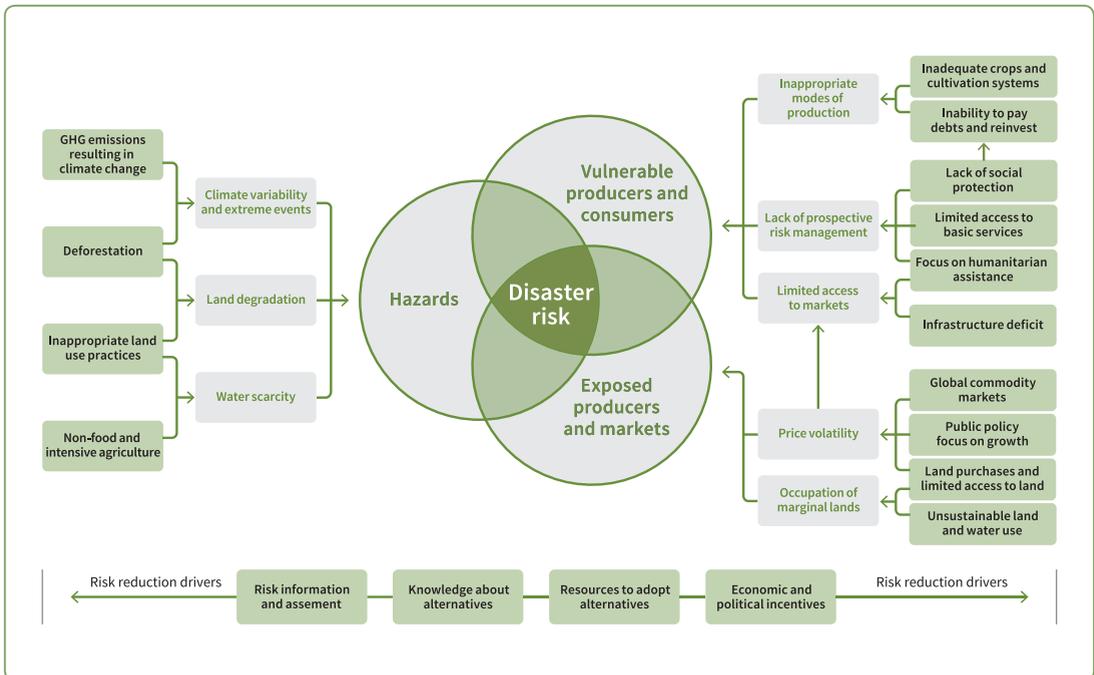
tween the moment farmers make decisions regarding what crops to produce and when they are able to harvest and sell their production. During this gap, in addition to other hazards, farmers face risks related to price volatility that are greater than in most other sectors (Fava Neves and Alves Pinto, 2012). Figure 10.3 shows how, in the agribusiness sector, disaster risk lies at the junction of a broad spectrum of hazards, vulnerabilities and exposures.

## 10.2 Drivers of production and price: local and global vulnerabilities

**Dynamic global food markets and volatile prices are affected by disasters but also act as an important driver of food insecurity and disaster risk.**

Despite inherent uncertainty and risk in the sector, constant hikes in global prices for agricultural commodities since 2000, including exceptional food price spikes towards the end of the last decade (Figure

**Figure 10.3** The multiple dimensions of disaster risk in agriculture



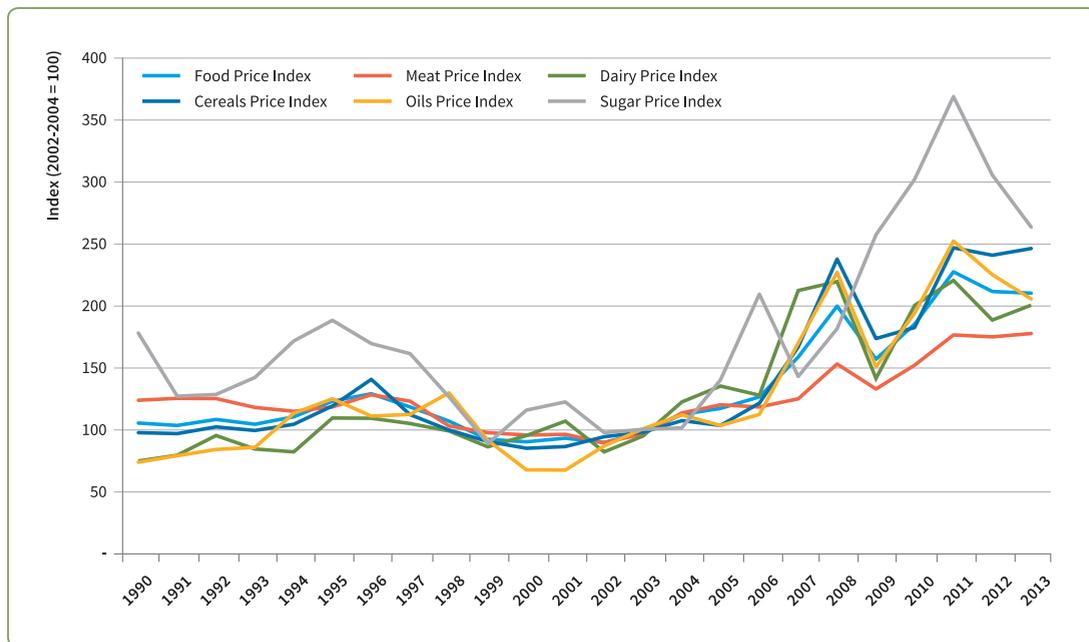
(Source: UNISDR, adapted from Fava Neves and Alves Pinto, 2012)

10.4), have stimulated major new investments in the agricultural sector and in global food production.

Growth estimates for the cereal market, for example, project that by 2021, world wheat production

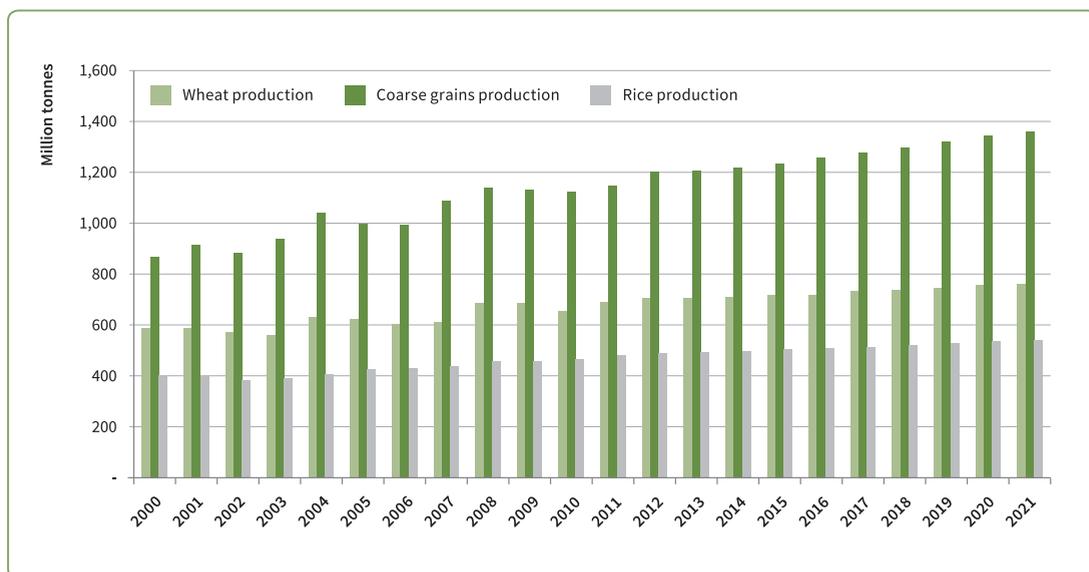
will increase by 12 percent from the base period 2009–2011 (reaching 761 million tonnes (Mt)); world coarse grain production will increase by 20 percent (1,359 Mt); and world rice production by 16 percent (542 Mt) (OECD and FAO, 2012) (see Figure 10.5).

**Figure 10.4** Rising food prices since 2000 (as observed January 2000–August 2012, not adjusted against inflation)



(Source: FAO, 2012c)

**Figure 10.5** Observed and expected price and production of wheat, coarse grain and rice, 2000–2021



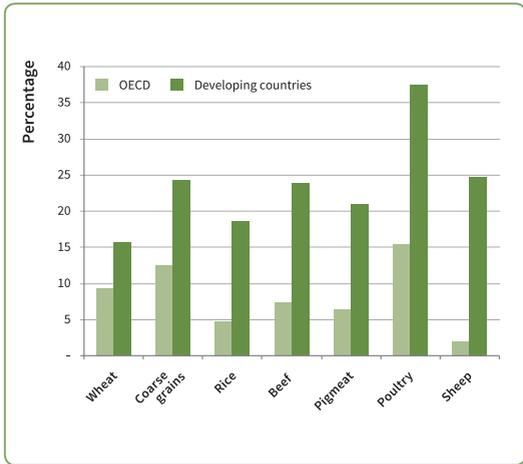
(Source: UNISDR based on OECD and FAO, 2012)



Countries expected to contribute to this growth include Kazakhstan, Russian Federation and Ukraine for wheat; and Argentina, Brazil as well as several Sub-Saharan countries for coarse grain.

Rising global food prices are being driven by several factors. These include rising demand for food owing to population growth, urbanisation and changing

**Figure 10.6** Expected increase in the consumption of crops and livestock in developing countries<sup>1</sup> (percent change in consumption: 2021 relative to average 2009–2011)

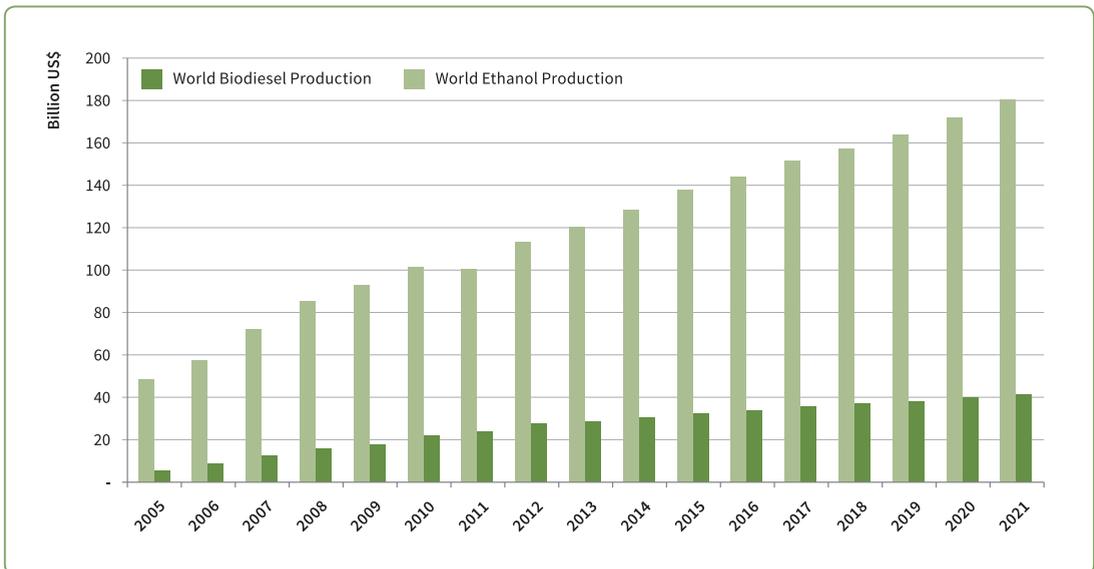


(Source: UNISDR based on OECD and FAO, 2012)

food consumption patterns, particularly in rapidly growing low and middle-income countries; high crude oil prices; use of agricultural commodities for the production of biofuels; and lower global stocks (FAO, 2012c; OECD and FAO, 2012; FAO et al., 2011; World Bank, 2008b). For example, although consumption is expected to increase for all products in all regions, meat consumption in low-income countries in particular is expected to increase to double that in high-income countries; the reason for the strong demand is increasing per capita income and population growth, especially with large growing middle classes (Figure 10.6).

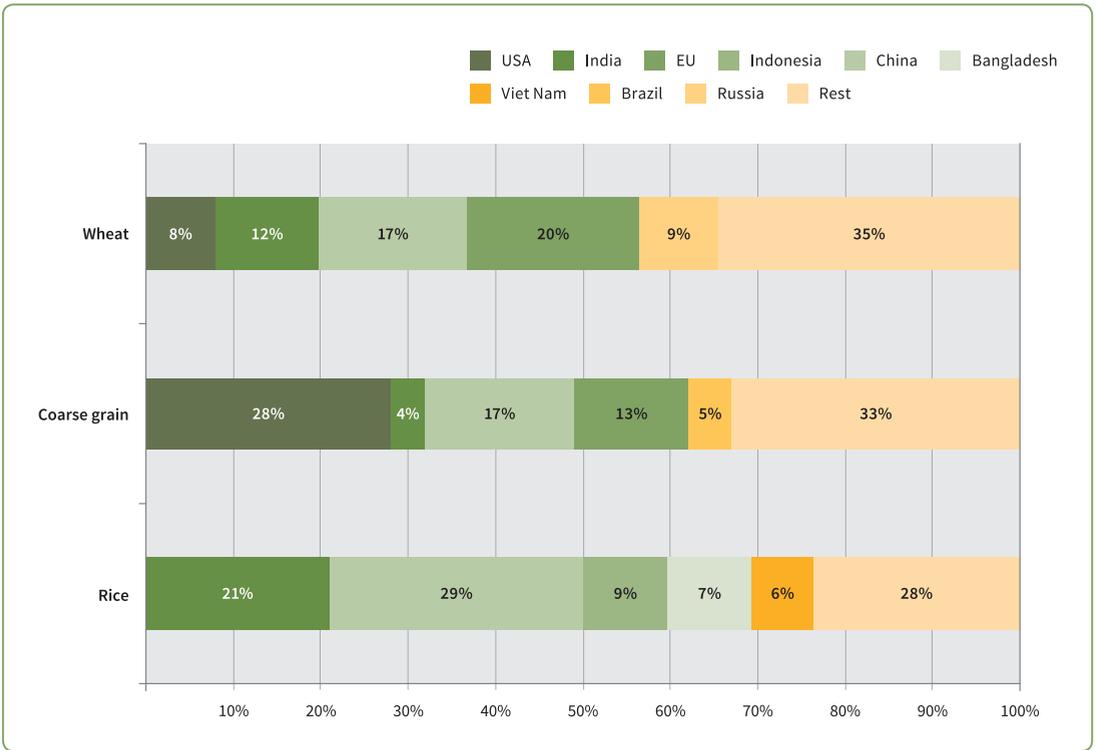
The balance of supply and demand, however, does not directly translate into prices in the agricultural commodity market. National food security policies, such as export restrictions and hoarding, can prevent produced commodities from being traded in the global market. Price volatility and international price spikes are further catalysed by factors such as the concentration of production in a few hazard-exposed regions, declining stocks, the role of commodity markets and weather and climate related disasters. Despite this, global market projections for

**Figure 10.7** Global production and prices of ethanol and biodiesel, 2005–2021



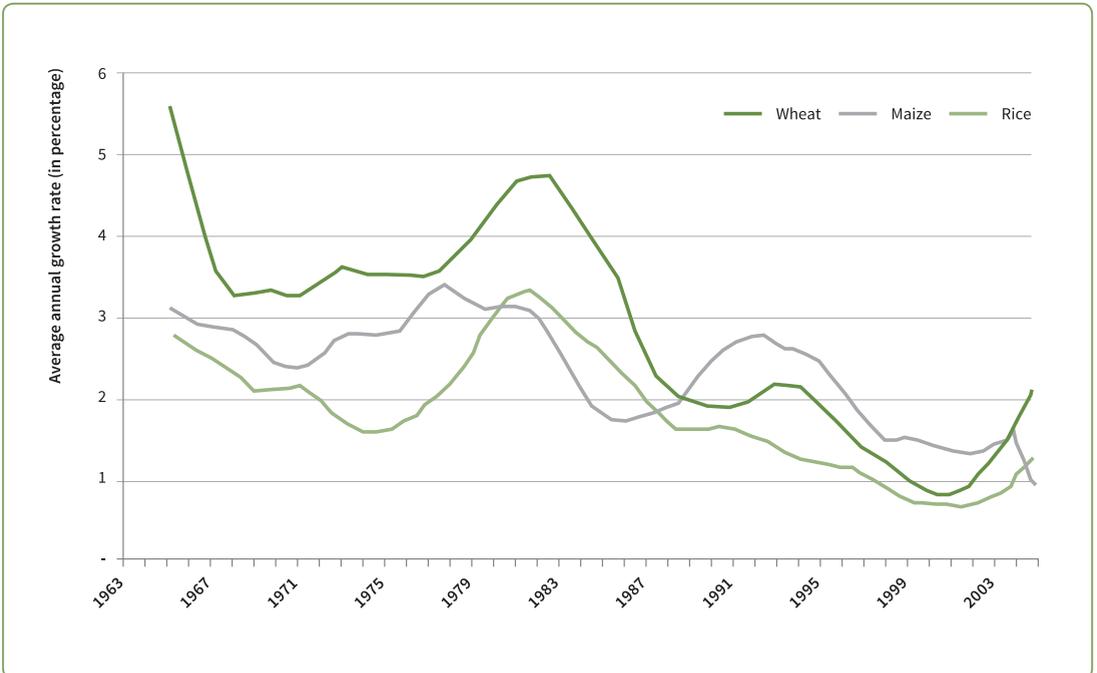
(Source: UNISDR based on OECD and FAO, 2012)

**Figure 10.8** World production of wheat, coarse grain and rice by country, 2011



(Source: UNISDR based on OECD and FAO, 2012)

**Figure 10.9** Growth rates of yields for major cereals in low-income countries



(Source: World Bank, 2008b)



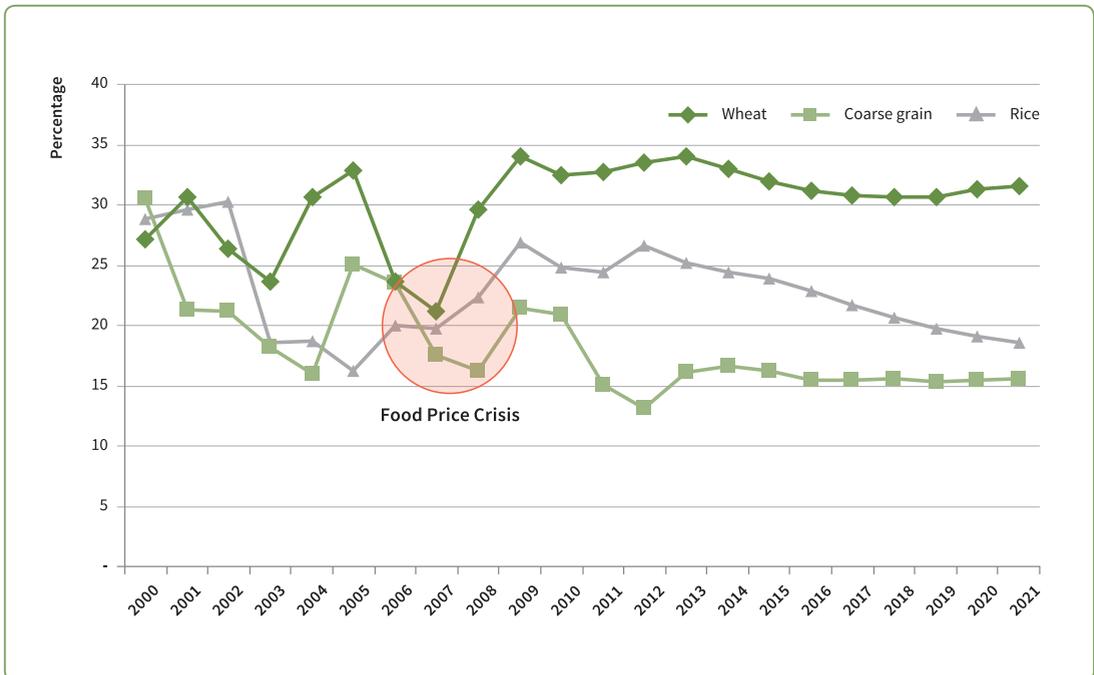
crops, livestock and fisheries products often still presume “normal weather conditions” as part of “a plausible view on the evolution of the global agricultural markets over the next decade” (OECD and FAO, 2012), and continue to discount for disaster risk in growth projections.

Increasing global demand for biofuels, triggered by higher oil prices, has significantly underpinned price hikes (Matondi et al., 2012; Fava Neves, 2011; Ambali et al. 2011). Currently, about 65 percent of EU vegetable oil, 50 percent of Brazilian sugarcane and about 40 percent of US corn production is used as feedstock for biofuel production (OECD and FAO, 2012). By 2021, global ethanol and biodiesel production are projected to rise by 373 percent and 779 percent, respectively, compared with production levels of 2005 (Figure 10.7), and related crop production increasing correspondingly. Also by 2021, 14 percent of global coarse grain production, 34 percent of global sugarcane production and 16 percent of global vegetable oil production are expected to be used to produce biofuel (Ibid.)

The production of major food crops is concentrated in selected countries that are exposed to frequent hazards. For example, as Figure 10.8 shows, in 2011, the United States of America grew 28 percent of the world’s coarse grain and 8 percent of wheat, whereas China produced 17 percent of wheat and coarse grain and 29 percent of rice. Another hazard-prone country—India—also produced 21 percent of rice, 12 percent of wheat and 4 percent of coarse grain. Rice production especially is heavily concentrated in hazard-prone regions, with more than 70 percent of production concentrated in five hazard-prone Asian countries (OECD and FAO, 2012).

Higher costs of inputs, such as fertilisers owing to high oil prices, and growing constraints from water and land degradation, tend to slow yield and productivity growth, lessening the pace of production and contributing to lower stocks (OECD and FAO, 2012). For example, growth in yield rates for major cereals in low-income countries has been declining consistently since the 1980s, as shown in Figure 10.9.

**Figure 10.10** Global stock in relation to domestic demand for wheat, coarse grain and rice, 2001–2021



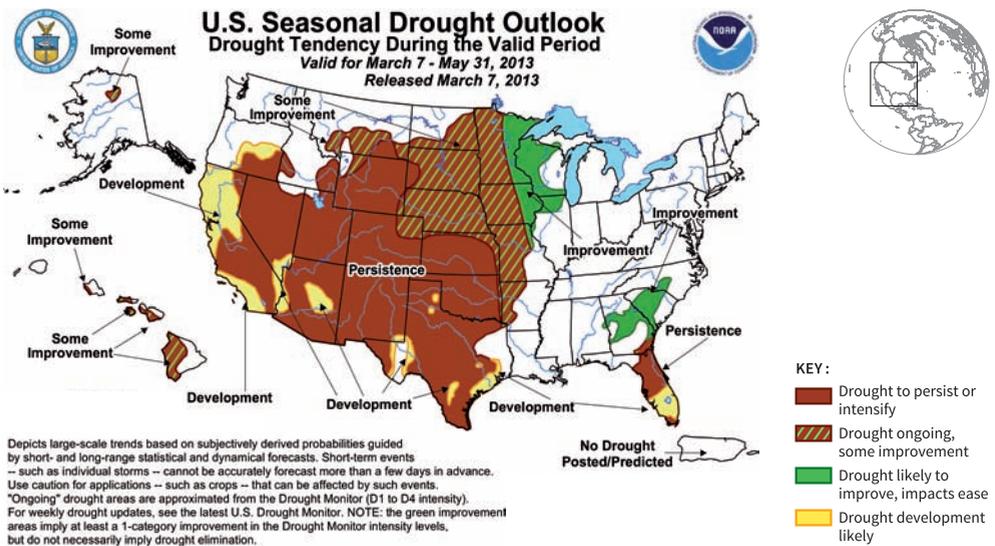
(Source: UNISDR, based on OECD and FAO, 2012\*)

In 2012, the most severe and extensive agricultural drought in at least 25 years was affecting agriculture in the United States of America and parts of Canada and Mexico, with impacts on livestock and crops. 2012 production deviated significantly from expectations early in the growing season. In the first weekly rating of the corn crop reported by United States Department of Agriculture's National Agricultural Statistics Service (NASS) on 20 May, more than 75 percent was rated as good-to-excellent, whereas only 3 percent was in the poor or very poor category. By 30 September, only 25 percent of the crop was rated good-to-excellent with 50 percent rated poor or very poor. Sharp declines in soybean crop ratings also occurred, with only 35 percent of the crop rated good-to-excellent as of 7 October compared with 65 percent in first 2012 weekly soybean rating on 3 June.

By November 2012, production estimates for corn and soybean were down by 13 percent and 4 percent, respectively, from 2011. This represented the lowest corn production in the United States of America since 2006. The drought also affected the transport of harvest within the country. Millions of tonnes of grain travel each month on the Mississippi River, but when water levels dropped to a historic low, barge traffic was severely hampered, and costs for alternative transport increased.

The Food and Agriculture Organization of the United Nations (FAO) calculated that global cereal production in 2012 was 2 percent lower than in 2011 owing to severe droughts in the United States of America and across part of Europe and central Asia. Stocks are expected to decline even further as the 2013 outlook for the United States of America continues to be unfavourable with severe drought conditions continuing to plague the southern Plains (Figure 10.11). This will have direct impacts on global food prices.

Figure 10.11 Agricultural drought in the United States of America



The US midwest represents a key node for worldwide agricultural production with implications for global commodity supply chains. When analysts' predictions for a record harvest collapsed, in futures markets, "prices for corn, soybeans, soy meal and rapeseed [...] exploded to record highs".<sup>iv</sup> International wheat quotations also surged 19 percent amid worsened production prospects in the Russian Federation for 2012 and expectations of firm demand for wheat as feed because of limited maize supplies. Combined with the drought forecasts in the US this year, this means that importing countries across Asia, Africa, Europe and Latin America will continue to face uncertainty over supply and significant food price spikes, with global knock-on effects, as farmers elsewhere switch to wheat for animal feed, thereby driving up prices for another staple.

Decreased stocks weaken the agribusiness sector's resilience to shocks, including to hazards such as drought. Low stocks and uncertainty about stock levels in some parts of the world contributed to the 2007–2008 price hikes (Figure 10.10). In fact, even expectations of depleted stock may lead to price hikes (FAO et al., 2011).

High price volatility results partly from speculative trading with futures contracts in global commodity exchanges—the volumes of which have risen significantly over the last years (Fava Neves and Alves Pinto, 2012; UNCTAD, 2011). In turn, the volatility of food prices may well have encouraged speculative trading as profits to be gained in price fluctuations usually attract traders (see also Chapter 12).

The deregulation of futures markets in the United States of America and the European Union has resulted in a further increase of pure speculation in commodity futures (Clements-Hunt, 2012). Excessive speculation, combined with regulatory failures for certain financial transactions in the commodities markets, have meant that from 2004 onward, dealers have used US\$173 billion of institutional investment to trade in main commodities (Masters and White, 2011). To absorb this new money, commodities futures markets expanded, leading to a dramatic rise of futures prices, including for major agricultural products (Ibid.). In fact, traders in commodity and futures markets can benefit directly from agricultural droughts and temperature spikes as these create the conditions for dynamic markets with higher returns (Clements-Hunt, 2012; IATP, 2009).

The correlation of commodity and equity markets and herd behaviour by investors make the market very sensitive to even small shocks (UNCTAD, 2011). For example, as commodities such as cereals become increasingly securitized, a perceived risk of crop failure, owing to drought or flood, may be magnified via speculative market behaviour, dramatically increasing global food prices as a result (FAO, 2010).

Speculative investment in futures contracts—for example, from index funds—can stimulate price spikes that magnify actual production shortfalls (Masters and White, 2011; IATP, 2009). In 2011, the indexation of commodity markets attracted large investors, such as pension funds and insurance reserves, increasing the volume of speculative trading from 30 percent to 80 percent of commodity futures trading (Ibid.). Index funds currently hold about one-fourth of all agricultural futures contracts, and their participation is growing. Between March 2006 and December 2011, for example, the volume of commodity index funds trading in corn increased by 157 percent on the Chicago Board of Trade (IFPRI, 2011).

All these factors influence the impact that hazards—such as drought—may have on food prices. International food price spikes, for example, as occurred in 2008, 2010 and 2012, are often said to be triggered by production shortfalls in major producing countries, such as Australia, Russian Federation and the United States of America.<sup>iii</sup> As Box 10.1 shows, the severe drought that affected the US Midwest in 2012 had a significant effect on global food prices. With the failure of the US corn and soya bean harvest in 2012, importing countries across Africa, Asia, Europe and Latin America face uncertainty over supply and significant food price spikes. The rapid rise in US corn prices has knock-on effects globally, as farmers elsewhere, for example, switch to wheat for animal feed, thereby driving up prices for another staple.

## 10.3 Enter the dragon: new agribusiness investments in low-income countries

**Investment in agribusiness in low-income countries, particularly in Africa, is rapidly increasing, resulting in increased land pressure and potentially increased disaster risk.**

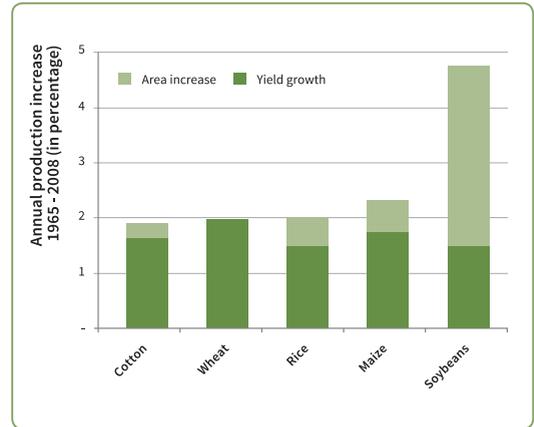
Until 2008, increase in agricultural production was driven by increasing the cultivated areas as well as from significant growth in yields (Figure 10.12).

Yield increases are projected to account for up to 90 percent of future growth in agricultural production (FAO, 2009), but the expansion of arable land, particularly in low and middle-income countries, is still significant. It is expected that by 2021, low and middle-income countries will put into production about 10–12 percent of global arable land (Nellemann et al., 2009). This corresponds to 107–120 million hectares of land in sub-Saharan Africa and Latin America (FAO, 2012a; Nellemann et al., 2009). This presents a huge business opportunity for agricultural investors and companies.

Recognising this opportunity, large businesses are buying productive, arable land and investing in export-oriented commercial agriculture, particularly in sub-Saharan Africa. Globally, 13 of the top 20 target countries for international investment in agricultural land acquisitions are in Africa (Figure 10.13). Most of these countries have a high share of agricultural GDP and also high levels of food insecurity (Anseeuw et al., 2012).

Although there is little reliable information on these deals, inventories carried out in Ethiopia, Ghana,

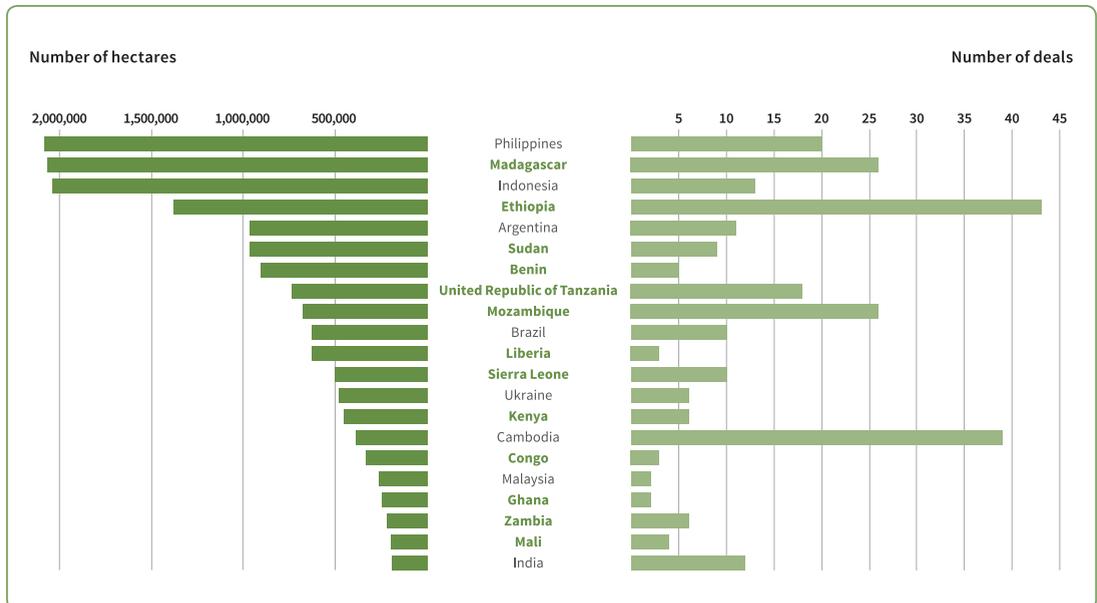
**Figure 10.12** Increase of crop production owing to growth in yield and area (1965–2008)



(Source: World Bank data cited in Nellemann et al., 2009)

Madagascar and Mali (Cotula et al., 2009) confirm land acquisitions of some 2 million hectares in the four countries. International investment accounts for about three-fourths of this land area (Ibid.). Another study—based on FAO data—shows that land acquired in seven countries in sub-Saharan Africa (Ethiopia, Ghana, Liberia, Madagascar, Mozambique, South Sudan and Zambia) comprises more

**Figure 10.13** Foreign investments in land acquisitions in selected countries according to size of total reported acquisitions



(Source: UNISDR, based on Land Matrix data.)<sup>34</sup>



than 65 percent of total area acquired on the continent (Schoneveld, 2011).

Thus, some countries with relatively small areas of productive land, such as Congo, Ghana and Liberia, have become key targets, mainly driven by the acquisition of farmland for biofuel feedstock production (Ibid.). An increasing number of national inventories of land deals are being developed, highlighting the unprecedented scale of land acquisitions, particularly in Africa (IIED, 2012b).

Governments are leasing land through many forms of public-private partnerships (PPPs)—through sovereign wealth funds, state-owned enterprises and involvement of private enterprises. Opportunities for broader public benefits in host countries are rare, and provisions for risk management and distribution of benefits in contracts are limited (IIED, FAO and IFAD, 2011). However, for several low-income countries, such as Madagascar or Ethiopia, it is unlikely that agricultural productivity could be increased without this investment.

As with other sectors examined in this report, investments in the agribusiness sector involve trade-offs. From an investor's perspective, agribusiness is an increasingly profitable and attractive sector owing to high food prices and growing future food shortages. Investments also increase the productivity of agricultural production over large areas and thus contribute to increased global food production.

Many governments sell or lease land, which is a means of increasing their wealth using their natural capital. Agribusiness is one of the few sectors where governments can have comparative advantages to attract investment. This investment creates opportunities to capitalize on the agricultural sector, increase employment and volume of exports and achieve economic growth.

However, as with investment in urban development and tourism, these investments may increase disas-

ter risks if hazards associated with droughts, floods and other events are not identified, estimated and taken into account. As Chapter 6 of this report highlights, compared with other risks, the mapping and estimation of agricultural drought risk is still incipient in most low and middle-income countries. It is likely then that risk levels are not being adequately considered in investment decisions, let alone the shared social and environmental costs.

## 10.4 The externalised cost of agribusiness investment

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**Business investment in agriculture that does not take into account the risk of drought, floods and other hazards may face high losses and result in high external environmental and social costs.**

As Chapter 6 highlighted many countries where investments are being made have high levels of agricultural drought risk and land degradation, which may be increasing owing to climate change. Globally, according to the OECD and FAO (2012), approximately 25 percent of the world's agricultural land areas are highly degraded. Degraded soils are more vulnerable to temperature extremes, droughts and floods.

Without reliable information, it is unclear to what extent businesses in the sector are assessing these and other weather-related risks before making investments. However, if drought and other risks are not being adequately factored into agribusiness investment decisions, businesses may face higher-than-expected losses, which can have negative repercussions on the price and availability of agricultural commodities.

The cost of increasing an area of intensive agriculture is usually justified through expected increases in production and yields (Yumkella et al., 2011). This assessment of costs and benefits, however, rarely includes the potential increase in direct losses owing to agricultural droughts and longer-term loss of

natural capital, for example, through land degradation; nor does it address the question of who owns these risks and pays the price.

Lack of accurate drought risk information may encourage investment in inappropriate agricultural practices, which in turn can further increase risks owing to overexploitation of finite water resources and through land degradation. For example, mono-cropping increases the risk of loss of biodiversity, competition for water in rain-fed agriculture and the possibility of introducing alien invasive species (Ambali et al., 2011).

Agribusiness companies will also face new risks, as underlying risk drivers such as climate change, land degradation and dwindling water resources increase agricultural drought risk. Cases of increasing agricultural drought, driven by changing micro-climates and potentially climate change, are affecting agribusiness across the world.

For example, the global agribusiness and food company Bunge suffered a loss of US\$56 million in its sugar and bioenergy segments in the fourth quarter of 2010 only, owing to agricultural drought in its main growing areas in Brazil.<sup>vii</sup> In fact, Bunge reported that the overall impact from droughts in various regions exceeded US\$70 million for this one quarter. The company was affected not only by lower production that resulted in lower sales and gross margins, but also by increased cost absorption from its fixed costs, charges related to writing-off damaged cane and replanting and costs related to the settlement of their hedge positions on global commodities markets.<sup>viii</sup>

The agribusiness sector has particularly high external social and environmental costs. It is estimated, for example, that currently the costs externalised by the agribusiness sector outweigh the earnings of the entire sector (KPMG, 2012). This clearly presents an opportunity for reassessment of current value creation within the industry from both business and society perspectives. A few select busi-

nesses in the sector are beginning to recognise a number of risks that may impact their performance in the medium to long term should they not begin to think about shared rather than just shareholder value.

In a context of increasingly constrained global food markets, the spread of agribusiness investments into regions with high but poorly understood agricultural drought and other hazards generates risks of future and more severe food price spikes. As will be highlighted in section 10.6 of this chapter this poses a greater threat to the food security of low-income rural and urban households than drought itself.

## 10.5 Water risks

**Agriculture is the biggest water consumer, with around 70 percent of all water withdrawn globally. Increasing demands on water resources by agricultural production, including biofuel production, are driving water scarcity, also contributing to trans-boundary conflict.**

The World Economic Forum's Global Risks 2012 report identifies water supply crises, food shortage crises, extreme volatility in energy and agricultural commodity prices, and rising greenhouse gas emissions among its top global risks over the next 10 years.<sup>ix</sup> Demand for food, water and energy is expected to grow by 35 percent, 40 percent and 50 percent, respectively, by 2030 (National Intelligence Council, 2012), and because of their interdependence, problems pertaining to one resource will be linked to supply and demand for the others.

High demands of water by agricultural production, coupled with declining rainfall in some areas, can lead to a dramatic depletion of non-renewable water sources. Agriculture, including crop and livestock production, remains the biggest global water consumer—about 70 percent of all water with-



drawn (FAO<sup>x</sup>; Hoekstra and Chapagain, 2008; OECD and FAO, 2012). This percentage includes water consumption for animal feed production.

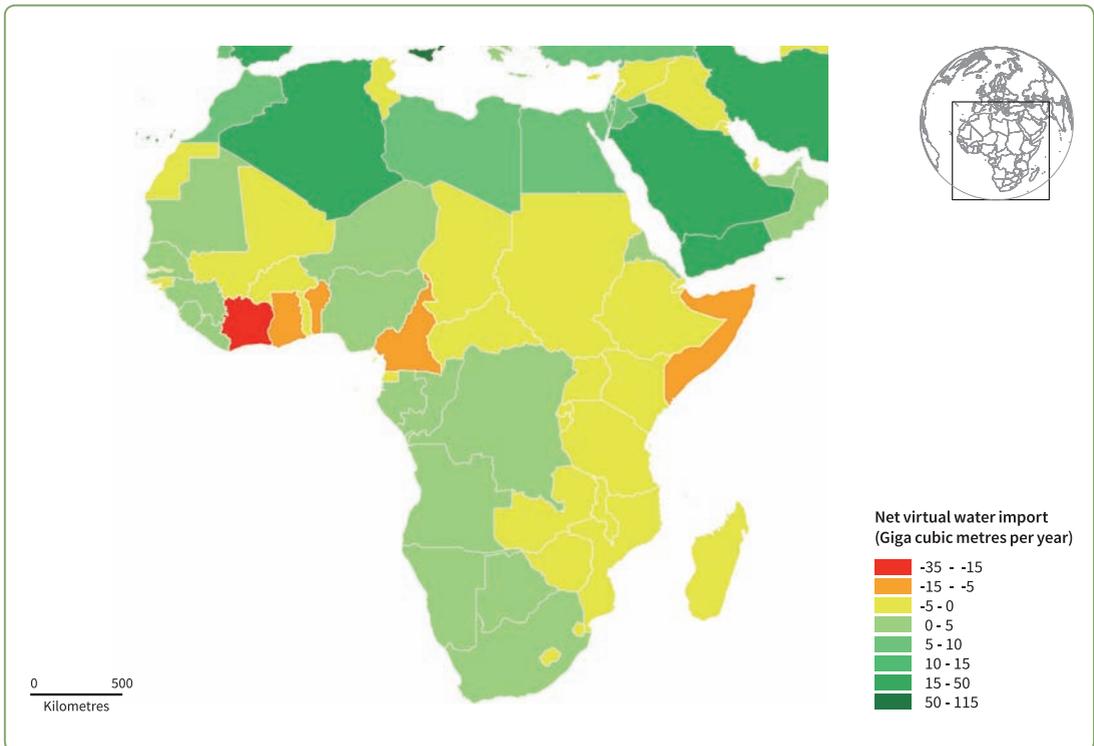
Biofuel production—depending on what crop is grown and in which region—potentially causes significant pressure on existing water resources (National Academy of Sciences, 2007). But perhaps more important is that water used in biofuel refineries can create a significant local footprint; for example, a refinery that produces 100 million gallons of ethanol per year uses an equal amount of water as does a town of 5,000 people (Ibid.).

The impact of decades of overconsumption of water can be felt in the agribusiness sector worldwide. In several countries, such as India and Egypt, electricity for pumping groundwater and the water itself are free if used for agricultural production. This clearly affects levels of water use and abuse, resulting in unsustainable water practices; for example, 85–95

percent of all water use in India and Egypt is used for agriculture irrigation (Saeijs and van Berkel, 1995). On a global scale, about 15–35 percent of all water use for irrigation is considered unsustainable (WBCSD, 2005).

When water price is undervalued or water is free of charge, the price of water consumption is not added to the cost of the final product and trade, which means that exporting countries trade their precious water resources for free. Through exporting products, be it raw material, flowers, tea or industrial goods, water utilised in the process must also be considered as exported. In drought-affected countries, such as the Sahel belt and the Horn of Africa, 5–15 billion m<sup>3</sup> of virtual water<sup>xi</sup> a year are being exported (see Figure 10.14), probably unaccounted for (Mekkonen and Hoekstra, 2011) and leaving local farmers, pastoralists and agribusinesses increasingly vulnerable to water scarcity and droughts.

**Figure 10.14** Virtual water balance in Africa in terms of import (+) or export (-)



(Source: adapted from Mekkonen and Hoekstra, 2011)

The growing demand for freshwater is posing several issues related to water availability and sourcing.

The overextraction of groundwater is irreversibly undermining water quality. Furthermore, this practice ultimately leads to land subsidence, which increases risk from river and coastal flooding. In Bangkok, Thailand, it was estimated that the land has subsided up to 10 cm/year, mainly owing to excessive water extraction (Lorphensri et al., 2011). This phenomenon contributed substantially to the 2011 floods (Aon Benfield, 2012a).

Increasing demand towards finite water resources also heightens trans-boundary conflicts. In Africa alone, there are 59 trans-boundary river basins, accounting for 80 percent of the continent's surface water resources. In Arab countries, about 65 percent of annually renewable resources, including water, originate outside the boundaries of the Arab region, which makes these countries particularly vulnerable to water-related disputes (Erian et al., 2012). Similarly, Egypt relies virtually exclusively on run-off from the Nile's headwaters in the Ethiopian and Equatorial Highlands several thousands of kilometres south (Calvert, Ceres and Oxfam, 2010). The construction of the Renaissance Dam in Ethiopia may have positive outcomes for Ethiopia, but is likely to affect water availability and security in Egypt (Vella, 2012; Erian et al., 2012).

Climate change is likely to add more constraint on water availability. Because of climate change, annual discharge in the Euphrates River is expected to decrease by 29–73 percent by 2070 (compared with its flow in 2000) (Erian et al., 2012).

## 10.6 Risk transferred to smallholders and pastoralists

**Food insecurity and crises are linked more strongly to the accessibility rather than the availability of food. This means that increases in agricultural production will not necessarily result in increased food security, particularly for low-income households.**

Agribusiness investments may transfer risks and costs to already vulnerable local communities. In the localities and regions where these investments are being made, already limited access to fertile land by smallholder farmers may be further reduced. Over the past 40 years, per capita availability of farmland in Africa has halved and its distribution is highly unequal (Yumkella et al., 2011). Host communities may lose access to productive land, grazing areas or transhumance routes, and are dispossessed of land and water resources under customary tenure (Anseeuw et al., 2011).

Agricultural drought is already a major challenge to smallholder farmers and pastoralists in Africa, particularly in areas of low productivity where a high percentage of the population lives from subsistence agriculture and livestock production in marginal areas with low and irregular rainfall. In these environments, even a small shift in seasonal precipitation can lead to major crop and livestock losses (UNISDR, 2009).

However, the relationship between crop and livestock losses from agricultural droughts and food insecurity is far less simple. In fact, there is no simple linear correlation between crop production and food security (Sen, 1981; Dreze and Sen, 1989; Bouis and Welsh, 2010; Burchi et al., 2011).

As Box 10.2 highlights, studies of household economies in sub-Saharan Africa repeatedly reveal that subsistence agricultural production provides only a small part of food requirements (Ruel et al., 1998;



Louw et al., 2007; Baiphethi and Jacobs, 2009). Most food consumed in households is purchased or comes from food aid and assistance, which in turn is also often sold.

This study, with a similar study conducted in Niger (Holt et al., 2009), also highlighted the importance of livestock as a source of household wealth, and explains why food crises often occur even during good harvests. Households sell the food they produce on the market to buy staple cereals. Food price spikes can drastically alter the terms of exchange; in other words, households cannot buy enough food with what they are able to sell.

Food price spikes particularly affect low and middle-income countries, where households spend a

far higher proportion of their income on food than in high-income countries. For example, in Indonesia, 46 percent of household expenditure goes to food, compared with only 6 percent in the United States of America (IFPRI, 2011). National food markets are closely correlated with global markets. Rising and volatile global food prices therefore impact directly on food security and vulnerability in low-income countries. During the 2005 food crisis in Niger, for example, malnutrition was highest in areas with abundant production and was driven largely by a spike in the price of millet—driven by the dynamics of the export market to Nigeria.

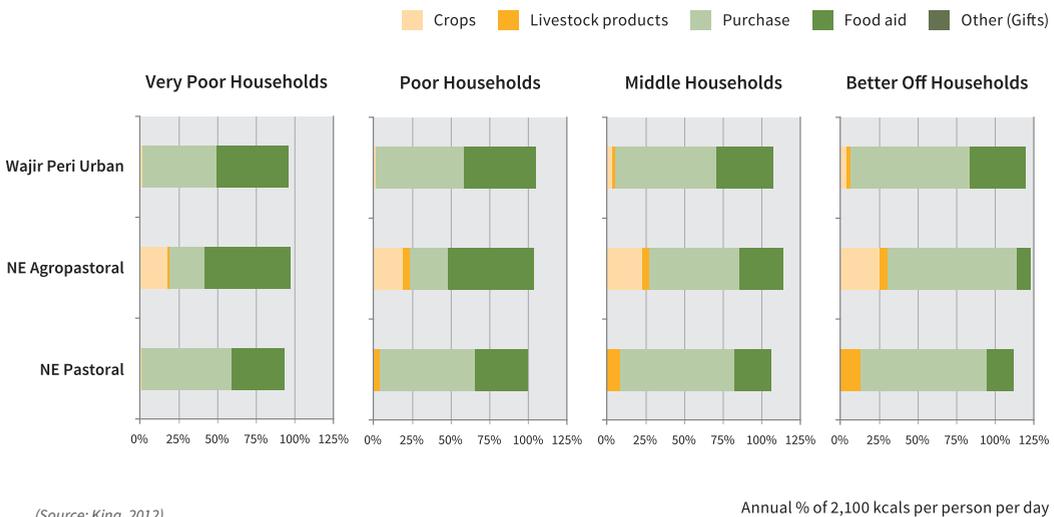
Similarly, an estimated 18.4 million inhabitants in the Sahel faced a food crisis in 2012. However, cereal production in the region in 2011 was only 3

**Box 10.2** Understanding the underlying causes of food insecurity and malnutrition

The Household Economy Analysis (HEA) tool is a livelihoods-based survey designed to provide a clear and accurate representation of household economies. The analysis is conducted at different levels of a wealth continuum, in different livelihood zones across a region of a country, assessing the cost of diet (COD), energetically and nutritionally.

An analysis (below) carried out in October 2012 in the most drought-affected areas in Kenya shows a high dependency of households on purchased goods and food aid; illustrates the resilience deficit; and explains the slow recovery after the 2011 food crisis (Fig 10.15).

**Figure 10.15** Source of food per livelihood zone and wealth group in northeast Kenya



(Source: Save the Children International)

percent lower than the average of the previous five years, and 2010 had seen a bumper harvest (Gubbels, 2012). As Box 10.3 highlights, food crises can occur even in growing economies.

By increasing farmers' income and assets, improving agricultural production contributes to reducing hunger in rural areas. However, data from the Sahel and the Horn of Africa show that child malnutrition rates are not related to general food availability (Burchi et al., 2011). Despite this recognition, there is a tendency in food security policies to focus on food production as a main solution (Bouis and Welch, 2010).

The root causes of food insecurity in regions such as Africa are therefore less related to agricultural drought as to chronic vulnerability and the underlying development deficit (Gubbels, 2012). For example, during the 2010 Sahel crisis, the case-load of severe acute malnutrition (or SAM) in Niger, the epicentre, was 320,000 children (IASC, 2012). A year later, in 2011, Niger had exceptional rains and a record agricultural harvest. However, the case-load of SAM dropped only slightly, to 307,000 children (Ibid.).

Because households depend so heavily on purchases or aid, food markets heavily mediate food crises. Rising retail food prices are a particular problem for low-income countries and low-income households, more generally. When examining annual food price inflation rates over the past 10 years, one can conclude that they have been both higher and more variable in low-income countries than in OECD countries (OECD and FAO, 2012). This is caused partly by the greater weight of basic food in the con-

sumer food basket in low-income countries.

In some countries, such as Kenya, overall food production has been increasing owing to higher productivity and despite increasing agricultural drought (Erian et al., 2012). In other countries, such as Niger, production has increased through developing new cultivated areas and owing to improved rainfall, relative to the 1980s (Ibid.). However, many African countries are heavily dependent on imports for the main staple foods (Mkumbwa, 2011). As Figure 10.16 shows, national production is increasingly surpassed by consumer demand, with projected unmet consumer needs in East African countries by 2020 potentially increasing by 75 percent.

Between the early 1970s and early 2000s, East Africa's import dependency ratio for cereal food commodities grew from 6 percent to 20 percent (Mkumbwa, 2011), leaving consumers—in particular low-income groups—vulnerable to price hikes of staple cereals (see also Box 10.3). A key challenge for countries in today's globalised food system is that increases in food production at the national level are no longer directly linked to food security. At best, the relationship is indirect; at worst, it does not exist at all.

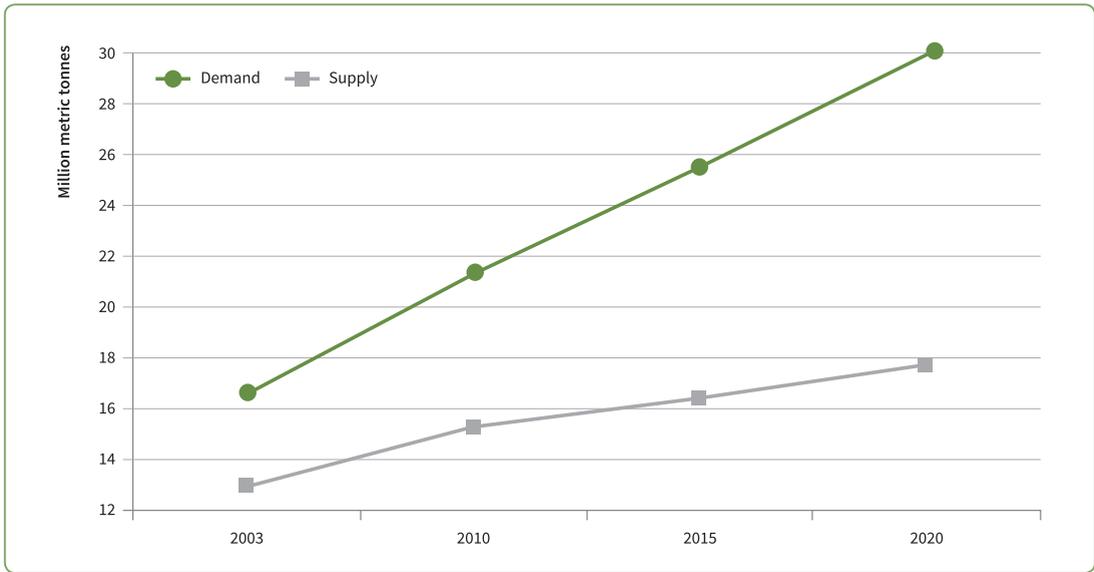
The import and trading of cereal crops is determined not only by national production deficits, but also and importantly by government food and trade policies, such as import protection and domestic agriculture support policies, and export taxed or bans. National food supply deficits are often subject to adjustments of regional and international trade imbalances. For example, Malawi in 2012, de-

#### Box 10.3 Price increases and food insecurity in Ethiopia

Ethiopia is one of the fastest growing non-oil producing economies in Africa (African Development Bank, 2012); in 2011, the economy grew at 11.4 percent, marking the eighth consecutive year of rapid growth. In 2012, the country witnessed significant rises in food prices, e.g. wheat by 20 percent and maize, the main staple food, by 80 percent (FAO, 2012a). As a result, and despite its strong economic performance in agricultural production for export (coffee), the same year saw 3.2 million people registered in need of humanitarian assistance (FAO, 2012b).



**Figure 10.16** Future supply and demand for East African Countries



(Source: Mkumbwa, 2011)

spite a bumper harvest of 3.2 million tonnes of maize compared with a national consumption of 2.4 million tonnes, announced an export ban to rebuild the national reserve. This narrowed the options of countries with a food deficit, such as Kenya, to secure maize imports at the reduced 25 percent import tariff within the Common Market for Eastern and Southern Africa (COMESA) as opposed to a 50 percent tariff on imports from non-COMESA members.<sup>xii</sup>

## 10.7 A way forward? Another approach to agribusiness investment

**Policy and practice that continues to prioritise humanitarian assistance over long-term investment in increasing smallholder productivity and access to markets is becoming increasingly unviable. New partnerships between farmers, governments and agribusiness companies are emerging that may more effectively strengthen the resilience of local producers and markets.**

For decades, existing policies and practices in Africa seem to have been focused, on the one hand, on

promoting export-oriented, commercial production in more favourable areas that have access to more reliable rainfall, inputs, roads and markets. They still rely today, on the other hand, on international humanitarian assistance to buffer food insecurity among smallholder farmers and pastoralists. Given the internal and external risks posed by large agribusiness investments, on the one hand, and continued food insecurity, despite decades of massive investment in humanitarian assistance, on the other hand, a new approach is urgently required. National and regional efforts, such as the Ethiopian Government’s Productive Safety Net Programme described in GAR11, aim to address this challenge, but remain exceptions to an overall trend of stagnant policies and investments.

There is a massive disproportion of spending on reducing disaster risks and strengthening resilience, which over the last decade (2000–2009) accounted for only 1 percent of total overseas development assistance (ODA) in the 40 countries receiving the highest humanitarian aid (Kellet and Sparks, 2012). Humanitarian assistance has been continuously high over the last decades (see Figure 10.17), but is increasingly unsustainable and has become part of

the continuation of disaster risk and food insecurity rather than part of the solution.

FAO (2011a) estimates that roughly one-third of food produced for human consumption alone (not counting animal feeds that take 37 percent of grain production) is wasted. Another study shows that potentially 30–50 percent of all food produced never reaches a human stomach (IMECHE, 2012). The causes of food losses in low-income countries are mainly connected to financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities, infrastructure and packaging and marketing (FAO, 2011a). In medium and high-income countries, which contribute more to food waste than low-income countries, food loss tends to occur at the consumption stage.

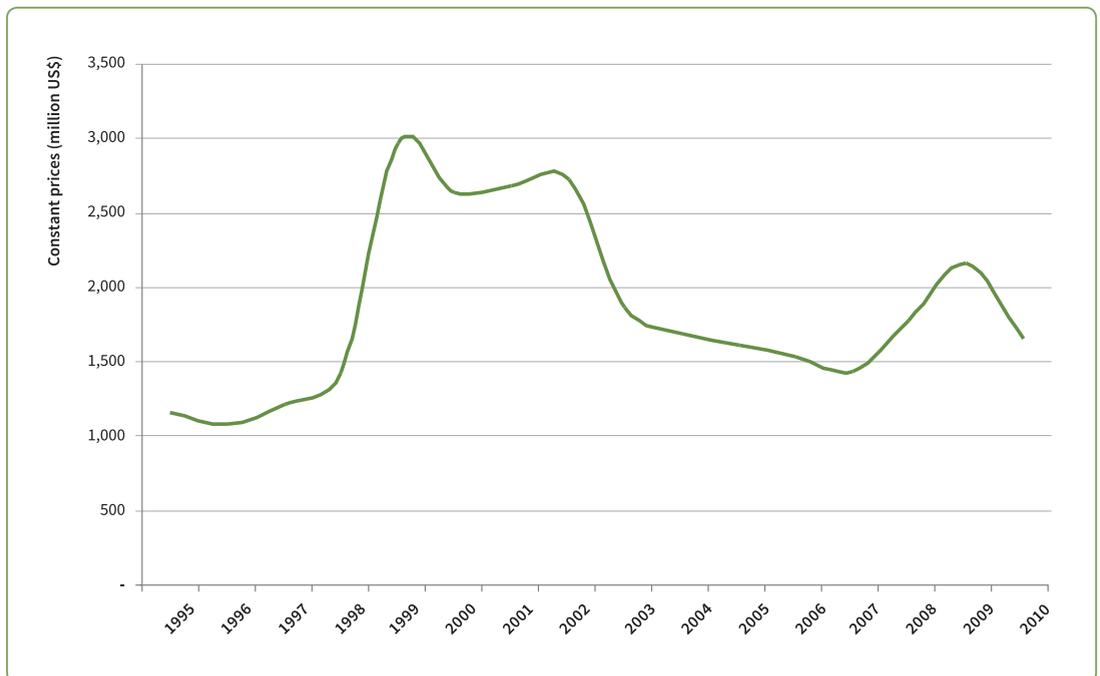
Given the dependence of food-insecure households on purchased food, investments in global logistics to reduce food waste and efforts to change consumption patterns, coupled with improving access to food for low-income households, may do

more to increase global food security than any further investments in the intensification of production (Fava Neves, 2011; Maxwell and Slater, 2003; Webb et al., 2006).

Investments to address infrastructure deficits may also contribute to increased food security. In Africa, for example, a persistent infrastructure deficit is a key determinant of low productivity and trade. Less than 4 percent of sub-Saharan Africa’s arable land is irrigated—a much lower proportion compared with South Asia (almost 39 percent) or Latin America and the Caribbean (11 percent) (Yumkella et al., 2011). Supplemental irrigation, which allows earlier planting in appropriate time, would dramatically increase yields in those areas.

And as Table 10.1 shows, Africa’s infrastructure networks consistently lag behind those of other low-income countries. In such contexts, damage to infrastructure from even small and localised disaster events, such as floods, can have severe implications for the resilience of smallholder farmers as well as

**Figure 10.17** Overseas development aid flows for food aid and food security



(Source: UNISDR, based on data from OECD Creditor Reporting System<sup>38</sup>)



big companies owing to major disruptions in market access.

Agriculture promotion policies should be carefully designed. For example, instruments—such as input or insurance subsidies—can, on the one hand, reduce vulnerability of producers and other actors in the agricultural value chain, but, on the other hand, may increase overall vulnerability of the local agricultural system by facilitating production on marginal lands and possibly increasing drought exposure (Hazell and Hess, 2010).

New partnerships between smallholders, local and national governments and large agribusiness companies may pave the way for a longer-term strategy that effectively strengthens the resilience of smallholder farmers. More and more companies are recog-

nising the business opportunities inherent in addressing existing agricultural challenges (see Box 10.4).

Owing to rising agricultural commodity prices, some multinational agribusiness corporations are now seeing opportunities to invest in improving the productivity and strengthening the resilience of smallholder farmers.

As Box 10.5 highlights, although still controversial, commercial initiatives are providing technology and outreach to smallholder farmers for food production in regions with high potential and where limited gaps in infrastructure, markets and production deficits may relatively cost-effectively relieve some risks to natural and human capital. At the same time, investments by major global corporations raise new concerns regarding the use of genetically modified

**Table 10.1** Infrastructure deficit of Africa’s low-income countries

Normalised Units	Sub-Saharan Africa low-income countries	Other low-income countries
Paved road density	31	134
Mainline (telephone density)	137	211
Generation capacity	37	326
Electricity coverage	16	41
Mobile density	55	76

(Source: adapted from Foster and Briceno-Gardena, 2010)

**Box 10.4** Creating shared value in agriculture in India

In India, Jain Irrigation Systems, the largest manufacturer of irrigation systems and a leading fruit and vegetable processing business, developed a micro-irrigation system based on the principle of drip irrigation that was appropriate for smallholder farmers and that reduced water usage by 30 percent compared with commonly used flood irrigation systems (Borgonovi et al., 2011). Targeting small farmers with less than 1 hectare of land, the company has developed a significant new market and claims to have grown at a compounded annual growth rate of 41 percent from 2005 to 2010 (Borgonovi et al., 2011).

Another example from the subcontinent is a public-private partnership (PPP) that seeks to address farmers’ vulnerability to volatile commodities markets. Gramin Suvidha Kendra (GSK) has established partnerships with a variety of private companies, non-governmental organisations and government institutions, such as the state postal departments, to provide farmers with agricultural inputs and expert advice as well as information on storage, financing and futures prices; the latter via the Multi Commodity Exchange of India Limited (MCX), a founding partner of GSK. First surveys of participating farmers indicate real success, with 57 percent of farmers reporting the successful use of MCX futures prices for their cropping decisions and 66 percent claiming productivity increases owing to access to improved seeds and fertilisers.

(Source: UNISDR)

seeds and the creation of monopolistic dependence. This is despite growing recognition that in future, new developments in biotechnology for plant breeding to address the challenges of an increasingly changing climate will be required.

The 2008 World Development Report on Agriculture reported strong synergies between agribusiness, agriculture performance and poverty alleviation (World Bank, 2008b). Strong links between agribusiness and smallholders via effective government policy can reduce rural poverty and increase resiliency if they are successful in promoting components critical for small farm production as well as commercial agriculture (Figure 10.19).

Agribusiness companies usually seek to do this via a combination of partnerships to increase opportunities for technology transfer, contract farming and hybrid schemes of small and large-scale farming.

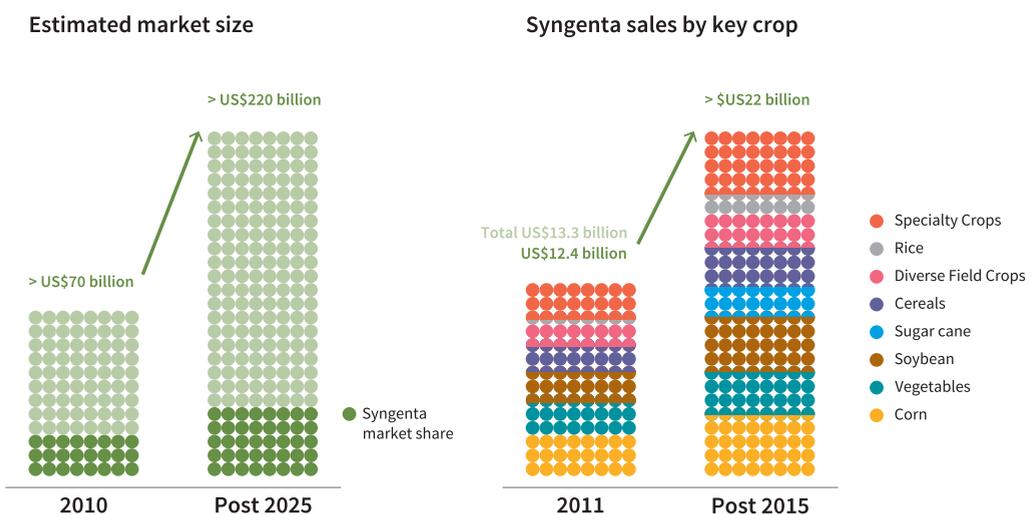
Many of the elements in this approach are already well known and have been successfully demonstrated to produce results: agro-ecological approaches to agriculture, which can increase productivity, strengthen resilience and conserve natural capital (Pretty, 2006; Altieri, 1987); decentralised natural resource management (Sekar, 2000); investments in infrastructure and development of markets that link smallholders to modern national and international supply chains (Le Courtois et al.,

**Box 10.5** Agribusiness investing in smallholders

Syngenta—a world leader in crop protection—recognises the productive regions of sub-Saharan Africa as a market that is vast and virtually untapped. In 2012, its CEO announced plans for a significant investment in smallholders across Africa.<sup>xiv</sup>

More than 75 percent of maize production is currently provided by small farmers in the region (FAO, 2011b). By treating smallholders as individual firms, Syngenta has committed to enter into partnership agreements with them, providing the full package of required inputs, technical services, insurance and knowledge to create viable smallholders. As smallholders get access to key inputs for increased productivity, Syngenta will invest to increasing the size of the market and with it, its overall market share (Figure 10.18), possibly creating shared value for both groups.

**Figure 10.18** Syngenta estimated global market size and crop sales



(Source: Syngenta)

2010); social protection, through conditional cash transfers and temporary employment programmes (Farrington et al., 2008; Devereux, 2003; UNISDR, 2011); and parametric crop insurance schemes (see example in Box 10.6).

But for approaches like these to be viable, an enabling policy environment will be required, involving all institutions engaged in property and land-holding registration, environmental protection and land-use departments as well as business regulators (Fava Neves and Alves Pinto, 2012; Hill and Pittman, 2012).

In Brazil, for example, the government has been successful in promoting substantial private investment into food and non-food agricultural production by creating incentives through a mixture of infrastructure improvements and policy instruments (Box 10.7).

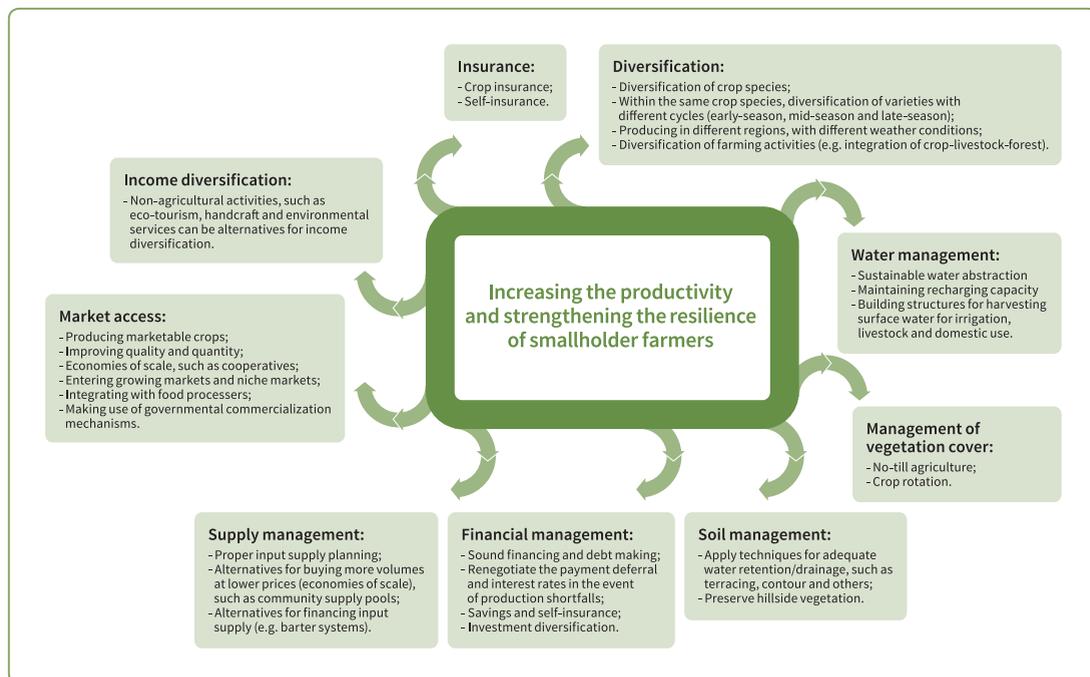
For government departments concerned with increasing growth and investment, the challenge is to present an approach as a competitive advantage in the context of stimulus packages for agribusiness

investments, such as the provision of local infrastructure; the regulation of environmental protection as well as human resources; taxation policies; and research and development (Fava Neves, 2011). Although Brazil was successful in attracting significant investment in agribusiness, the opening up of lands to national and foreign investors, for example in the Amazon region, has also resulted in large-scale deforestation (Cattaneo, 2002).

As highlighted in Chapter 6, improved modelling of agricultural drought and other hazards, together with down-scaled climate scenarios can provide an evidence base that would encourage informed investments by the agribusiness sector and more relevant and effective public policy decisions by governments.

Increasing agricultural productivity and resilience alone will not eliminate food insecurity for highly vulnerable rural households who rely on purchased food and aid. However, by increasing the value and quantity of crops smallholder farmers are able to

**Figure 10.19** Components for improving the resilience of smallholder farmers



(Source: UNISDR, based on Fava Neves and Alves Pinto, 2012)

**Box 10.6** The future of index-based insurance—the R4 Rural Resilience Initiative

The challenge of how insurance of property and assets can be relevant and affordable to low-income communities has triggered a number of micro-insurance initiatives over the last two decades (UNISDR, 2009 and 2011). Some of these instruments, such as index-based crop insurance schemes, have enjoyed remarkable success across the globe. However, even these targeted programmes rarely reached the most vulnerable of low-income populations—those with no land or productive assets to insure.

An innovative partnership between Swiss Re., a major global reinsurance company, the UN World Food Programme, and Oxfam, a large international development organisation, is testing and developing a new set of integrated tools to reach some of the most vulnerable populations in Africa. Building on the success of HARITA, the first micro-insurance scheme to offer poor farmers to pay for crop insurance with their own labour, the R4 Rural Resilience Initiative seeks to improve approaches to targeting and financing to mature the programme into a commercially viable option that is accessible to the poorest. Success will depend on a number of factors, not least the functioning of the partnership between public and private actors in this scheme. To date, although these innovations have shown promising results in reaching farmers for which normal insurance schemes are out of reach, such programmes have had to rely on heavily subsidised premiums and have not yet been scaled up to a level that would prove their viability and sustainability.

*(Source: Spiegel and Satterthwaite, in Orie and Stahel, 2012)*

**Box 10.7** Like moths to a flame—attracting private investment in agriculture through electricity

Secure energy supply is crucial for some agribusiness activities, as energy is necessary to operate pumps in irrigation systems, ventilators in poultry farms, cooling systems for the storage of some fresh food such as milk and meat, etc.

In 2000, about 10 million or 80 percent of smallholder farmers in Brazil had no access to public power supply (Government of Brazil, 2010). From 2003 to 2010, the government invested heavily to change this, and by 2010, the budget for this initiative had reached R\$20 billion (Ibid.). By September 2011, 14.2 million people had been reached.<sup>xv</sup> Hand-in-hand with this investment, a new policy on the creation of Production Community Centres, in which private investment was sought and supported, was established.

*(Source: UNISDR)*

sell and by reducing the risks of crop loss and yield reduction, it is possible to increase income, which in turn will allow farmers to purchase more food and increase reserves for lean periods, building theirs and society's resilience to disasters.



## Notes

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**i** Category of ‘Developing countries’ as used in OECD and FAO, 2012.

**ii** OECD and FAO (2012) explain that the decrease of stock ratio in rice is mainly caused by a contraction in China and India from the extraordinarily high inventory levels of recent years.

**iii** Years based on the FAO Food Price Index: <http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/>

**iv** “Stuck on dry land,” Financial Times (Analysis), 31 July 2012.

**v** [http://www.cpc.ncep.noaa.gov/products/expert\\_assessment/seasonal\\_drought.pdf](http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.pdf);

[http://US\\$a01.library.cornell.edu/US\\$a/current/CropProd/CropProd-11-09-2012.pdf](http://US$a01.library.cornell.edu/US$a/current/CropProd/CropProd-11-09-2012.pdf);

<http://www.fao.org/worldfoodsituation/wfs-home/csdb/en/>;

<http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/>;

[http://www.ers.US\\$a.gov/topics/in-the-news/us-drought-2012-farm-and-food-impacts.aspx](http://www.ers.US$a.gov/topics/in-the-news/us-drought-2012-farm-and-food-impacts.aspx);

[http://www.US\\$a.gov/oce/commodity/wasde/latest.pdf](http://www.US$a.gov/oce/commodity/wasde/latest.pdf).

**vi** <http://landportal.info/landmatrix>; accessed 18 February 2013 only using land deals in relation to agricultural production.

**vii** <http://www.morningstar.com/earnings/21927995-bunge-ltd-bgg4-2010.aspx?pinde=2> (accessed 21 February 2013).

**viii** <http://www.morningstar.com/earnings/21927995-bunge-ltd-bgg4-2010.aspx?pinde=3> (accessed 21 February 2013).

**ix** <http://reports.weforum.org/global-risks-2012>.

**x** FAO Aquastat, [www.fao.org/nr/water/aquastat/water\\_use/index.stm](http://www.fao.org/nr/water/aquastat/water_use/index.stm).

**xi** ‘Virtual water’ refers to the amount of water that is used by one country by consuming goods produced somewhere else. At country level, this water is neither accounted for in the population’s consumption nor in the country’s water demand. In the countries where the goods are produced, this ‘virtual water’ is subtracted to the local consumption. As this ‘virtual water’ is often not accounted for, the water balance for these producing countries might not capture correctly the sources of shortages.

**xii** COMESA = Common Market for Eastern and Southern Africa. Source of data: Agritrade, 12 February 2012 <http://agritrade.cta.int>.

**xiii** <http://stats.oecd.org/index.aspx?r=543569>.

**xiv** Verbal communication during Naivasha Drought Experts meeting, October 2012.

**xv** [http://www.brasil.gov.br/energia-en/light-for-all-program-1/what-it-is/br\\_infografico?set\\_language=en](http://www.brasil.gov.br/energia-en/light-for-all-program-1/what-it-is/br_infografico?set_language=en).





## **Part III**

# **Business Strategies and Risk Governance**

Business investment decisions are not taken in a vacuum. Seasoned investors weigh possible profits and risks, deciding whether to spread risk through insurance and how to manage uncertainty. Investors—private and institutional—operate similarly in an attempt to maximise return on investment. Insurance companies seek to price risk so that market share and profitability are maximised; risks are managed; and insolvency avoided. National and local governments also compete to attract investment while attempting to manage associated risks and costs.

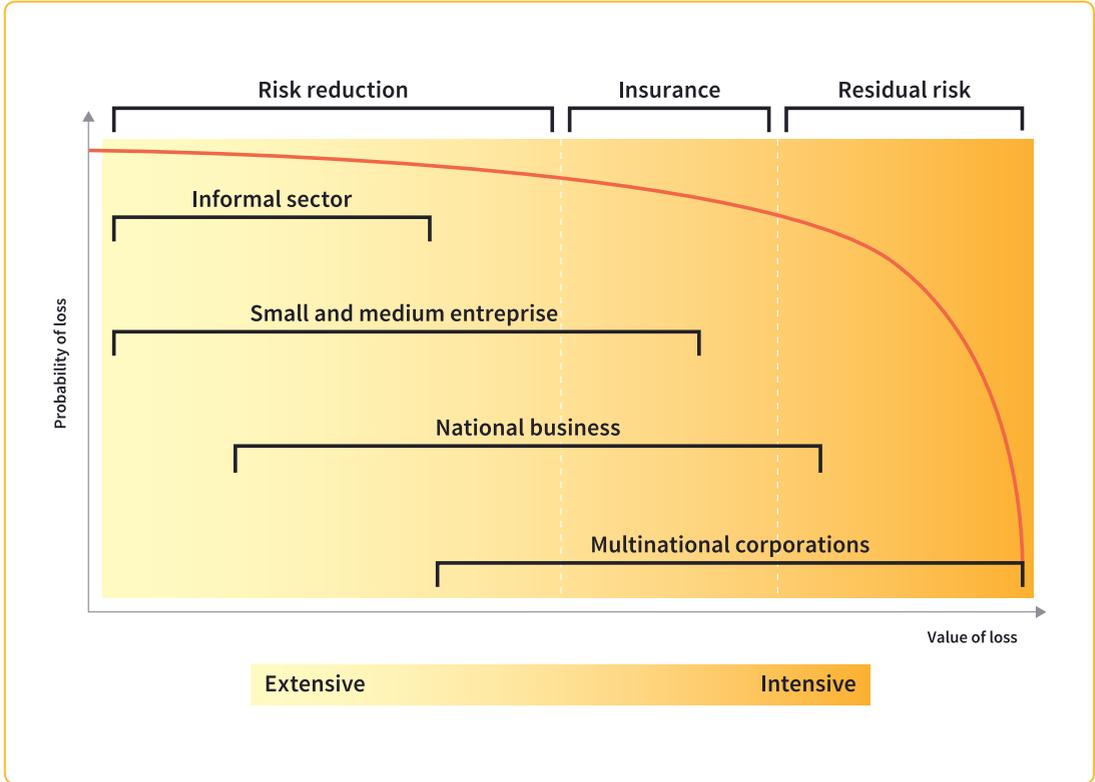
These competing interests created tension, which requires the stakeholders involved to negotiate perceived trade-offs. But recently, the concept of shared value and its focus on the interdependency of business, investment, insurance and public regulation and service provision has been recognised as a more mature approach to competitiveness (Porter

and Kramer, 2006 and 2011). When considering the different types of risk and risk layers as laid out in the first part of this report, businesses—ranging from small informal traders to large multinational corporations—may be impacted differently, but will all have an interest in bringing down risk levels and strengthening resilience.

For example, a small shop owner in an informal settlement who is most likely unable to take out individual insurance on his dwelling and stock will have a vested interest in his settlement’s association and municipality to maintain electricity, water supply and drainage systems in case of local floods.

Although the CEO of a large diversified global consumer goods company may not be too concerned about the flooding of one of its numerous plants located in the same municipality, the local manager will have a vested interest in uninterrupted local

**Figure III.1** Risk layers, differentiated impact on and relevant risk management strategies for business



(Source: UNISDR)

power supply and functioning local transport to ensure that his client base as well as his workforce is maintained.

Similarly, although a large national company will have adequate insurance covering its main assets, its operations are equally vulnerable if its local small suppliers are vulnerable to highly frequent, localised events. Thus, effective reduction of extensive risk, if translated into more resilient infrastructure and communities, also reduces risk to larger businesses (Figure III.1).

In the same way, national and local governments that effectively reduce the more extensive layers of risk protect not only their infrastructure investments and avoid growing liabilities for vulnerable communities, but also contribute to an increasingly business-friendly and enabling environment that attracts larger investments.

In the context of shared risks, how businesses, governments, investors and insurers perceive and assess disaster risk influences business decisions to invest in hazard-exposed areas. But equally, it can potentially motivate investments in reducing risks and strengthening resilience, thus creating a shared value for all stakeholders.

This subject will be the focus of Part III of this report. Chapters 11 to 13 look at the different ways that businesses, the finance sector and insurance industry consider disaster risks in their investment decisions. Chapters 14 and 15 then consider how different forms of risk governance mediate, regulate and provide incentives to these processes.





## Chapter 11

# From Managing Disasters to Managing Risks



**Business decisions to invest in hazard-exposed areas are seldom irrational. They usually reflect a search for spearheading competitiveness and increasing productivity by taking advantage of the comparative advantages offered by such locations.**

**Businesses have yet to systematically include disaster risk considerations into this process of weighing opportunities and risks. The integration of these considerations into corporate risk management functions is still incipient even in large businesses; and awareness of how these risks can be effectively managed is even lower.**

## **11.1 Managing new risks: disasters on the horizon**

**Risk management in the business sector continues to focus on financial, economic and legal risks. Disaster risk is still not considered fully even in large companies; and small enterprises usually do not undertake systematic risk assessments.**

In recent years, large businesses—particularly those with global operations—have become increasingly sensitive to the different risks that may affect their operations. Most large businesses employ a dedicated Chief Risk Officer and some have dedicated risk management departments. Increasingly, overall responsibility for risk management is at the C-Suite executive level, such as Chief Financial Officers (CFOs) or Chief Executive Officers (CEOs) (Deloitte, 2012).

However, the focus of corporate risk management is centred on financial, economic, market and legal risks. Although business surveys highlight an increasing imperative to manage risks, disaster risks are rarely considered. In recent surveys, despite the impact of recent major disasters, disaster risk is not listed in the top 10, 20 or 50 risks identified (Deloitte, 2012; Lloyds, 2012; Forbes, 2012; PwC, 2012).

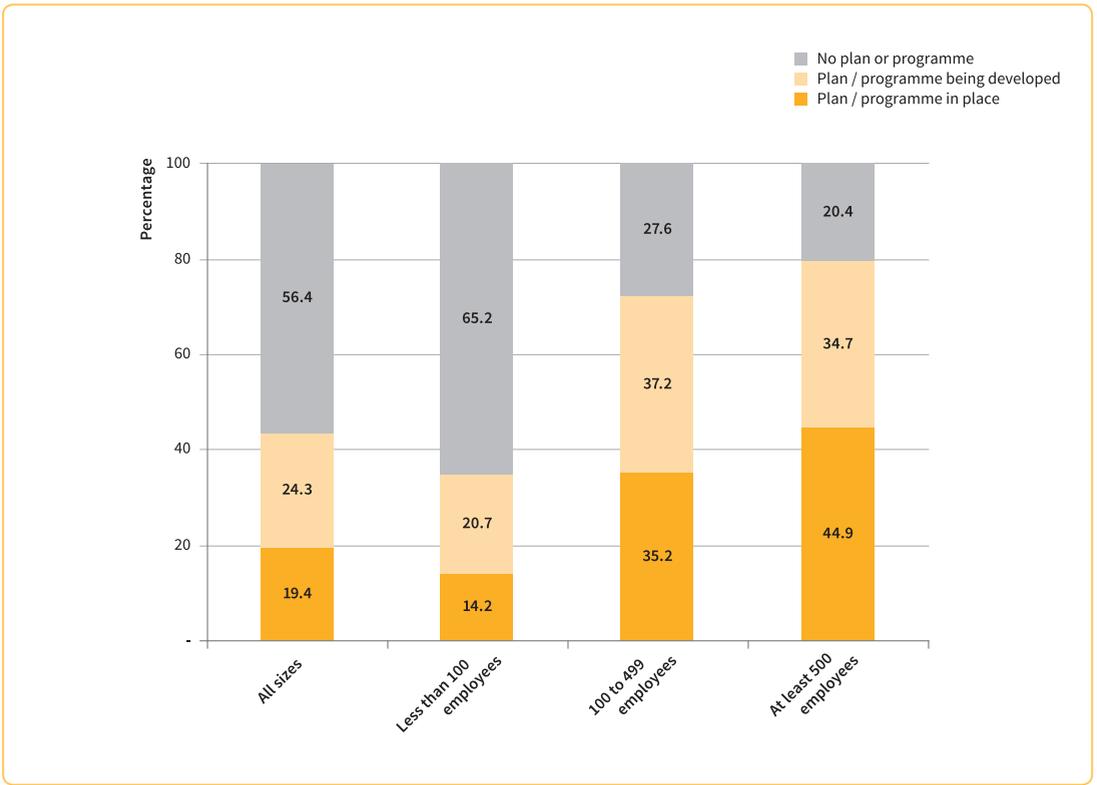
This practice is also reflected in curricula of many business schools. For example, courses on Risk Management for Corporate Leaders at Harvard Business School and the University of Oxford's Global Risk Investment Management Programme usually deal with risks such as credit risk, currency risk and reputation risk, but few schools explicitly include disaster risk in their risk management curriculum.

### **Box 11.1 Managing risks of local public entities through public-private partnerships (PPPs)**

In 2011, one of the world's leading consulting and insurance brokerage firms engaged in open dialogue with local and national governments on how to integrate disaster risk management practices into public risk governance structures. Marsh Risk Consulting, part of the Marsh and McLennan group, subsequently developed practical guidance for local governments on the adoption of the ISO Standard 31000 to their policies, practices and administrative structures (Marsh, 2011).

Recognising that the ISO standard neither explicitly mentions disaster risk nor lends itself easily to the functions of public administration, this initiative has brought principles of private sector risk management and public sector planning processes closer together. Perhaps more important, it has articulated clearly the need for proactive planning and risk assessment beyond the usual focus on response preparedness and contingency planning. Citing the example of the largest leaser of social housing in France, the Caisse des Dépôts Group (SNI), Marsh highlights that this conglomerate carries out systematic risk-benefit analyses ahead of any new investment (Marsh, 2011).

**Figure 11.1** Percentage of companies with business continuity plans or crisis management programmes (by company size)<sup>v</sup>



(Source: Sarmiento and Hoberman, 2012)

Similarly, international standards are not yet fully articulating disaster risk dimensions. For example, although the ISO 31000 standard on risk management can be adapted to any type of risk, it does not explicitly highlight disaster risk.<sup>i</sup> This gap has been identified, and companies are taking initiatives to address it (see Box 11. 1).

After witnessing large disasters, global businesses are now beginning to consider how to manage disaster risks. For example, a 2011 poll of 1,000 senior global executives highlighted that 29 percent had been financially affected by the 2011 Great East Japan Earthquake and accompanying nuclear disaster (PwC, 2012). And 24 percent of these were taking measures to strengthen their risk management capacities (Ibid.).

In another poll, 90 percent of businesses stated that they had suffered weather-related disaster impacts

over the last three years. Of these, 53 percent were now investing to strengthen risk management—for example, protecting operations and offices and bolstering supply chains (UKTI, 2011).

Supply chain resilience has attracted particular attention because risk has increased through globalisation (see Chapter 2 of this report). Factors that influence supply chain vulnerability include: dependence, for example, to what extent is the supply chain dependent on one single supplier; visibility, to what extent is the supply chain risk visible; and design information portability and substitution, how quickly can design information be transferred from one affected supplier to another and how quickly can production be resumed at the substitute supplier (Fujimoto, 2011).

Many smaller businesses, however, face a challenge in addressing disaster risk. Having an emergency

plan in place is key in explaining business performance after major events (Corey and Deitch, 2011), but, as Figure 11.1 shows, a survey carried for this report in six disaster-prone cities of the Americas<sup>ii</sup> highlighted that less than one-fifth (19.4 percent) of all surveyed businesses had a business continuity plan, and in highly risk-prone cities such as Bogota and San José, the percentage was even lower. Similarly, almost one-fourth was unable to estimate costs of a major disruption to their business (Sarmiento and Hoberman, 2012). In fact, although many methods and tools exist to measure the value and exposure of business interruption, there are difficulties in assessing this fully against other dimensions that need to be considered, i.e. time, revenue and costs.<sup>iii</sup>

In particular, small and medium enterprises (SMEs) are more likely to lack risk awareness or struggle to find the capacity to manage disaster risks, mainly owing to financial, human resource and technical limitations (Wedawatta et al., 2010; Corey and Deitch, 2011; Battisti and Deakins, 2012). Of companies with at least 500 employees, about 45 percent had a business continuity plan or crisis management programme in place, but companies with less than 100 employees, as few as 14.2 percent had a plan (Figure 11.1).<sup>iv</sup>

These findings are validated in other regions (Villaruel, 2012). SMEs are often more vulnerable per se and more likely to be located in less-resistant buildings and have a smaller, more localised customer base (UNDP, 2013; Battisti and Deakins, 2012). They usually do not engage in hazard management programmes and lack financial resources for recovery (Villaruel, 2012; Vitez, 2009).

Few SMEs have been able to articulate the case for or to strengthen their capacities to manage disaster risks. Where the case has been made, however, emphasis is on preparedness, such as evacuation plans and response measures, rather than on prospectively managing disaster risks (Sarmiento and Hoberman, 2012; UNDP, 2013). Very small and family-owned businesses—for example, fishing enterprises in low and middle-income countries—face even tighter constraints on their ability to invest in risk reduction. However, as Box 11.2 explains, certain simple measures have enabled businesses to survive disasters.

**Box 11.2** Successfully reducing losses on the coast of Yucatan, Mexico

Hurricane Isidore struck the southeastern coast of Mexico in 2002, resulting in economic losses of US\$500 million on the Peninsula of Yucatan. Of this, US\$8 million were estimated damages to the fishery industry, mainly from loss or damage of fishing boats and boat motors. The hurricane severely impacted small producers and holders of small ruminants, chicken and pigs. Learning from this experience, farmers and fishermen with the support of local governments developed risk management strategies to reduce future losses. These included safeguarding fishing equipment, such as boats and motors, and relocating farms to safe areas.

The local government of the municipality of San Felipe purchased land two kilometres from the shore and distributed it to 60 small producers. Although farmers remained in their original villages, they moved their livestock to safe ground. Similarly, fishermen negotiated access to cattle trucks and storehouses 15 kilometres inland where they could keep their fishing equipment safe. These strategies saved them approximately US\$35,000 per fisherman when in 2005, Hurricane Wilma hit.

Neighbouring municipalities have since adopted these risk-reducing strategies; it has been estimated that each municipality has saved about US\$6.5 million.

(Source: Cuevas, 2012)

### Box 11.3 New attitudes to risk in large global businesses

Global consulting firm PricewaterhouseCoopers and UNISDR are collaborating on a global initiative to better understand and support disaster risk management in the private sector. In-depth conversations and 11 risk management workshops with 14 large companies with a global footprint and therefore increasing risk exposure took place (Table 11.1).

**Table 11.1** Companies participating in a global initiative on comprehensive disaster risk management for national businesses and global corporations

Company	Country	Industry
ABB	Switzerland	Industrial Products
ARUP	India	Structural Engineering
BG - British Gas	United Kingdom	Energy, Mining
Citigroup	United State of America	Financial products and services
GE - General Electric	United State of America	Conglomerate - Infrastructure and Finance
HCC - Hindustan Construction Company	India	Infrastructure
HIRCO	India	Real Estate investment
Hitachi	Japan	Conglomerate - Infrastructure and Finance
IHG - InterContinental Hotels Group	United Kingdom	Hospitality
Nestlé	Switzerland	Nutrition, Health and Wellness
NTT - Nippon Telegraph and Telephone	Japan	Telecommunications
Roche	Switzerland	Healthcare
SPCL - Shapoorji Pallonji & Co. Ltd	India	Construction
Walmart	United State of America	Retail

(Source: PwC, 2013)

A few initial trends and new approaches can be identified. Senior managers consistently acknowledge that disasters have impacted their operations, and will continue to do so, with dire consequences in the future. They also recognise that indirect losses, through supply chain interruptions, can be as severe if not worse than direct losses. However, shared risks and costs represented by the wider and macroeconomic impacts of disasters are not yet fully considered.

Few global corporations collaborate actively with national and local governments across the countries in which they operate. But there is also concern among business managers that an in-depth engagement with governments may delay processes and obstruct effective business operations. There is, however, ad hoc collaboration and information sharing among industry peers.

Disaster risk management focus in most corporations remains centred on business continuity planning. Most businesses are engaging in some form of disaster risk assessment and management for their supply chains, and are increasingly moving towards the setting of risk management standards, which suppliers have to comply with.

Some corporations rely on the insurance industry for risk information and assessments, and most have only limited access to disaster risk models and information. This limits their disaster risk awareness or capacity to factor this information into investment decisions.

To date, disaster risk management usually falls under the responsibility of dedicated supply chain management functions rather than as an integral part of business development and investment planning. However, a shift is taking place where companies are moving strategic consideration of disaster risk to the level of senior management and advisory boards.

(Source: PwC, 2013<sup>61</sup>)



# 11.2 Emerging practices

**Global businesses have risk management strategies for their own assets and operations in place. Owing to recent experience, a number are now demanding risk assessments along their supply chain. But only a few are beginning to take the lead on a broader approach to disaster risk.**

New perspectives on business risk management are emerging, however. In the case of global corporations, additional consultations carried out for this report indicate a gradual shift in perspective. As Box 11.3 highlights, large global businesses are starting to move from a narrow focus on business continuity planning towards a broader approach to prospectively manage their disaster risks. However, these changes are still incipient and are only reflected in more recent (three-to-four year) risk management policies.

This gradual widening of focus from business continuity planning to a more comprehensive and strategic approach to disaster risk management mirrors developments in the public sector where central planning and finance ministries begin to assess disaster risks and integrate disaster risk considerations into national planning and accounting processes (UNISDR, 2011). Unfortunately, there are still few channels or forums for joint public-private en-

agement to agree on policies, strategies and plans to manage disaster risks or to develop appropriate risk governance arrangements.

In addition, where corporations have a global remit, their incentives to engage with local or national regulators and actors may be limited. Through diversifying their supply chains in different industry sectors they may, on the one hand, increase their vulnerability to disaster risks in specific locations; on the other hand, they may spread their risks and increase their room to manoeuvre in times of crises or when facing tough regulations in particular locations.

A number of large global businesses are now demanding risk assessments from small businesses that are key suppliers. A few companies have successfully combined enhanced information of potential disruptions, supply chain and financial impact with simulations of disaster events to reach a more comprehensive understanding of risk drivers and geographical concentration of risk as a basis for their supply chain management (Box 11.4).

But disaster risk management has also been recognised as a business development opportunity, particularly because of long-term climate change. A recent study of SMEs in Germany shows that the range of products and tools for risk management—particularly in flood management, which businesses already market—is significant and has the potential to

**Figure 11.3** Company risk management strategies



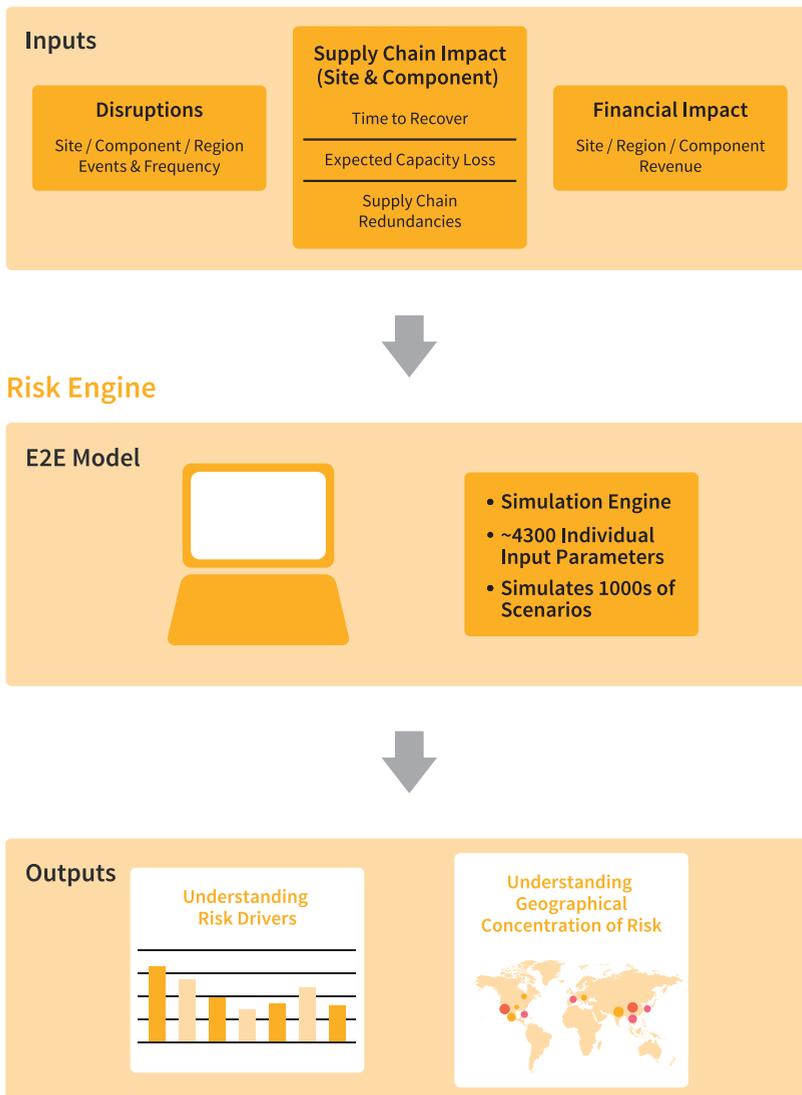
(Source: PwC, 2013)

**Box 11.4** Cisco's comprehensive, proactive risk management programme

Learning from the impact of the Chengdu earthquake of 2008, Cisco, one of the largest global providers of networking equipment, has developed a sophisticated supply chain crisis management system that allows it to proactively manage disaster risks to its assets and operations. Including its worldwide network of supply chain partners, the company combines business continuity planning information with supply chain visibility and disaster risk data, identifying hotspots before and during a crisis (Harrington and O'Connor, 2009).

The use of a risk engine enables Cisco to assess the likelihood of supply chain disruptions and to generate heat maps based on likelihood and impact (Figure 11.2). This engine incorporates complex datasets, including data on flood risk, geology and geopolitics, supplier performance, as well as actuarial data (Ibid.). This tool provides the basis for accumulation of comprehensive information on drivers, trends and patterns of risk and thus for success of Cisco's resilient supply chains.

**Figure 11.2** Risk engine used by Cisco



(Source: Adapted from Harrington and O'Connor, 2009)

expand and include prospective risk management (DKKV, 2012).

A number of businesses also recognise the value of collaborating and sharing their knowledge and expertise with the public sector (PwC, 2013). However, although several joint initiatives exist, mid- to long-term collaboration both among the private sector and with the public sector are isolated, insufficient and at early stages of maturity (Ibid., 2013). One limiting factor is the lack of familiarity and leverage of private sector skills and know-how by public institutions; as a result, existing initiatives on each side are not well aligned, and collaboration remains an untapped opportunity to date (Ibid.).

Businesses usually employ four distinctive strategies—similar to those considered by governments or communities—to manage exposure to risks, depending on their risk appetite and exposure profile (Figure 11.3).

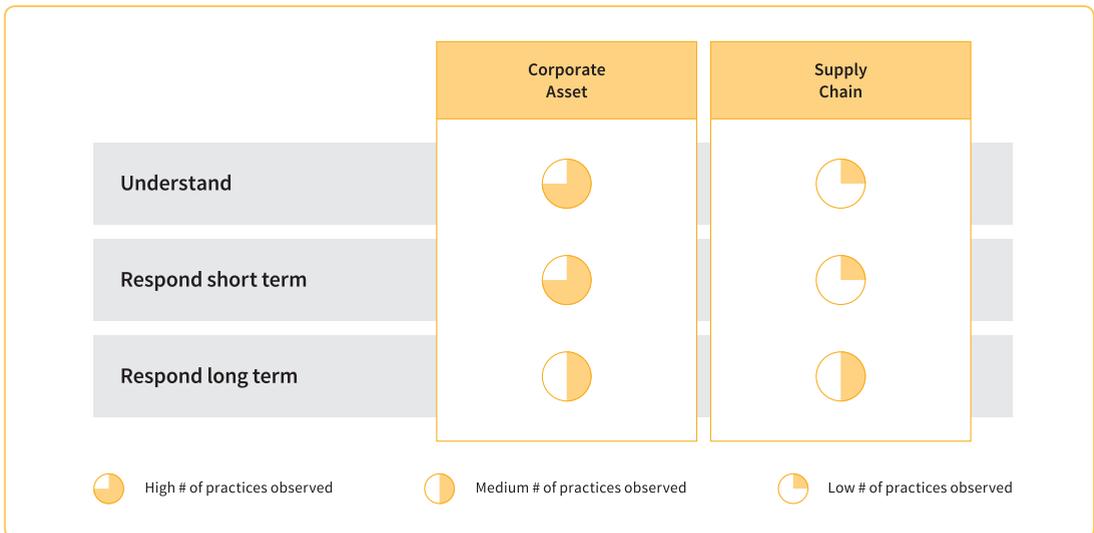
However, when global corporations were asked about their existing disaster risk management strategies, many show low levels of maturity vis-à-vis long-term risk reduction and prospective risk management (PwC, 2013; and Box 11.4 above). This

means that although there are good practices to be shared in understanding and responding to immediate risks to corporate assets, longer-term risks and risks to supply chains are less well understood (Figure 11.4).

Unsurprisingly, levels of maturity in understanding asset exposure and associated risks vary significantly. Although many companies rely on insurance providers to conduct risk assessments of their major assets, innovative examples exist. One of the global corporations consulted for this report creates ‘heat maps’ of each of its sites by overlaying company data on hazard and risk maps, setting up global risk standards and creating local compliance registers in line with the company’s global risk standards (PwC, 2013).

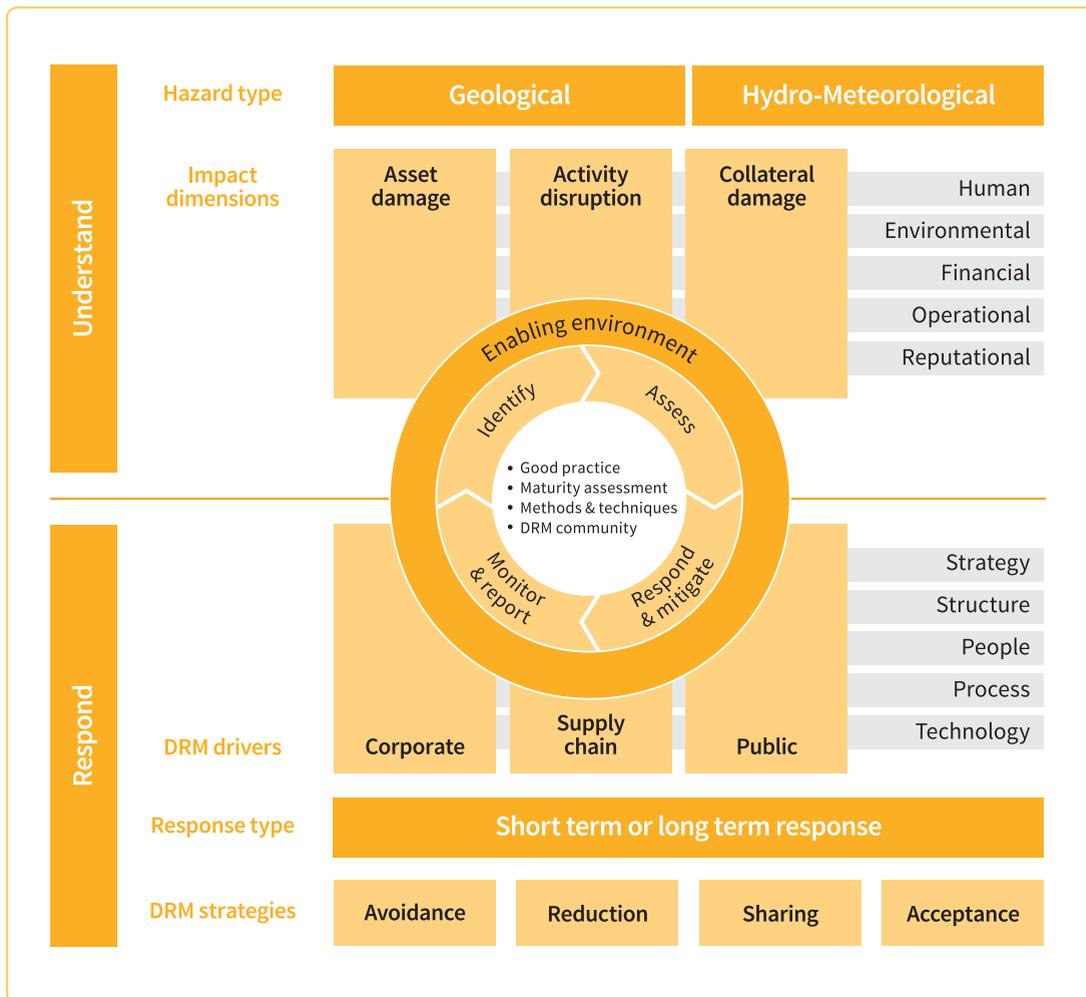
In addition, a process of positive and negative incentives and regular annual audits ensures increased and monitored levels of compliance (Ibid.). New initiatives towards developing integrated disaster risk management frameworks for the private sector (Figure 11.5) are promising steps in the direction of more effective business and public-private risk reduction.

**Figure 11.4** Level of maturity using number of good practices as a proxy



(Source: PwC, 2013)

Figure 11.5 Towards a disaster risk management framework for the private sector (under development)



(Source: PwC, 2013)

Notes

- i However, there is a promising sign that ISO 22301 Business Continuity Management may address disaster risk more directly, including a proactive approach for disaster reduction.
- ii This survey, carried out by Florida International University (FIU), York University and the Central American Institute for Business Management (INCAE), covered Vancouver, Canada; Miami, United States of America; Kingston, Jamaica; San Jose, Costa Rica; Bogota, Colombia; and Santiago, Chile.
- iii Dempsey, Myers and Company: Business Interruption Values and Exposures. Quinnipiac University, 14 June 2006: [http://www.google.de/url?sa=t&rct=j&q=dempsey%20myers%20%26%20company%20business%20interruption%20time%20revenue%20cost&source=web&cd=1&ved=0CCwQFjAA&url=http%3A%2F%2Fwww.theccc.org%2FCustomer-Content%2FWWW%2FCMS%2Ffiles%2F2nd\\_session2.ppt&ei=d\\_0wUzn0CoSotQaf1lDIDw&usg=AFQjCNHIS\\_NnrBRx-YiDdvfZ0iNB9buJA](http://www.google.de/url?sa=t&rct=j&q=dempsey%20myers%20%26%20company%20business%20interruption%20time%20revenue%20cost&source=web&cd=1&ved=0CCwQFjAA&url=http%3A%2F%2Fwww.theccc.org%2FCustomer-Content%2FWWW%2FCMS%2Ffiles%2F2nd_session2.ppt&ei=d_0wUzn0CoSotQaf1lDIDw&usg=AFQjCNHIS_NnrBRx-YiDdvfZ0iNB9buJA).

- iv A similar survey carried out for Japanese companies just after the Great East Japan Earthquake reports that the reasons for lack of BCP in 2,865 SMEs were lack of know-how (42.1%), lack of need (35.3%), lack of human resources (33.1%), lack of time (26.35%) and lack of financial cost (22.1%) (Teikoku Databank, Ltd, 2011, <http://www.tdb.co.jp/report/watching/press/pdf/k110601.pdf>).
- v Total N is 1,198 with n=939 for less than 100 employees, n=210 for 100–499 employees, and n=49 for 500+ employees.
- vi Additional information directly provided by PwC based on workshop discussions and internal reports.



## Chapter 12

# Risk Blind Investing



Financial markets have expanded since the 1980s, but the **right incentives to integrate disaster risk management into business investment decisions have not been provided.**

Investing has become an increasingly short-term and speculative activity, **losing sight of longer-term and systemic risks.** At the same time, asset owners and beneficiaries of pension and sovereign wealth funds have become **increasingly disconnected** from how their money is being invested, **weakening responsible and accountable investment behaviour.**

Risks, including **disaster risks, are rarely visible, hidden in complex and opaque financial instruments.** And analytical reports, models and **forecasts ignore disaster risk.** This has a profound effect on the way investment markets operate, building up new **hidden risks in private finance.**

## 12.1 Deregulation and expansion of financial capital

**The inherent logic of expanding and increasingly fast-moving capital markets has created new risks that materialised with severe global effects in the financial crash of 2007–2008. Disaster risk is another hidden risk that financial markets are still ignoring.**

The deregulation of financial markets since the 1980s has stimulated a staggering increase in the volume of financial capital linked to increasingly short-term investment behaviour and speculation (UNCTAD, 2011). By the end of 2010, total value of financial assets across the globe had reached US\$212 trillion (comprising equity market capitalisation and outstanding bonds and loans).

At the same time, financial capital has been concentrated in a limited number of large institutions and in a largely unregulated ‘shadow banking system’ (UNCTAD, 2011). This shadow banking system is a complex value chain of intermediaries, including investment banks, hedge funds and equity funds and instruments that enable assets to be moved around the world through a large number of financial instruments that enable investment in physical assets as well as in production and services (Ibid.). The scale of this shadow banking system has become so vast that by early 2008, it was estimated that assets under its management in the

United States of America alone amounted to almost US\$20 trillion (Ibid.).

The financial market has developed the ability to respond and adapt quickly to benefit from short-term profit-making opportunities. However, markets are more challenged to account for longer-term risks and liabilities or for systemic risks, as has been demonstrated in the financial crisis that began in 2007 (Clements-Hunt, 2012; Ritter 2004).

Recent surveys of investors’ perceptions and incentives for investments in low-income countries and emerging markets have revealed the following top catalysts—market size or access, human resources and domestic institutions, banking services, and political and economic forecasts (WEF, 2012; IIGCC, 2010; Bhinda and Martin, 2009). Perceived risks do not include the likelihood of loss owing to disasters but rather electricity supply constraints, corruption, interest rates, inflation and tax-related issues (Bhinda and Martin, 2009; UNCTAD, 2011).

The number of investors who explicitly consider how investments produce disaster risks remains unknown, particularly in the case of large hedge funds, government bonds and commodities (IIGCC, 2010). And the business case for risk-neutral investment is often undermined by uncertainties about public policy response (e.g. the price of carbon; land-use and zoning regulations; insurance legislation) and even, despite amassed evidence to the contrary

(IPCC, 2012), by a “lack of confidence in the materiality of climate change” (Ibid.: p.29).

## 12.2 Hidden risks in the institutional investment value chain

**Investors and their fund managers are far removed from the consequences of the investment decisions they take, all but erasing effective accountability. In addition, the increasing complexity of investment products and trading systems has resulted in an opaque system that creates hidden risks, including disaster risk.**

The institutional investment value chain includes institutional investors such as pension funds, mutual funds, sovereign wealth funds, hedge funds, insurance funds and private equity; and intermediaries, such as investment banks, asset managers and investment consultants (Cambridge Programme for Sustainable Leadership, 2011a).

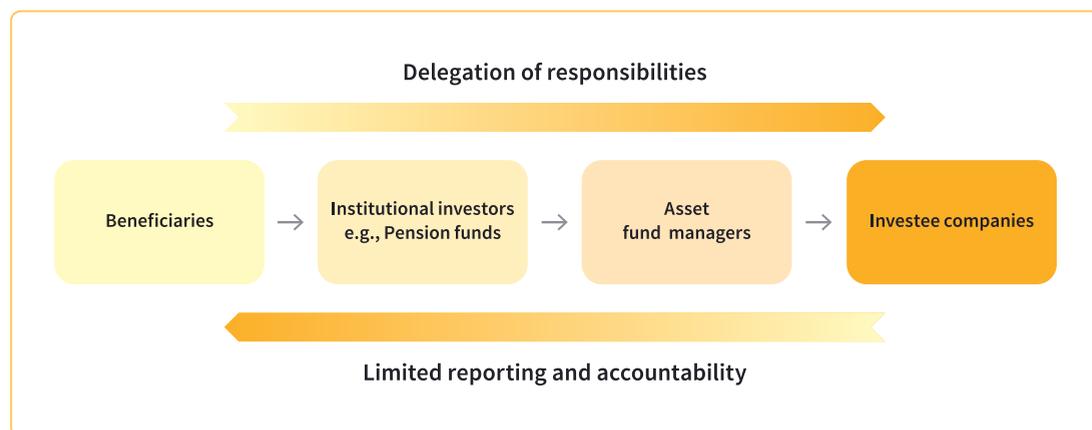
Institutional investors manage assets worth more than US\$80 trillion globally (Ibid.) on behalf of hundreds of millions of beneficiaries such as employees, in the case of pension funds; national citizens, in the case of sovereign wealth funds; premium holders, in the case of insurance funds; and rich in-

dividuals, in the case of foundation-based or high net worth wealth managers (Clements-Hunt, 2012). Figure 12.1 highlights how this value chain delegates responsibility for investment decision-making through a diverse ecosystem of intermediaries with only limited mechanisms for reporting and accountability back to beneficiaries or first investors.

Although intermediaries ultimately have a fiduciary responsibility vis-à-vis original investors (beneficiaries), their primary role is to identify investment opportunities that benefit from a certain level of risk and return. These investments are made across a range of financial instruments, including the trading of stocks and bonds. In particular, trading activity in so-called over-the-counter (OTC) markets significantly outweighs turnover on closely regulated and more transparent public stock markets (Clements-Hunt, 2012).

Asset managers rarely consider disaster risk when making investments. The increasing distance between these managers and beneficiaries means that the latter are increasingly disconnected from how their investment portfolios are being managed, including how much is at risk from disasters. And because the financial market has become increasingly disjointed from the real economy, it generates a further disconnection between asset managers and how the invested money is ultimately used.

**Figure 12.1** The institutional investment value chain (simplified)



(Source: UNISDR, adapted from Clements-Hunt, 2012)



Through TIAA-CREF, the leading US financial services company and the main provider of retirement services for US academic and research sectors, a number of pension funds, including from Sweden and Canada, have begun to invest heavily into farmland development across the globe<sup>1</sup>. Direct investment into agricultural production on commercial farms in South America and Africa produces high returns. As Chapter 11 in this report highlighted, these investments may not only internalise risks to the business, but also by extension to the investor. They may also externalise risks, for example, to displaced smallholder farmers and pastoralists or through the overexploitation of land and water resources.

Another big institutional investor, TLG Capital, announced in October 2012 its investment in an agricultural fund—EmVest—which manages more than 10,000 hectares of land across sub-Saharan Africa. TLG and EmVest have invested about US\$65 million across the region and are expecting to expand<sup>ii</sup>.

Recently, however, TIAA-CREF joined a number of European institutional investors to launch the Farmland Principles—a commitment to not invest in deals with high environmental or social costs or rights violations (Grain, 2012), suggesting that social demand—expressed in the United States of America and Europe through campaigns against investment strategies—can create disincentives.

(Source: UNISDR)

As the volume of financial capital has ballooned, so have the hidden risks—as the financial crisis that began in 2007 manifested. The increasing sophistication, complexity and opaqueness of financial instruments means that securities and bonds for businesses with high levels of disaster risk are bought and sold without considering how these risks may affect asset values (Clements-Hunt, 2012).

Even where risks are recognized and their impact on a particular asset is considered, willingness to invest in the asset can prevail because part of the risk tends to be transferred to the public sector or to other sectors and countries, and thus becomes shared risk. In other words, the risk is considered an externality for the business and therefore to the investment. For example, global investment in emissions-heavy industrial activity, such as coal mining, continues to increase—in 2010, total investment by banks in coal mining was almost double the amount before the financial crisis (Petherick, 2012).

Much of this investment is hidden within complex and aggregated corporate loans, funded by large funds or banks whose individual investors rarely know what specific activities are being financed

(Ibid.). Beneficiaries in high-income countries with well-established pension funds may unknowingly be benefiting through transferring disaster risk to countries most at risk or, as the example in Box 12.1 shows, by investing in agricultural practices that increase drought risk.

## 12.3 Eyes wide shut: consistently discounting disaster risk

**Economic growth projections and business forecasts at different levels do not account for disaster risks. The implications of disasters on a country's fiscal policy, infrastructure and utilities, and overall enabling business environment are not understood with potentially serious consequences for business investment decisions.**

The global crisis that began in 2007 demonstrated that investment decisions that are rational from an individual perspective can generate correlated and systemic risks to the financial system as a whole (Castells et al., 2012). Because investment decisions tend to be based on broadly similar risk models, analyses and forecasts, markets tend to become increasingly correlated and concatenated and hence

the risk increasingly systemic. By mid-2009, global wealth valued at US\$28.8 trillion, captured in equity and real estate values, had been lost in the resulting meltdown (McKinsey Global Institute, 2009).

In the same way, and as the Thailand floods epitomised, individual business investment decisions in hazard-exposed areas can, over time, generate systemic global disaster risks. The preceding years of profit-oriented investment may have resulted in 2011 as the year with the largest disaster-related economic and insurance losses ever (Orie and Stahel, 2012; Ferris and Petz, 2012; Worldwatch Institute, 2012). Investors seem to underestimate or are blind to systemic risk, whether associated with

sub-prime mortgages or hazard-exposed industrial estates (White and Fan, 2006).

Information on the economic risks associated with disasters, climate change or water scarcity is readily available. In 2002, for example, a group of financial institutions predicted that economic losses associated with disasters and climate change would amount to US\$150 billion per year (UNEP FI, 2002). This figure was surpassed just three years later, when Hurricane Katrina hit the US coast in 2005. In 2007, a revised scenario was developed that predicted potential losses owing to climate change of US\$1 trillion per year by 2040 (UNEP FI, 2007).

**Box 12.2** No more forecasting blind spots—applying future risk lenses

The Economist Intelligence Unit (EIU), one of the world's leading institutes for economic, political and social analysis, provides, among other information services, economic forecasts, risk and country briefings to businesses and public sector actors alike. These briefings and underlying data are widely used and globally referenced, and thus have a substantial level of influence on the public understanding of future risks and economic projections. These country and sector forecasts do not include risks associated with natural hazards, as the methodology of the EIU explicitly excludes assessments of future hazard and risk.

For example, the 2012 country report of Indonesia, one of the world's highly hazard-prone countries, does not address disaster risk at all (EIU, 2012a). The 2012 Kenya country report addresses drought risk more clearly. However, it is not integrated in the economic forecast model. Instead the report describes that policy-making will remain vulnerable to exogenous shocks, which include drought and volatile commodity prices, and continues to warn that droughts would pose downside risks to GDP growth forecasts, calculated at 4.8 percent for 2013 (EIU, 2012b).

However, specific analysis that is tailor-made for individual clients may include disaster risk analysis upon request. Further, in the aftermath of a disaster, regular country reports do refer to these events and their impacts on economic performance. For example, in case of Haiti, which was recently hit by tropical storms, including Hurricane Sandy, and is still in the reconstruction process, the country report addresses disaster risk in several places. Thus, the economic impact of past disasters caused, for example, by agricultural loss or physical capital damage is woven into the economic forecast, but the probability of future disaster risk is not (EIU, 2012c).

Although excluding disaster risk from standard forecasts may seem surprising from a disaster risk manager's point of view, from the perspective of an economic forecaster, it makes good sense. For example, the short time period of forecasts—two years in the case of EIU forecasts—means that including disaster risk probabilities is a tricky exercise.

New developments in probabilistic risk modelling and assessments, however, and increasingly sophisticated concepts of resilient economies and supply chains in the business sector could change this trend and help the emergence of a new generation of economic forecasts. The EIU has recognised the significant impact that disaster events can have on economic and business performance and is therefore considering an integration of relevant indicators for disaster risk into its models (EIU, 2012d). Although in its infancy, this process could greatly enhance the understanding of other dimensions of economic and business resilience than those currently dominating and limiting investment decision-making.



**Box 12.3** Forecasting risk—lessons from Thailand?

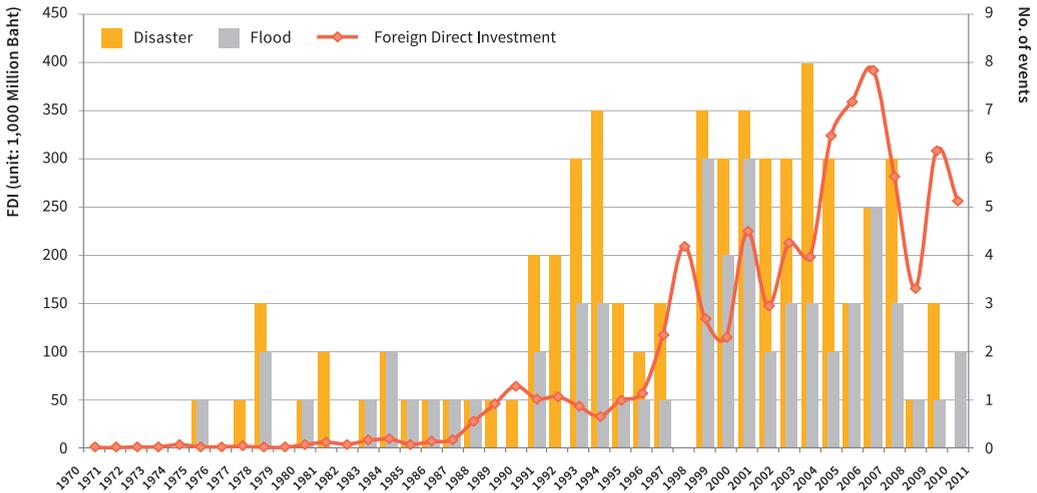
In October 2011, only a few weeks before the country’s economy was engulfed by the Chao Phraya river floods, the EIU, a major source for country risk profiles generated by businesses and investors across the globe, forecast an expansionary fiscal policy of the Thai Government for 2012 and estimated GDP growth of 3.8 percent in 2011 to 4.8 percent in 2012 (EIU, 2011a).

After the floods shut down more than 14,000 businesses nationwide, this estimate of real GDP growth was revised downwards to 2.5 percent in November and to 1.2 percent in December (EIU, 2011b & 2011c; Atradius, 2011). Political and related policy forecasts had to be revised also owing to expected repercussions from the floods.

A few months earlier, an investor country briefing by a major bank, based heavily on EIU data, did note that the export-heavy Thai economy was “very vulnerable to external demand shocks” (Rabobank, 2011), and had been affected by the Japan disaster in March 2011. Yet its growth projections for Thailand in 2011 remained unchanged.

An empirical study of the relationship between foreign direct investment (FDI) flows and the occurrence of disasters over the last 40 years in Thailand shows that investment has not been influenced by disaster occurrence in general, and floods in particular (Figure 12.2; Thampanishvong, 2012).

**Figure 12.2** FDI and disaster occurrence in Thailand from 1970 to 2011



(Source: Thampanishvong, 2012, based on data from Bank of Thailand and EM-DAT)

However, other studies covering 94 countries over a 20-year period have found a negative and significant relationship between disasters and FDI (Escaleras and Register, 2011).

In Thailand’s 2012 economic forecast briefing, flood risk is mentioned, suggesting that the “perfect storm of factors that combined to produce the floods in 2011” were not in place for 2012 (EIU, 2012e). Yet, it cautions that the risk of renewed flooding had not disappeared and notes that investor confidence had not been restored, exacerbated by intra-government conflict over water management and flood drainage between the city of Bangkok and surrounding areas.

(Source: UNISDR)

Public domain global disaster risk information developed for the GAR has been available since 2009<sup>iii</sup> and similar information published since 2004 (UNDP, 2004; World Bank, 2005). Commercial risk models are also produced for the insurance industry.

But this information is not generally included in business surveys, economic forecasts and country briefings that guide investors and credit ratings. Even in high-risk countries, disaster risk is rarely mentioned, contrary to quality and availability of labour, access to export markets, political and economic stability and incentives, such as tax breaks. Forecasters consider disaster risk too uncertain and volatile, particularly over the relatively short periods that are used for forecasting, to allow the integration of expected impacts into economic growth projections (see Box 12.2).

Global reference reports such as the International Monetary Fund's World Economic Outlook and the Organization for Economic Co-operation and Development's Economic Outlook do not include disaster risk into their economic modelling, possibly owing to the difficulty of estimating disaster risk per se and lack of consensus on the possible impact of disasters on economies.

Even in a weather-sensitive sector such as agribusiness, forecasts in 2011 and 2012 did not consider disaster risk-related factors in their projections. Thus, the risk of a global food spike posed by the 2012 drought in North America was not identified (see Chapter 10).

In these projections, other risk factors and uncertainties, such as fluctuating crude oil prices or exchange rates, are considered but disaster risk is not. Despite recent weather-related impacts on global commodity markets, these projections claim to provide "a baseline for further analysis of alternative economic or policy assumptions" and to analyse the conditions for "increasing agricultural productivity in a sustainable manner" (Ibid.).

Similarly, as Box 12.3 shows, even while water levels were rising in Thailand in October 2011, none of the major forecasting agencies and analysts warned of potential impacts on economic activity. This was certainly not because information on flood risk was not publicly available,<sup>iv</sup> but more likely because of a low level of awareness of disaster risk by economic forecasters and risk analysts and the difficulties of incorporating disaster risk-related metrics in their work.

## 12.4 Winds of change

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**Recent efforts of investor groups concerned with climate change have begun to show results with 10 percent of global investment managers now integrating environmental, social and governance (ESG) issues into their investment process (IIGCC, 2010).**

Increasingly, companies, investors and governments are recognizing that more transparency in business practices, the spread of investment portfolios and patterns of natural resources consumption may create opportunities for greater efficiency and effectiveness in business operations (CDP, 2011). Correspondingly, a growing number of resources are available today for companies and investors to assess and disclose physical risks, particularly climate-related risks (Calvert, Ceres, and Oxfam, 2012).

Regulators are also requiring that businesses disclose hidden risks. For example, the Climate Change Act in the United Kingdom in 2008 led to a requirement that companies in the energy, water and transport sectors publish a report on the risks posed by the impact of climate change. And the Canadian Securities Administration (CSA) has issued similar guidance (Calvert, Ceres and Oxfam, 2012). Although currently these requirements only refer to climate related risks, in the future they could also address other disaster risks, for exam-



ple, associated with earthquakes, tsunamis, volcanic eruptions and landslides.

A changing approach to investment is also taking root in some large institutional investors. For example, the Government Employees Pension Fund of South Africa has recognized that the information available and used in each stage of the investment chain is asymmetric. This means that providers of investment opportunity know more than investors and control the information of those whose money they manage (IISD et al., 2012). In addition, regulation is encouraging long-term investors, such as large pension funds, to invest in securities with low risk to ensure liquidity and stability of their portfolios. The South African pension fund is seeking to diversify its portfolio by investing in longer-term development projects across the country (Ibid.).

One of the largest sovereign wealth funds, the Norwegian Pension Fund Global, is another example. It passively invests in more than 8,000 companies worldwide and yet has established standards for environmental, social and governance issues to be taken into account in all of these. However, to quantify the benefits to these initiatives and to estimate the cost of externalized risks is not a trivial exercise, particularly when it comes to valuing natural capital. As a result, performance criteria for investment contracts and loans that take natural capital – and disaster risk considerations – into account have yet to be identified (Cambridge Programme for Sustainable Leadership 2011b). Recent initiatives are now addressing this gap (TEEB, 2010) though there is still a need to link the real costs of externalities such as environmental pollution, the destruction of natural capital or the cost of increased disaster risk.

While these changes still involve a minute proportion of the total value of global financial assets, they do indicate a change in direction. These changing values are now guiding both regulators concerned with reducing systemic risks as well as investors who want to protect their investments against such risks and at the same time avoid making invest-

ments that generate environmental and social costs.

The threat of falling equity prices or negative analyst ratings for businesses that do not manage or disclose their disaster risks may in time become a powerful incentive that rewards those businesses and governments, which more effectively manage those risks.

## Notes

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i [https://www.tiaa-cref.org/public/about/press/about\\_us/releases/articles/pressrelease422.html](https://www.tiaa-cref.org/public/about/press/about_us/releases/articles/pressrelease422.html) and <http://www.top1000funds.com/news/2011/06/08/swedish-fund-goes-farming-for-diversification/>.

ii [http://www.emvest.com/latest\\_news\\_media.aspx](http://www.emvest.com/latest_news_media.aspx).

iii <http://www.preventionweb.net/english/maps/?pid:34&pif:3>.

iv A flood risk model including Thailand has been available since 2009. <http://www.preventionweb.net/english/hyogo/gar/2011/en/what/rdp.html>.

## Chapter 13

# Securing Investment - Insurance Revisited



**Insurance pricing and availability has a major influence on business investment decisions and behaviour. Currently, a number of disincentives work against the adequate pricing of disaster risk: on the one hand, expensive premiums may make investment unattractive; on the other hand, overly low premiums can exacerbate the discounting of future risk, potentially resulting in the creation of new disaster risk.**

In rapidly growing economies, particularly in Asia, insurance penetration is spreading faster than disaster risks are being reduced. The **over-supply of capital through insurance-linked securities** may also distort risk pricing. It also generates fiscal risks when **premiums are not risk-based** and public sector institutions with limited experience of the insurance market are involved.

## 13.1 Creating an enabling environment for effective insurance

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**Insurance can potentially play an important role in disaster risk reduction, but only where the enabling environment allows for appropriate pricing and coverage. Governments and insurance companies are yet to take full advantage of this potential.**

Insurance pricing and availability has a major influence on business investment decisions and behaviour. Unless assets such as factories and other facilities can be insured, businesses cannot obtain loans and other forms of finance. Expensive premiums may make the investment unattractive, making the business look elsewhere. Conversely, however, when premiums are too low, businesses may be encouraged to overly discount the risks and invest in hazard-exposed areas, accumulating disaster risks for themselves and creating wider risks and costs.

Insurance is one of the main financial tools for households and companies to strengthen their disaster resilience. This is achieved by spreading the risk of exceptional disaster loss among a large number of policyholders and over a long time. Insurers compensate disaster damages in return for the premiums each insurance buyer paid ex-ante, in accordance with the agreed contract. Although few financial institutions undertake an overall assessment of disaster risk, most require insurance coverage as a condition for

providing loans to businesses. This chapter will discuss how insurance can be a useful financial tool for businesses and individuals to strengthen their resilience, competitiveness and sustainability.

Although the details of insurance coverage vary widely, insurance rarely guarantees business continuity or protects businesses from the wider impacts of disaster. Insurance can provide protection from asset loss and even supply chain interruption, but does not compensate for wider effects like low employee morale, increased absenteeism, stress or unrest, low productivity, declining customer demand and goodwill, and other impacts (Kataria and Zerjav, 2012). In other words, insurance is not a substitute for sound risk-based investment decisions.

Additionally, the insurance required when applying for a loan does not necessarily cover all hazards, resulting in limited payouts to affected households or businesses and even countries, in the case of national catastrophe insurance. For example, in Australia, an ‘insurance gap’ exists whereby different definitions of flood by insurers limited the insurance payout after the 2010–2011 floods, and brought confusion and frustration among insurance buyers (World Bank, 2011).

Similarly, when governments insure their sovereign risk, instruments such as catastrophe bonds may be effective in avoiding short-term welfare losses and reinforcing macroeconomic stability, but generate no net income. If, following a disaster, income

declines in the long term, the primary gains from the smoothing obtained from reinsurance, contingency loans and catastrophe bonds are obtained by delaying losses (Hsiang and Jina, 2012). Insurance alone and in itself, in other words, does not enable disaster-affected countries to catch up and cannot substitute for investments in risk reduction (Hamdan, 2012).

In principle, insurance should also act as a powerful incentive for disaster risk reduction. An insurance premium should represent the economic value of risk, which in a perfect market would equal the expected loss plus transaction costs (Galegatti et al., 2008). However, perfect markets do not exist and whether owing to an inadequate or inaccurate assessment of risks or to government intervention in the market, insurance premiums do not necessarily reflect a realistic pricing of risk (Nguyen, 2012).

Classic problems surrounding insurance include moral hazard and adverse selection<sup>i</sup>, both related with information asymmetry in the market (Galegatti et al., 2008). If insurance pricing reflects real risk,

insurance can facilitate risk reduction investments, for example, as in the case of the California Earthquake insurance (see Box 13.1 below). When lower premiums are set, for example, for earthquake-resistant properties, this provides an incentive to invest in retrofitting and earthquake-resistant design, thus avoiding moral hazard and adverse selection.

Although risks in developed markets, such as Europe, Japan and the United States of America, are modelled with precision by the commercial risk modelling industry, this is often not the case in new and emerging insurance markets. At the same time, although sophisticated risk models enable the insurance and reinsurance industry to calculate premiums, data from these actuarial models are rarely available to those who purchase insurance policies, generating information asymmetry. The accuracy of loss estimates and the translation of those into premiums cannot be easily verified by the insurance buyers. Developments of public disaster databases and risk models have the potential to start to bridge this information asymmetry (see Chapter 15 for examples).

**Box 13.1** National and regional insurance mechanisms in the United States of America

The US National Flood Insurance Programme (NFIP) provides subsidised flood protection insurance to properties located in designated special flood hazard areas. In addition, the government was not allowed to purchase reinsurance. As a result, it had accumulated debts of US\$17.8 billion by 2007. Legislation requires the NFIP to offer subsidised premiums even to homes that suffer repetitive losses, thus decreasing or negating risk reduction investment for those properties and resulting in an estimated 25–30 percent of claims paid for repetitive losses.

In addition, policy-holders often stop paying their insurance and instead rely on the government's relief support as soon as mortgage lenders, who are supposed to control this, have transferred their account to capital markets and thus lose oversight. In such cases, debt-based private ownership—in this case, housing at risk of flood damage—once again increases public liabilities. The government recognised this problem and in June 2012, passed legislation that will phase out NFIP subsidies on properties with repetitive losses, introduce minimum deductibles as well as allow for a rezoning of areas to correspond more closely to new risk assessments, all which are expected to avoid moral hazard and have positive impacts on risk reduction investment.

In contrast, the California Earthquake Authority has proven a successful public-private partnership (PPP), where risk-based pricing and cost-effective structures have ensured a solvent programme that offers affordable premiums. Actuarially sound methods were used while benefitting from government reinsurance and support. Recently, the adoption of a building code for retrofitting existing structures is trying to link with lower insurance premium offers to lower the cost of insurance in general.

In doing so, a double incentive for insurance purchase and risk mitigation strategies would be created that would ultimately benefit the insurance market, the insured and government budgets.

(Source: *Orie in Orie and Stahel, 2012*)



Governments are critical determinants of the role that insurance markets can play in managing disaster risk. Their interpretation of the social contract of the society they govern shapes the landscape of risk financing and risk management. To develop the insurance market, many governments play the role of regulator, framing how the market works, acts as reinsurer and, in some cases, directly sells insurance to citizens and companies. The latter has the potential to distort premiums, for example, when insurance is subsidised to increase penetration rates. Underpriced premiums that do not reflect risk levels do not provide incentives to invest in disaster risk reduction. When, in addition, governments act as insurers of last resort, this may encourage moral hazard and perverse incentives in favour of investment in hazard-exposed areas (Nguyen, 2012). In addition, it exposes governments and ultimately taxpayers to losses, as in the case of the US National Flood Insurance Programme (NFIP), outlined in Box 13.1.

But there are also other successful insurance products where the premium does not directly reflect expected loss. For example, in the case of parametric insurance, the payout from insurance companies is related to the scale of a predetermined event, such as the severity of a storm and not to the

scale of the loss. Insurers can instantly calculate total payout amount after the trigger event and do not have to evaluate individual loss claims. Parametric insurance gives the insured incentives to invest in risk reduction, given that if losses are reduced they still receive the same payout. It also lets the insured decide how much risk they want to transfer.

If comprehensive risk, exposure and vulnerability models do not exist, as is often the case in many low and middle-income countries, parametric insurance may be easier to implement than conventional insurance. However, it still requires investment in the infrastructure to monitor hazard levels in a way that can produce credible and transparent estimates of the severity of each event. This investment is a prerequisite for the expansion of insurance penetration in low-income economies.

Regional approaches to disaster insurance can offer a solution by pooling not only risks but also resources across a greater area and number of actors. For example, in south-eastern Europe, the South Eastern Europe and Caucasus Catastrophe Risk Insurance Facility (SEEC CRIF) provides homeowners, farmers, enterprises and governments with access

#### Box 13.2 Catastrophe insurance in China

China's insurance penetration is still comparatively low, particularly outside the agricultural sector. This is despite almost two decades of rapid economic growth, usually associated with significant growth in the insurance market (Ranger and Williamson, 2011). Earthquake insurance penetration is only 3 percent across China (Wang et al., 2009) and with typhoons and floods rises to only 5 percent (Swiss Re., 2008). Consequently, insured losses are usually low even following major disasters. After the Huaihe and Yangtze River flooding in 2007, insurance claims only amounted to 6 percent of total estimated loss. And during the Wenchuan Earthquake in 2008, payouts made by the insurance industry only equalled about 1 percent of total losses (Lloyds, 2012).

Insurance regulation can trigger growth in insurance markets, but there are also other types of public policies and regulatory mechanisms that can result in increasing demand and facilitate the effective capital markets required for insurance to operate (Ranger and Surminski, 2011). In China, although public policy is seen as a means to promote insurance in the agricultural sector, no similar approach exists to support development of insurance for the property sector. However, this may change in the coming years owing to continued and growing urbanisation—today, more than 44 percent of the country's population lies in urban areas (Kamal-Chaoui et al., 2009). In 2010, industrial and service sectors accounted for 89 percent of total GDP<sup>iii</sup>, which means that public policies on insurance and reinsurance as part of overall risk governance arrangements can be expected to change.

(Source: Surminski in Orié and Stahel, 2012)

The two major earthquakes that hit New Zealand in September 2010 and in February 2011 generated insurance losses of an estimated US\$17 billion. These losses were a combination of payouts through the country's public residential insurance, the Earthquake Commission (EQC), losses to the commercial sector and losses to residential properties in excess of the EQC, covered by private insurers. The EQC alone faced more than 310,000 claims, with each of the two events drawing the highest number of claims by far in the EQC's 65-year history. The second largest insurer in the country—AMI, with 85,000 policyholders in Christchurch alone—had to be bailed out by the government with an estimated US\$800 million. Insurance claims could not be paid in a timely manner, creating a bottleneck for residents' relocation to safer areas. Therefore, a programme was initiated by the government, in partnership with the insurance sector, in which 80 percent of residents in high-risk areas were allowed to not only sell their land but also to hand over the insurance claim.

Following the two earthquakes, zoning policies and building regulations were revised, including a decision to abandon selected suburbs and depopulate the severely affected and densely built-up central business district of Christchurch. Moreover, the insurance industry announced several important changes, including incapacity to pay out (AMI) and the termination of insurance policies (Ansvar Insurance). As a result, the EQC premiums trebled from early 2012 onwards to reduce the insurance policy's cash shortfall and begin to rebuild its reserves. A major concern, however, is that new earthquakes may hit New Zealand in the coming years, repeating the country's experience between 1929 and 1942, when a series of seven major earthquakes struck.

(Source: Muir-Wood, 2012; IRP, 2012; Canterbury Earthquake Recovery Authority (<http://cera.govt.nz/>))

to affordable catastrophe and weather risk insurance (World Bank and UNISDR, 2010). This regional risk pooling mechanisms is the result of a successful cooperation between a private reinsurer, national governments and international organisations, which continue to support countries to enact appropriate regulatory and policy reforms to enable increasing insurance coverage<sup>ii</sup>.

Historically, one of the main drivers of growth in the non-life insurance market has been increasing income per capita (Feyen et al., 2011; Enz, 2000; Zheng et al., 2008). But it is not the only determinant of how insurance penetration develops within a country. Public policy and regulated insurance markets have proven to be another strong driver towards increasing insurance coverage in countries with limited penetration (Hussels et al., 2005) and may become the main factor of new regulatory responses to climate change (Ranger and Surminski, 2011).

History shows that insurance contributes to disaster risk reduction only in countries with a mature risk management culture (Muir-Wood in Orié and Stahel, 2012). The Netherlands provides a good example.

Investments made in hazard mitigation since the early 17th century now mean that flood mortality is 500 times lower than during the Middle Ages (Van Baars and Van Kempen, 2009).

Until recently, Dutch citizens could not legally purchase flood insurance, which forced the government to ensure flood risk protection levels (Orié and Stahel, 2012). Although this legal barrier has been removed, flood insurance is still not widely available. Discussions to develop a public-private partnership (PPP) for insurance coverage were halted in 2010 as a result of the economic crisis and tightening fiscal space (Ibid.).

In rapidly growing economies, particularly in Asia, insurance penetration is spreading faster than disaster risks are being reduced (Muir-Wood in Orié and Stahel, 2012). This practice increases exposure of the insurance industry to high and growing losses, even if existing risks are accurately modelled, which may not always be the case. In these countries, low insurance pricing, aimed at increasing market penetration or attracting investment, may not encourage risk-averse investment.



On the contrary it may stimulate increased business investment and hence accelerate the accumulation of disaster risk. It also generates fiscal risks when premiums are not risk-based and public sector institutions with limited experience of the insurance market are involved (Orie and Stahel, 2012.). In China, as Box 13.2 shows, insurance penetration in the property sector is still very low.

Recent catastrophes such as the Christchurch, New Zealand, earthquakes and Thailand flooding also have forced the insurance market to reconsider how to price intensive risks and to review their engagement in the market based on principles of insurability<sup>iv</sup>. Major disasters can lead to insurance pricing being revised and availability constrained. In Christchurch, a number of devastating earthquakes in 2010 and 2011 led to a thorough review of the coun-

try's insurance policies and land-zoning regulations (Box 13.3; Muir-Wood, 2012).

In another example, insured losses from the Thailand floods were estimated between US\$15.2 billion (Aon Benfield, 2012a) and US\$18 billion (Orie and Stahel, 2012). Subsequently, insurers and reinsurers have revised their risk ratings, and significant increases in the price of insurance and reduction of coverage are expected (Aon Benfield 2012a; Box 13.4). This could result in a potentially negative effect on foreign direct investment for Thailand but may discourage business investment in flood prone areas.

PPPs have the potential to greatly improve coverage and functioning of insurance markets. For example, in Norway, mortgage lenders are legally obliged to require that property owners purchase fire insur-

**Box 13.4** The role of insurance in private investment promotion and business continuity

About 65–70 percent of insurance losses suffered in Thailand were borne by Japanese insurance companies through local subsidiaries, joint ventures or direct presence in the country (Courbage et al., 2012). Many of these had already paid out large amounts owing to the Great East Japan Earthquake and tsunami (Aon Benfield, 2012b). In spite of significant reinsurance, the three largest property insurance companies announced that their net loss owing to the flood was expected to be as high as US\$5.1 billion as of mid-February 2012.

As a consequence, private insurers and reinsurers began to restrain flood coverage and charge higher premiums owing to the high risk of the country. This created challenges for Japanese companies with facilities in Thailand. As a result, the Japan External Trade Organization (JETRO) and Japanese business association requested the Thai Government to establish a public reinsurance fund to restore business confidence by providing flood insurance and reinsurance<sup>v</sup>. The Thai Government set up the National Catastrophe Insurance Fund in March 2012. However, if insurance pricing does not reflect risk levels, this may encourage rather than discourage increased disaster risk in the country. With the new Fund, these risks are now in effect owned by the Government of Thailand.

(Source: JETRO<sup>vi</sup>)

**Box 13.5** Mexico's MultiCat catastrophe bond

MultiCat Mexico 2009—catastrophic bonds to transfer earthquake and hurricane risks in Mexico to capital markets—was a product of a formal PPP. Swiss Re, one of the world's largest reinsurance companies, acted as co-lead manager and joint book-runner, drawing on its experience in providing insurance in emerging markets. The Mexican Government constructed the Fund for Natural Disasters (FONDEN) and an accompanying loss estimation model (R-FONDEN) to financially and technically underpin the MultiCat transaction. The partnership can be also indirect. According to Swiss Re, the public sector and the insurance industry are 'implicit partners' (Swiss Re, 2011b).

(Source: UNISDR)

ance, which is again legally mandated to accompany natural peril coverage (Orie and Stahel, 2012). Private insurance companies that wish to sell these policies are legally required to join an insurance pool called the Norwegian Natural Perils Pool (NNPP). The premium rate is the same for all insurance buyers, as stipulated by the Pool Board that represents all participating companies. The government manages the NNPP, provides reinsurance, and regulates the payout (Orie and Stahel, 2012). To avoid moral hazard potentially associated with a universal premium rate, insurance companies are allowed to reduce or waive indemnity if the insured cannot show that appropriate measures were taken to reduce the risk of loss (Ibid.).

PPPs, as in the Norwegian case, can ensure high solvency, high penetration rates, and high amounts of accumulated capital reserves. They can also encourage risk-sensitive investment behaviour for businesses. However, care should be taken to maintain appropriate levels of competition among insurance companies, with the public sector focusing on facilitating and regulating the development of insurance markets based on sound risk assessments and

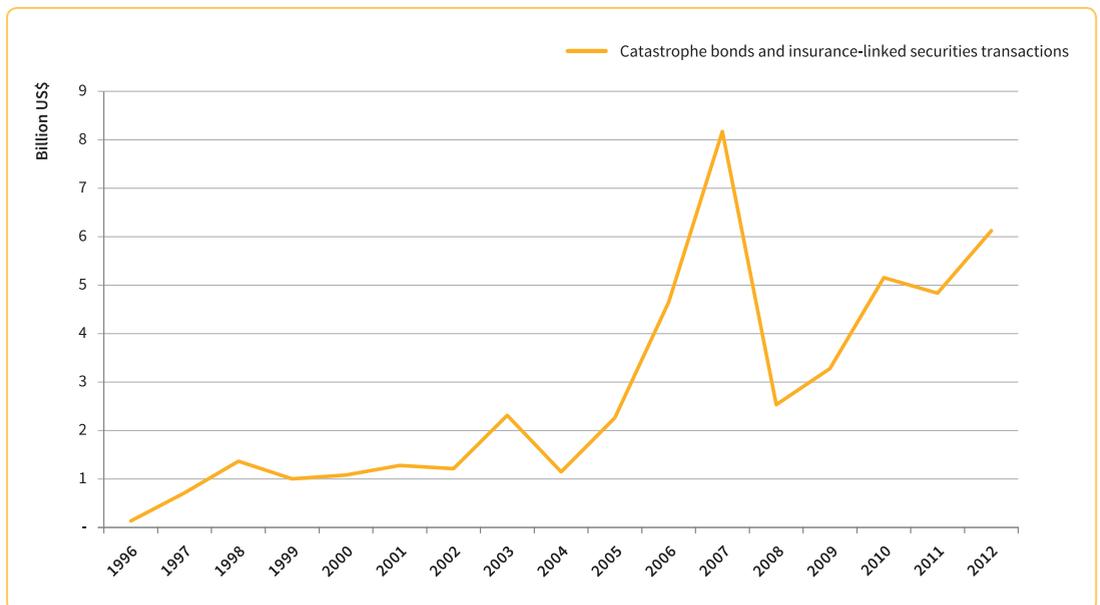
providing an enabling environment for investments in risk reduction. Moreover, it is in the interest of national governments to use strong partnerships with the insurance sector to bolster its own financial liquidity and ensure fiscal stability during major disasters (see Box 13.5 and Chapter 5 of this report).

## 13.2 Risk for sale: insurance-linked securities

**Financial markets are now increasing the supply of capital to the insurance industry through insurance-linked securities and similar financial products. This increases competition and the choice of insurance products available to manage disaster risks. However, these advantages may be undermined if asset managers and catastrophe bond issuers favour short-term gains in bond prices over the more sustainable long-term returns derived from potentially more realistic risk analysis.**

The capital market around insurance and reinsurance has grown rapidly over recent years (Figure

**Figure 13.1** Growth in the catastrophe bonds and insurance-linked securities market, 1996-2012



(Source: UNISDR, based on Artemis Catastrophe Bond & Insurance-Linked Securities Deal Directory<sup>36</sup>)



13.1) —now one of the few markets with a net inflow of funds<sup>vii</sup>. In the first quarter of 2012, for example, the issuance of catastrophe bonds<sup>viii</sup> reached a record level, driven by an ‘excess supply of capital’ for which investment opportunities have to be found (Aon Benfield, 2012d). The growing interest in these and other insurance-linked securities is expected to increase further (WCMA, 2012).

This market growth is neither driven by disaster risk reduction objectives nor directly requires that insured or reinsured parties reduce or manage their risks. The demand-side incentive comes from pension funds and institutional asset managers who seek to diversify their investment portfolios with alternative products that have uncorrelated risks and yields<sup>x</sup>. The incentive for the insurance industry includes the spreading of disaster risk over a wider capital base through a diversity of securities and other financial products. This extra capacity is especially attractive considering increased need to cover intensive risk. The multi-year fixed price capacity also makes investment planning of insurance companies more sound and easy compared with the usual annual term coverage of reinsurance (WEF, 2008).

The use of capital markets is not limited to insurers seeking alternatives for reinsurance. To smooth catastrophic risk, some countries issue catastrophe bonds instead of purchasing insurance, as shown in the Mexico example. In addition, companies such as Tokyo Disney, Universal Studio and Electricité de France have sponsored catastrophe-linked securities (OECD, 2011).

Despite significant insurance losses in recent years, the insurance-linked securities market remains strong as most contracts to date cover wind events in the United States of America rather than Asian earthquakes, floods and tsunamis (Aon Benfield, 2012a; WCMA, 2012). However, this may change with an increasing flow of capital into securities covering other regions and new hazards, and for which reliable catastrophe models are only now being developed.

Catastrophe bonds have been diversified in line with increasing investment trends (WEF, 2008). Their indices and premiums are based on detailed industry catastrophe models and risk assessments, which are regularly revised and updated, sometimes, as Box 13.6 shows, in real time. However, this risk information is very difficult for potential investors to

**Box 13.6** Pricing risk in real time – lessons from Hurricanes Irene and Gustav

Insurance-linked securities are traded not just before or after disasters happen, but also during events. In such cases, the pricing of risk, via the pricing of securities, takes on a dynamic that is directly based on the evolution of the hazard event. For example, when Hurricane Irene was categorised as a Category 3 storm in August 2011, the prices of several catastrophe bonds fell by 30–50 percent. Once Irene was downgraded to a Category 1 storm and then subsided, prices quickly rebounded.

Thus, while risk modelling underpins the pricing of insurance-linked securities, trading is reactive to real events and on a real-time basis. So-called Live CAT Bonds have now been developed where trading takes place while the event, usually a hurricane, develops. Such Live CAT Bonds are commonly industry loss warranties, i.e. insurance products where payout is triggered by a predefined loss limit across an entire industry rather than an individual company's loss.

During Hurricane Gustav in 2008, US\$9 million Live CAT Bonds were made available based on a new real-time hurricane index, through contracts between reinsurers and investment banks, hedge funds, etc.

The real-time aspect of the hurricane index and because it is fungible enabled the issuer to settle trades within three business days of hurricane landfall. Although this meant a cash-flow benefit to clients on both sides of the process, the simplicity of the index trigger may imply that risk levels may have been underestimated or not correctly priced, encouraging risk-increasing investment behaviour.

(Source: UNISDR, based on Aon Benfield, 2012d and<sup>xi</sup>)

comprehend and is rarely disclosed to them<sup>xi</sup> owing to over the counter transactions of products (see Chapter 12). There are, however, signs of change, with information being provided to investors at a higher level of disaggregation (Aon Benfield, 2012d).

In February 2011, leading catastrophe modeller Risk Management Solutions (RMS) released a new version of its US hurricane risk model that significantly revised upwards the probability of hurricane risk. As a result, several US hurricane catastrophe bonds priced using the RMS model were downgraded as concerns of their profitability in light of the new model's results grew. Bond issuers began pricing new bonds on the risk models of competitor AIR Worldwide (AIR), which estimated lower probabilities (Aon Benfield, 2012d).

This highlights the tendency of asset managers and bond issuers to favour short-term gains in catastrophe bond prices over the more sustainable long-term returns derived from potentially more realistic risk analysis. RMS has since been forced to market its revised model in a more comprehensive 'Resilient Risk Management' strategy that raises awareness about exposure not only to hurricanes and

earthquakes but to uncertainties in the catastrophe models (Ibid.).

Leading risk modellers, including AIR, are now committing to provide longer-term risk analysis in addition to medium-term perspectives on potential losses by improving the use of historical data and future projections in their risk models. Several industry leaders have highlighted the need to make explicit the uncertainties associated with commercial risk models available in the market (Aon Benfield, 2012d) to facilitate a more accurate pricing of risk.

The development of capital markets for insurance-linked securities is desirable considering that increased competition within and between the market and reinsurance companies would bring better product quality and affordability for insurance coverage. However, to increase investors and expand market size in a way that does not increase disaster risk, asymmetric information problems must be overcome by collecting and disseminating risk and loss information. Institutional infrastructure, such as accounting or solvency rules, also needs to be developed.

## Note

**i** Moral hazard is a case where insurance buyers become less risk adverse owing to the coverage purchased. Adverse selection arises when risk-seekers are more likely to buy insurance than risk-averse individuals, potentially hiding real levels of risk.

**ii** The regional approach was initiated with support from the Global Environment Facility, the Swiss government, UNISDR and the World Bank.

**iii** [http://www.economywatch.com/world\\_economy/china/structure-of-economy.html](http://www.economywatch.com/world_economy/china/structure-of-economy.html)

**iv** When assessing risks, any insurer or reinsurer must take into account the fundamental principles and limitations of insurability. Insurability is not a strict formula, but rather a set of basic criteria that must be fulfilled in order for a risk to be insurable. Disregarding these constraints ultimately jeopardises the (re)insurer's solvency and its ability to honour its policy obligations. However, the strict criteria required for insurability can mean that certain exposures may remain uninsurable. Some basic principles considered include randomness of the event, quantifiable events and losses, mutuality of risk, and economic viability. For more information see: [http://media.swissre.com/documents/The\\_Essential\\_Guide\\_to\\_Reinsurance\\_EN.pdf](http://media.swissre.com/documents/The_Essential_Guide_to_Reinsurance_EN.pdf)

**v** <http://www.jetro.go.jp/world/asia/th/biznews/4f7d27132e248>

**vi** <http://www.jetro.go.jp/world/asia/th/biznews/4f7d27132e248>

**vii** Luca Albertinie, CEO, Leadenhall Capital Partners LLP in Aon Benfield 2012a: p.42; and [http://www.artemis.bm/deal\\_directory](http://www.artemis.bm/deal_directory)

**viii** Catastrophe bonds are high yield bonds that contain a provision which may cause the principal or interest payments to be delayed or lost to investors in the event of a specified loss such as a hurricane or earthquake (OECD, 2011).

**ix** [http://www.artemis.bm/deal\\_directory](http://www.artemis.bm/deal_directory)

**x** Niklaus Hilti, Head of Insurance Linked Securities, Credit Suisse Asset Management in Aon Benfield 2012a:p.45.

**xi** <http://www.riskandinsurance.com/story.jsp?storyId=124326385>

**xii** <http://www.riskandinsurance.com/story.jsp?storyId=124326385>





## Chapter 14

# Risk Governance: In Search of the Missing Paradigm



Even in today's globalised economy, **national governments and local administrations** remain one of the most important mediators and **regulators of private investment** and thus disaster risk management. Governments report **significant progress** in achieving **effective disaster response and preparedness** and are investing more in risk reduction. Yet, the required shift towards **prospective risk management** remains a challenge for most.

The future of disaster risk reduction<sup>xii</sup> will depend on governments and **political leaders** becoming more successful at **combining** the promotion of local and national **economic growth with effective disaster risk management** on the ground. Thus, they will have to **expand their approach to risk governance** to include the creation of incentives for risk sensitive investment.

## 14.1 Evolving risk governance: evidence from the 2011–2013 HFA Monitor

**Results from national self-assessments of progress against the Hyogo Framework for Action (HFA) confirm countries' previously reported challenges, particularly in addressing the underlying drivers of risk.**

Risk governance, understood as a systemic approach to decision-making related to physical and technological hazards, has become an important concept for businesses and governments to effectively manage disaster risks (Fra Paleo, 2009; Renn, 2008; IRGC, 2005; IRGP-IHDP, 2010). Since the previous Global Assessment Report (UNISDR, 2011), which focused on public risk governance and associated government strategies, it has become apparent that risk governance structures and policies need to be expanded to include real consideration of the business sector, as well as civil society.

This is particularly pertinent, owing to evidence of rising economic loss risk from business investments in hazard-exposed regions. As highlighted in previous chapters, economic analyses and forecasts used by investors rarely mention disaster risk. Moreover, policy-makers in national government institutions and international organisations, although beginning to recognise changes in the nature of risks and risk management requirements, are still limited in their capacity to comprehensively assess and ad-

dress identified risks and future uncertainty (World Bank, 2012a; Kent, 2013).

In overall terms, HFA Progress Reports 2011–2013 (see Box 14.1) highlight broadly similar successes and challenges as reported in the 2007–2009 and 2009–2011 cycles.<sup>i</sup>

Risk governance arrangements established by countries and cities to manage their disaster risks have evolved significantly since 2005<sup>v</sup>.

From the 1980s onward, a growing number of countries reformed their legislation, policy and institutional frameworks for disaster risk management. Civil defence and protection organisations, focused on response, gradually gave way to a second generation of national systems for disaster risk management with common characteristics (UNDP, 2012a and 2012b; World Bank, 2012a; ADPC, 2003). Multi-sector committees now provide coordination and articulation across different ministries and departments; responsibilities are decentralised to local governments and dedicated budget lines for risk reduction activities are established.

As of December 2012, 85 countries had established multi-sectoral national platforms for disaster risk management; 191 countries had a dedicated focal point for disaster risk reduction in a central government department; and 121 countries enacted legislation to establish policy and legal frameworks for disaster risk reduction<sup>vi</sup>. But with notable excep-

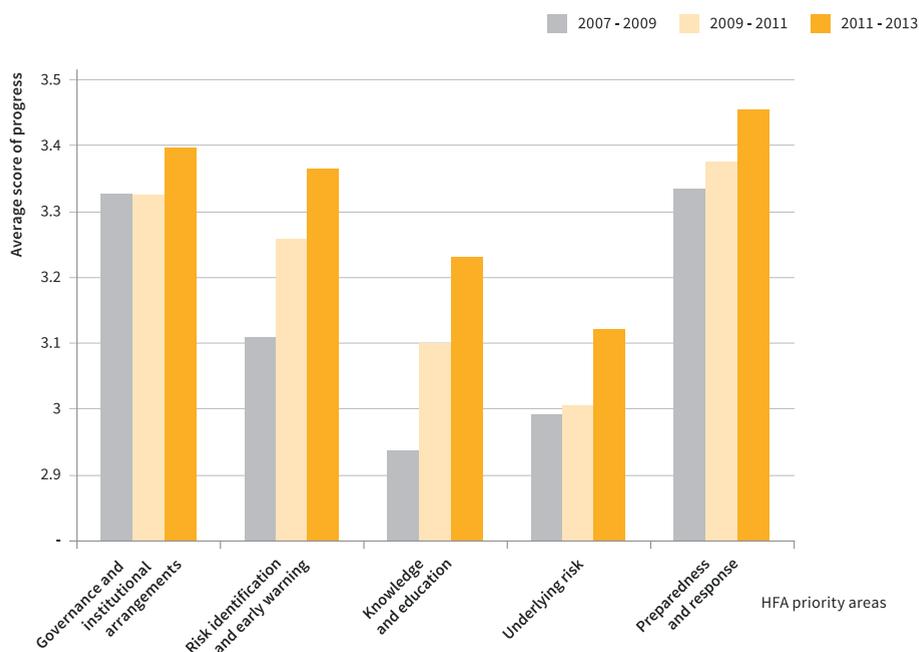
**Box 14.1** Regional, national and local self-assessments of progress against the Hyogo Framework for Action

Since 2007, national governments have been assessing their progress against the five priorities of the Hyogo Framework for Action (HFA) in a systematic manner, through the HFA Review process and HFA Monitor. In 2009, a regional self-assessment process was established for interested inter-governmental organisations and in 2011, local governments began to use a similar process and tool to review progress at the provincial, district and municipal levels.

The HFA Review process is entirely voluntary. The self-assessment process is led and owned by inter-governmental organizations, and governments and local government institutions at regional, national and local levels, respectively. It is designed to promote a multi-stakeholder appraisal progress in implementing the HFA. It is intended to stimulate an inter-disciplinary planning process that ensures that disaster risk is appropriately considered in public and private investment portfolios, not least to reduce mortality, minimise fiscal exposure and losses, and contribute to sustainable development.

The corresponding HFA Monitor is a multi-tier online tool, facilitated by UNISDR and led by country governments.<sup>ii</sup> The tool provides a mechanism to capture responses against progress indicators of the HFA, ensuring some degree of comparability of data over time series and between countries. Achievements in each core indicator are rated by governments themselves on a scale of 1 to 5, with 1 representing 'minor' achievement and 5 indicating 'comprehensive' achievement. Figure 14.1 gives an overview of progress reported against each priority area from 2007–2013.

**Figure 14.1** Progress against the five HFA priority areas, 2007–2013 (comprising three reporting cycles)

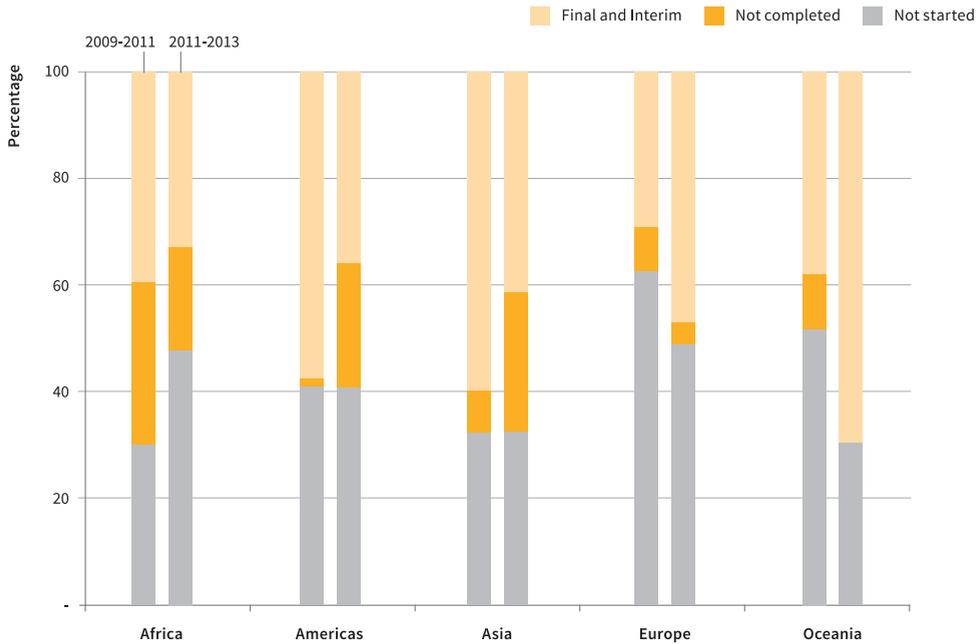


(Source: UNISDR, based on HFA Monitor data)

More than 100 countries and territories used the HFA Monitor in 2007–2009 and 109 submitted final reports in the 2009–2011 review. It should be underlined that strict comparisons across time periods are difficult, as not all countries participate in every reporting cycle. Only 45 percent of countries participating in the 2011–2013 reporting cycle have participated in all three progress reviews to date. At the time of writing, 94 national authorities have submitted reports covering June 2011 to January 2013, with a further 37 undergoing further assessments due to be published in mid-2013<sup>iii</sup>. Encouragingly, since the last reporting cycle the geographical balance of engaged countries has improved.



**Figure 14.2** Breakdown of percentage of countries reporting by region<sup>iv</sup>



(Source: UNISDR, based on HFA Monitor data)

Unless cited otherwise, all country-specific information in this chapter is based on the quantitative and qualitative analysis of the final or interim national HFA progress reports that countries have voluntarily submitted in the 2011–2013 cycle (as of March 2013). A more in-depth analysis is available in Annex 3 of the online version of this report and all national reports are available on Preventionweb.

(Source: UNISDR)

tions, these institutional and legislative systems have remained focused on disaster preparedness and response, including through improved planning, training and capacity building. This has contributed to declining mortality risk in many countries, at least in weather-related disasters (UNISDR, 2007; UNISDR, 2009; UNISDR, 2011).

Several countries have progressed in passing legislation and policy that attempts to integrate disaster risk considerations into sector strategies and wider planning. For example, a policy framework for reducing disaster risk has been incorporated in the National Development Plan 2011–2013 of the State of Palestine and integrated in the sectoral plans and strategies of the agriculture, health and security sectors. Some countries also highlight the success

of integrating disaster risk reduction into broader frameworks; examples include Burkina Faso in its Strategy for Accelerated Growth and Development; Ethiopia and its Growth and Transformation Plan; Rwanda in its Vision 2020; and Bangladesh in its Perspective Plan 2012–2021, which ties together all investment plans for the Government of Bangladesh.

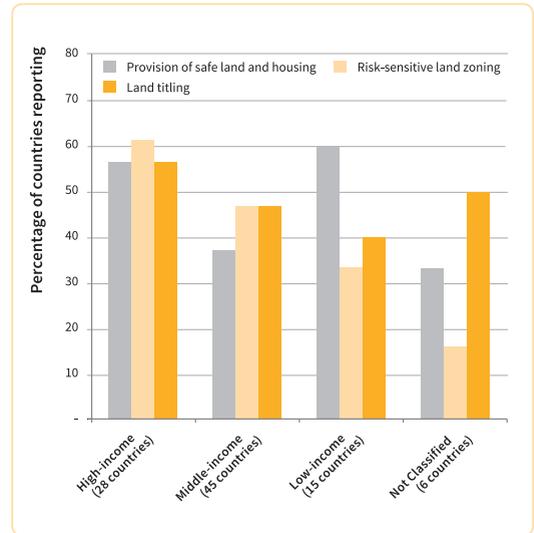
Countries have been less successful, however, in making substantial inroads to achieving risk-sensitive investment. Papua New Guinea cites the existing Disaster Management Act and Disaster Management Plans as providing legislative and regulatory provisions for disaster management in the country, but recognises that these need updating to reflect a shift in government policy from emergency re-

sponse to integrating disaster risk. Lesotho notes that the sectoral legal framework needs further strengthening and greater emphasis required to promote implementation of decentralized disaster risk reduction (DRR) activities.

Captured under HFA priority area 4, countries continue to make less progress across all three HFA reporting cycles since 2007 and the figures are sobering: of the countries that reported, only half confirm having in place simple regulatory mechanisms for providing safe land and housing for low-income communities, for risk-sensitive land zoning and private real estate development, or for land titling (Figure 14.3). From that perspective national policies, institutional frameworks and legislation on disaster risk management have been largely peripheral in addressing the underlying risk drivers, through which disaster risks accumulate.

In many countries, legislation that mandates risk-sensitive investment and development is in place and budget allocations for disaster risk manage-

**Figure 14.3** Number of countries reporting on regulatory mechanisms for risk-sensitive land use



(Source: UNISDR, based on HFA Monitor data 2011–2013)

ment have increased. However, the HFA Progress Reports of 2011–2013 highlight the continued challenge of implementing these policies, strategies and laws. As highlighted by previous

**Box 14.2** Implementation gaps

China reports that, although it has a relatively coherent disaster prevention and reduction law and regulation system, it struggles with implementing risk reduction efficiently and even of integrating its response mechanisms.

India, owing to its federal state system, struggles with lack of synergy and complementarity of national and state policies and institutional structures. Relatively new state and district disaster management agencies may have limited capacity and lack authority vis-à-vis better-established national institutions.

Germany faces similar challenges with strong federal states (or Länder) whose disaster management strategies are rarely coordinated with each other or with the national system.

Niue reports that, although limited capacities in each sector can result in implementation problems, the key issue is lack of ownership for cross-sector coordination and local implementation.

Uruguay strengthened the risk management capabilities of municipalities, while recognising that decentralized management requires commitment and installed capacities at local and departmental levels.

Myanmar established an action plan on disaster risk reduction for 2009–2015, but will have difficulties enforcing it without policy guidance or directives for townships and villages, where gaps already exist.

Pakistan cites a dependency syndrome of local institutions and communities on provincial and federal governments in managing local disasters.

Enforcement on the ground and accountability at all levels tend to be weak, confirming once again findings from the 2011 Global Assessment Report.

(Source: UNISDR)

HFA reporting cycles (UNISDR, 2009; UNISDR, 2011), problems of articulation and coordination exist between disaster risk management agencies, sector ministries and departments and local governments, compounded by lack of political muscle and technical capacities. As Box 14.2 highlights, there has been a major gap between development of policy and institutional frameworks and implementation on the ground (GNDR, 2011).

## 14.2 Attracting investment, constructing risk

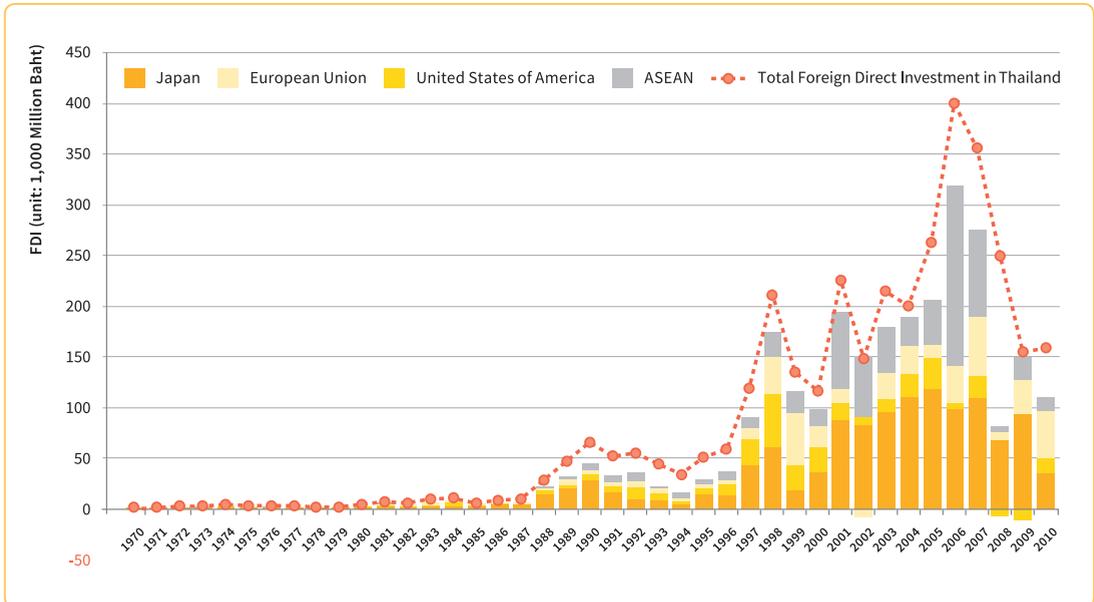
**As governments need to attract domestic and foreign direct investment (FDI), the effective management of disaster risk can be compromised. This may be mainly a result of the current disconnect between investment promotion and risk management functions within their administrations.**

Governments report difficulty in regulating investment and development in a way that reduces disaster risk; this should be examined more broadly.

Economic globalisation has been accompanied by radical changes in the role of the state in many countries. To maintain competitiveness and reduce financial risk, in some countries, welfare services and national industries have been privatised and state regulation has been reduced (Hobsbawm, 2011; Loko et al., 2003; Rondinelli and Cheema, 2003). Although this trend was briefly reverted at the outset of the global crisis in 2007 and 2008, pressure to deregulate and privatise services and infrastructure management in particular has now been renewed (Gerulis-Darcy, 2012; Heise and Lierse, 2011; Lapvitsas et al., 2010).

Across many low and middle-income countries, structural adjustment programmes, and more recently, poverty reduction strategy papers (PRSPs) were used as vehicles to remove barriers to investment and growth; to reduce government spending; and to ensure debt servicing (Dollar and Svensson, 2000; Easterly, 2003; Craig and Porter, 2003). Consequently, state-owned enterprises were privatised and private investment and participation was encouraged in sectors such as health, education, pensions, banking, ports, airports and telecommunica-

Figure 14.4 Major sources of FDI into Thailand



(Source: Bank of Thailand, in: Thampanishvong, 2012)

tions, which were previously subject to state monopolies (Kyrili and Martin, 2010; Babb, 2005; Bouton and Sumlinski, 2000; Epstein et al., 2003). This shift in fiscal and economic policy has also characterised many high-income countries, in Europe and elsewhere (Gerulis-Darcy, 2012; Lapvitsas et al., 2010; Elkins et al., 2006; Maarse, 2010; OECD, 2008).

In parallel, governments began to play an active and explicit role as promoter and facilitator of private investment. Financial, property, labour and other markets were deregulated and liberalised; tariffs on trade were reduced or eliminated; and incentives

were provided for foreign investment. At the same time, in some countries, national mechanisms and institutions for development planning were either weakened or wound down (UNCTAD, 2012; Cernea, 2005; Likosky, 2009).

As a result, the global economy is increasingly characterised by geographical competition between countries and cities to attract investment on the basis of their real or perceived comparative advantages.

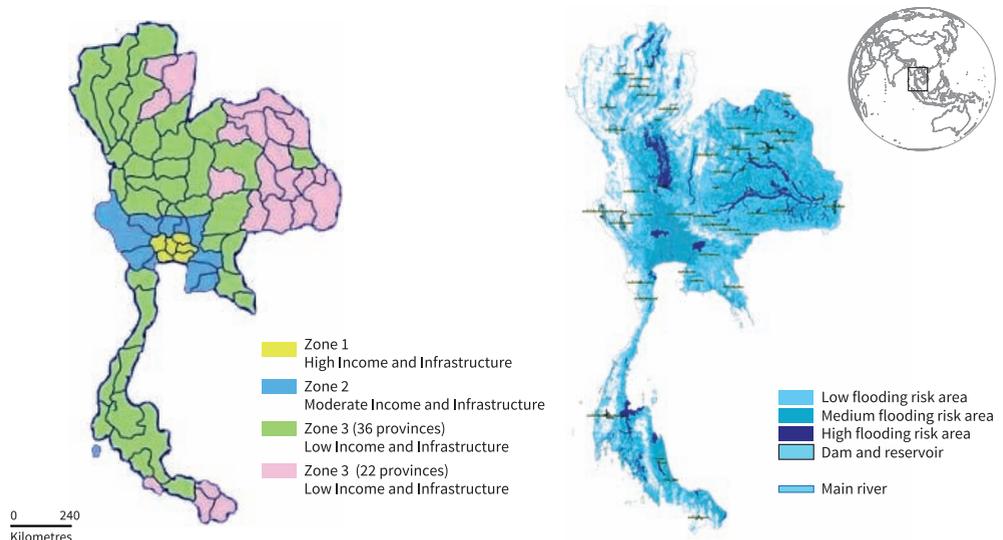
As described earlier in this report, SIDS compete to attract tourism investment; other countries with sig-

**Box 14.3** Attracting new risk in Thailand

Thailand's powerful Board of Investment (BOI) encouraged investment in three promotional zones<sup>vii</sup>—through tax privileges; sectoral incentives through BOI-identified priority projects; and privileges provided by the Industrial Authority of Thailand (IEAT). Although privileges offered in Zone 1, the areas surrounding Bangkok, were lower than those offered in regions further inland, they were still substantial, including corporate tax exemption for 3 years and a 50 percent reduction on import duty for machinery (BOI, Government of Thailand, in: Thampishvong, 2012).

Although this policy was successful in attracting FDI, it led to massive increases in flood exposure. As Figure 14.5 shows, much of the investment took place in former rice paddies located in floodplains of the provinces Ayutthaya and Pathumthani (Thampishvong, 2012), which paved the way for the 2011 Chao Phraya flood disaster (Marome, 2012).

**Figure 14.5** Thailand map of investment zones and flood risk



(Source: BOI, Government of Thailand (<http://thailandboi.com/investment-zones.html>) and Emerald Insight.<sup>viii</sup>)

(Source: UNISDR)

nificant reserves of natural capital offer broad concessions for investment in primary production, including mining, oil and gas, timber and more recently agricultural production. Yet others provide incentives for export-oriented special economic zones (SEZs) or similar mechanisms to allow the assembly and export of products with imported components (World Bank, 1998). SEZs, which aim to promote FDI, have expanded rapidly over 20 years—from 176 zones in 47 countries in 1986 to 3,500 zones in 130 countries in 2006 (Boyenge, 2007).

As inter-country and intra-country competition for increasingly footloose investment has increased, many governments now have a competitiveness agenda in which they seek to strengthen their comparative advantages in one or more sectors. The World Economic Forum classifies several basic requirements for competitiveness, which includes institutional environment, sound infrastructure, macroeconomic stability and health and primary education; efficiency enhancers, which include higher education and training, goods and labour market efficiency, a developed financial market, technological readiness, market size and innova-

tion; and sophistication factors, which includes business sophistication and innovation (WEF, 2012).

High levels of disaster risk are a negative competitiveness value because they undermine these requirements and pose risks to investors. However, instead of highlighting success in managing and reducing these risks, many governments have preferred to downplay or simply ignore them, contributing to the investor risk blindness already highlighted in the previous chapter. Instead, governments, through promoting the advantages of low labour costs, access to export markets and low taxes, may instead encourage investments in high-risk areas.

Together with the ineffectiveness of public regulation of development, particularly from a risk reduction perspective, highlighted in the previous section, this implies that the current practice of risk governance does not provide adequate disincentives to business investment that produces disaster risks.

In Thailand, for example, since 1977, the government began to grant tax exemptions and import duty reductions to companies investing in industrial activity

**Box 14.4** Guangzhou: producing risk over centuries of economic activity

As early as 200 AD, Indians and Romans came to the city also known as Canton, to trade, making Guangzhou China's oldest trading port. In the 18th and 19th centuries, China was already an important global manufacturing hub (Roy and Ong, 2011). Today, Guangzhou and its surrounding industrial areas are a major manufacturing and export hub and a global supplier of goods.

However, it also ranks just behind Miami and much ahead of Shanghai, Mumbai, Tokyo, Hong Kong and Bangkok in a recent global index of port cities' exposure of population to flooding (Nicholls et al., 2008). Moreover, it comes second in terms of assets exposed to flood risks projected for 2070 (Ibid.). In May 2010, extreme rains killed at least 86 people in Guangzhou and disrupted the lives of 8 million. The most damaging storm in 30 years, which cost Guangzhou US\$85 million, challenged the city's flood-control drainage systems and damaged 256,800 acres of farmland (Bloomberg, 2012).

Yet, despite these apparent risks, investors and their advisors do not rank them on par with other investment considerations such as corporate tax breaks, labour laws and costs and other direct business costs. Recent risk analyses of Guangzhou and Guangdong provinces do not refer to disaster risk other than the possibility that companies could be held responsible by government or communities for environmental impacts or disasters.

Instead, there are broad incentives for increased investment in flood-prone areas. The government offers 100 percent corporate tax relief for the first three years of an investment earning returns. As a result, in 2005, assets worth US\$84 billion and almost 3 million people were at risk; and these figures are estimated to increase to US\$3.4 trillion of assets and more than 10 million inhabitants by 2070 (Bloomberg, 2012).

(Source: UNISDR)

Only six years after the occurrence of a category 5 cyclone in 1999, the Government of Orissa designated the coastal district of Jagatsinghpur to be the site for the largest FDI project in the history of India: a deal was signed with a South Korean company for the development of a major steel plant, mines, railway links and a captive port to exploit the state's rich iron ore and coal deposits. The Memorandum of Understanding provided investors with a 100 percent tax exemption for five years—part of a recent initiative to further boost FDI inflows.

Without a clear risk-sharing framework in place, the Government of Orissa was potentially taking on unlimited liabilities for future disaster losses. In addition to the social and environmental costs associated with the relocation of existing communities, the clearing of forests and farmlands and the loss of livelihoods for landless and fishing communities, the project would increase hazard exposure and probably act as a magnet for further risk-increasing development in the area.

The controversial project has ignited protests from communities, the National Human Rights Commission and environmental agencies, forcing several reviews to be undertaken, most recently, in August 2012 by the Ministry of Environment and Forests. The review resulted in environmental clearance for the project to be temporarily suspended; but the project remains a priority for both state and federal governments.

*(Source: Patra, 2012)*

in the country. As Figure 14.4 shows, this led to a significant increase of FDI flows starting in the mid-1980s (Brimble, 2002), particularly from Japan.

But as Box 14.3 shows, success in attracting this investment led to a rapid increase in exposure of economic assets in flood-prone regions of the country (Thampanishvong, 2012).

In Guangzhou, China, public incentives to attract investment have also contributed to increasing hazard exposure and disaster risks (Box 14.4).

On the western coast of India, in Jagatsinghpur District, more than 8,000 lives were lost and 230,000 homes destroyed during the 1999 Orissa Super Cyclone (Patra, 2012). Today, as Box 14.5 highlights, the district is being considered for the largest FDI project in the history of India.

In some countries, therefore, the role of governments has been contradictory to the stated objective of the HFA to achieve substantial reduction in disaster risk. This paradox reflects a broader trade-off between rapid economic growth and risk reduction, which ultimately reflects national political priorities. If perceived additional costs of disaster risk reduction have been considered a barrier to invest-

ment flows, then many governments have prioritised growth over risk reduction. In other countries where vigorous economic growth has meant that expected annual losses from disaster (AAL) represent only a small proportion of annual capital formation (GFCF), governments may calculate that they have the capacity to absorb the risks. In this case, the implementation of policies to reduce disaster risks may be postponed until growth has led to a high level of economic development.

At the same time, there is little evidence from any of the HFA progress reports since 2007 of the engagement of investment boards, trade ministries and private investors in national disaster risk governance frameworks. As a result, coordination between economic promotion and growth policies, on the one hand, and disaster risk management strategies, on the other hand, is absent.

This lack of coordination may be exacerbated by a limited capacity for assessing the costs and benefits of disaster risk reduction. For example, while 56 countries reporting through the HFA Monitor in 2013 note that costs and benefits of disaster risk and risk reduction are taken into account in the planning and operation of major development projects, only one third confirm that national science agendas and



budgets include studies on the economic costs and benefits of DRR. Just under 80 percent of countries report that they assess what impact new development investments may have on disaster risk; however, how these assessments are translated into policy and practice is rarely made explicit.

## 14.3 Increased investment in disaster risk management

**Countries do not know how much they currently invest in disaster risk management. Complexities in budgeting and accounting across sectors add to the challenge of tracking current investments, but several governments have begun to tackle this problem as well as significantly increasing investments, particularly in corrective disaster risk management.**

If countries are to realistically assess the trade-offs between disaster risk reduction and policies that promote rapid economic growth, one particular challenge is that few countries are able to quantify their investments in disaster risk reduction and hence estimate the resulting costs and benefits.

In the 2011–2013 HFA progress reviews, 90 percent of countries report that they consider disaster risk in relation to national and sector public investment. However, just 52 percent report having systems in place that allow them to do so. Further, only 36 percent reported dedicated funding to risk reduction and prevention versus response and preparedness.

However, a number of countries in both Asia (India, Indonesia, Philippines) and Latin America (Costa Rica, Guatemala, Mexico, Panama and Peru) have been involved in dedicated efforts to track and estimate their investments in disaster risk reduction.

Capturing overall annual expenditure in dedicated disaster contingency or reserve funds is relatively straightforward. However, in a fiscal environment where disaster risk reduction investments, particu-

larly in prospective risk management, are rarely classified in national budgets, and officials with fiduciary responsibilities have little familiarity with disaster risk management, the accurate portrayal of budgetary allocation and realised expenditure is particularly challenging. This is compounded when analysis is extended to local public investment.

Although identification of expenditure managed by a national disaster risk management agency may be possible, identifying expenditure by other spending units in a government, for example across sectors, is complicated, as expenditure is seldom coded as disaster risk reduction (Box 14.6). For example, a project to strengthen water management may reduce drought and flood hazard, but would probably not be coded as disaster reduction expenditure. This ‘embedded’ expenditure on disaster risk reduction may be particularly hard to identify. Even more challenging is identifying whether public investment in general, to build schools, roads and health centres, for example, has integrated disaster risk reduction considerations.

To track embedded expenditure, close coordination between the investment planning and the financial arms of national or even local government is critical. Investment plans that take disaster risk into account may not actually be translated into budget plans (Orihuela, 2012). Budgetary officials may have excellent knowledge about budgeting, but little knowledge about investment projects from planning and sectoral agencies. This contributes to difficulty in tracking embedded investment (Ibid.).

As Box 14.6 shows, countries have taken different approaches to identifying this investment.

Investment tracking can allow better identification of costs and benefits of disaster risk reduction, but as the above examples highlight, requires significant efforts and resources. From this perspective, another approach may be to embed disaster risk reduction into national asset management. The asset management approach has been adopted in some

high-income countries to reduce expenditure on public infrastructure while assuring and improving service levels. The first step is to create inventories of public assets, which can then be used for tracking investments in disaster risk reduction. This can align the interests of finance ministries with disaster risk reduction objectives. Inventories can then be used for risk assessment or to develop risk financing solutions. For example, the Mexican Government has an inventory database of buildings, roads and other public assets and data are used for estimating exposure to design risk transfer strategies (G20/OECD, 2012).

In countries where public infrastructure and services have been privatised, the adoption of an asset management approach to disaster risk reduction investment tracking is challenging. However, in the United States of America, the national asset data-

base maintained by the Department of Homeland Security (DHS), which contains information on more than 77,000 assets—including national critical infrastructures, including dams and nuclear power plants (Moteff, 2007)—takes into account the 85 per cent operated by the private sector.

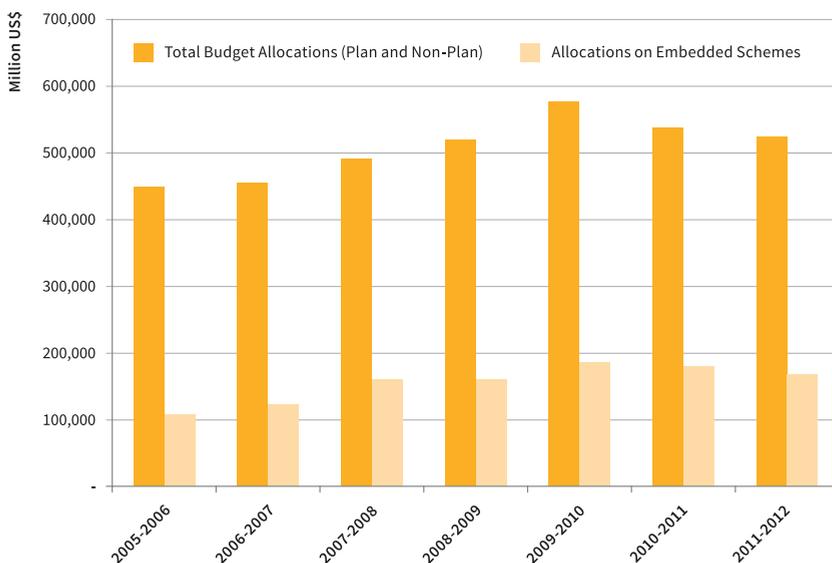
Widely varying interpretations of terminology also make inter-country comparison difficult (Gordon, 2013). This makes it complicated to clearly differentiate between expenditure on disaster response and expenditure on different kinds of risk reduction.

Despite these difficulties and the consistent message by countries regarding the limited resources available over the long term to make the required investments, there is anecdotal evidence, both from reviews of budget allocations as well as from the HFA Monitor, which highlights that overall expendi-

**Box 14.6** Tracking investment in disaster risk reduction

In India, although the allocation to Dedicated Schemes on Disaster Management remained stable from 2005–2006 to 2011–2012 (from US\$5.09 billion in 2005–2006 to US\$4.96 billion in 2011–2012), embedded disaster risk reduction investments has grown both in absolute terms and as a percentage of total budget (Dhar Chakrabarti, 2012). Figure 14.6 shows estimated budget allocations of 85 plan and non-plan schemes identified in 35 ministries and departments as having the potential for reducing risks of disasters.<sup>ix</sup>

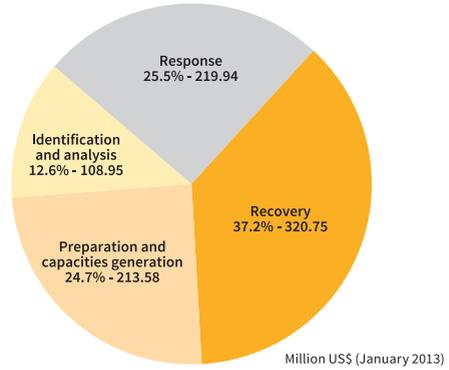
**Figure 14.6** Total budget allocation and allocations on embedded schemes in India



(Source: Dhar Chakrabarti, 2012)

In Guatemala, as Figure 14.7 below shows, the Guatemalan Ministry of Finance has developed a tool to code its expenditure in four categories: risk identification and analysis; preparation and capacity building; disaster response; and disaster recovery. None of these categories explicitly identify strategies of either corrective or prospective risk management although related activities could be embedded within these, particularly in identification and analysis, recovery and capacity building.

**Figure 14.7** Guatemala disaster risk management expenditure in 2010



(Source: Orihuela, 2012 (based on Expenditure Structure for Disaster Risk Reduction Management – Year 2010. Technical Budget Directorate (DTP), Vice Ministry of Financial Management, Ministry of Finance, Guatemala, 2012))

In Panama, the Directorate of Investment Planning (DPI) estimated government expenditures on disaster prevention, mitigation, response and reconstruction over the last decade. Using similar categories as Guatemala’s tracking system, total calculations amounted to about US\$200 million for 2000 to 2010 (Orihuela, 2012). Results revealed that expenditure on prospective risk reduction was difficult to track and unreliable, whereas dedicated expenditure on emergency response and reconstruction was easier to identify, particularly when this required a specifically documented amendment to the national annual budget (Ibid.).

In Mexico, the government, with support from the World Bank, has initiated assessment and monitoring of public investments in disaster risk reduction<sup>xi</sup> at the federal level.<sup>x</sup> The project will analyse investments; the use of hazard and risk information in federal decision-making for disaster risk reduction; and the impacts of investment through sectoral case studies. It will also develop a mechanism to follow up and better monitor future investments in disaster risk reduction<sup>xi</sup>.

(Source: UNISDR)

ture on disaster risk reduction is growing.

Some countries are now skewing their budget allocations in favour of investments in corrective disaster risk management and strengthening financial resilience (see Annex 3), often through the establishment of dedicated funds and budget lines, during post-disaster recovery or when faced with imminent events.

For example, the HFA Monitor 2011–2013 highlights that in Sri Lanka, 60 percent of the Ministry of Disaster Management’s annual allocation is dedicated to corrective disaster reduction projects. In 2012, Sweden allocated US\$60 million for disaster reduction in the transport sector. Japan’s 2012 disaster management budget is US\$46 billion, of which

US\$6.4 billion is allocated to disaster prevention management and US\$9.5 billion to national land conservation. In Australia, the National Partnership Agreement on Natural Disaster Resilience (NPA) provides state governments with approximately US\$27 million per year to invest in disaster risk reduction projects prioritised in accordance with state-wide risk assessments complementing private sector investments.

The Government of Canada allocated almost US\$100 million in its 2012 Budget to share the cost of permanent flood mitigation investments made by provinces and territories affected by spring floods in 2011. In addition, the Building Canada programme, administered by Infrastructure Canada, seeks to create a more competitive and prosperous

**Table 14.1** Disaster management budget as a percentage of Indonesia's total budget, 2006–2012 (in percent)

Benchmark	2006	2007	2008	2009	2010	2011	2012
National Budget	0.38	0.47	0.44	0.41	0.49	0.68	0.69
Central government budget	0.58	0.71	0.63	0.61	0.74	0.99	1.02
GDP*	0.08	0.09	0.09	0.07	0.08	0.12	0.12

(Source: Darwanto, 2012)

economy by investing in projects to reduce the vulnerability of communities or public infrastructure to hazards and climate change.

China has also made major investments, for example, US\$10.5 billion in flood prevention and drought relief in 2011 by the central government; US\$400 million per year for geological disaster prevention and control, with 23 provinces, 176 cities and 932 counties establishing special complementary funds amounting to an estimated US\$2 billion since 2011. Central government has also invested just under US\$600 million in agricultural disaster prevention and reduction. Its Comprehensive Disaster Prevention and Reduction Plan (2011–2015) aims to reduce direct economic losses from disasters to less than 1.5 percent of GDP.

Reviews of budget allocations also show that in the Philippines, for example, disaster risk reduction investments are trending upward, for example, from 1.4 percent to 2.1 percent of the country's national budget between 2009 and 2011 (Jose, 2012).

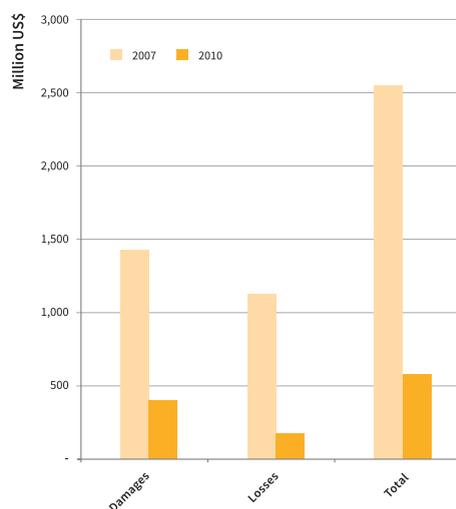
In Indonesia, disaster risk reduction allocations almost doubled from 2006 to 2012 (Table 14.1) as a proportion of the national budget. About 75 percent is allocated to (mainly corrective) disaster risk management (Darwanto, 2012).

More than half of the countries have also reported in the last two HFA review cycles that they specifically incorporate allocations to disaster risk reduction and resilient recovery into their post-disaster recovery budgets. However, only 15 percent are able to report on the percentage of this allocation.

**Box 14.7** Investments in risk reduction: the case of Tabasco, Mexico

The National Disaster Fund (FONDEN) of Mexico is currently investing between 25 percent and 30 percent of its resources to rebuilding better. These investments in risk reduction can enable significant reduction in disaster losses. The floods in the State of Tabasco in 2007 (UNISDR, 2009) caused losses equivalent to 30 percent of the state's GDP. Following the disaster, FONDEN financed a range of studies of the region's hydrology, urban development and land use, which led to the implementation of an integrated programme of investments to reduce disaster risk. The value of these investments became apparent during the state's 2010 floods. Even though rainfall levels in 2010 were comparable with levels in 2007, direct and indirect losses of 2010 were only one-fifth of those in 2007 (Figure 14.8).

**Figure 14.8** Comparing losses from floods in 2007 and 2010 in Tabasco, Mexico



(Source: FONDEN)



Indonesia, for example, after the experiences of the Yogyakarta and Central Java Earthquake of 2006, the West Sumatra Earthquake of 2009 and post Merapi Eruption of 2010, estimates that 5 percent of recovery and reconstruction funds are assigned to disaster risk reduction.<sup>xii</sup> Estimates in other countries vary considerably: Senegal estimates this at 2 percent; Bahrain, 5 percent; Anguilla, between 20 percent and 40 percent; and Colombia, 60 percent. How these funds are used is currently not well documented. But as Box 14.7 shows, investments in corrective risk management in recovery and reconstruction programmes may contribute to reductions in disaster risks.

These investments in corrective risk management are essential. Without appropriate maintenance and potentially required retrofitting, aging infrastructure becomes a risk in both high-income and low-income countries. The bridge collapse in Minnesota, United States of America, in 2007, is a well-known example that aging infrastructure causes deaths and injuries (National Transportation Safety Board, 2007). In Africa, on average, about 30 percent of countries' infrastructure assets need rehabilitation (Briceno-Garmendia et al., 2009).

However, risks to the stock of existing infrastructure puts to the test even the most risk sensitive investment planning systems. For example, though Peru is at the forefront of building disaster risk considerations into public investment planning, it reports major challenges with assessing and addressing disaster-related risks to major development projects and its stock of infrastructure. It rates itself as having made some progress, but without systematic policy and institutional commitment (progress level 2 in the HFA Monitor). Similarly, Switzerland, a country with sophisticated disaster risk management policy, legislation and practices in place, reports that a major challenge will be the retrofitting of a large stock of existing buildings that are vulnerable to earthquakes, including a number of historical buildings.

Poor coordination between capital and maintenance expenditures often occurs in countries that operate dual budgeting systems, which separate capital from current expenditure (Orihuela, 2012). Though this practice might be useful to make investment priorities clearer, investment in infrastructure needs to be appraised in terms of both capital and operating (including maintenance) costs.

## Notes

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**i** Unless cited otherwise, all data referring to national progress or challenges presented in this chapter are based on national self-assessment reports of progress against the HFA as submitted through the HFA Monitor.

**ii** <http://www.preventionweb.net/english/hyogo/hfa-monitoring/national/?pid:73&pih:2>.

**iii** As of 22 March 2013.

**iv** Geographical regions are defined according to the 'Composition of macro geographical (continental) regions' of the United Nations Statistics Division, Standard Country and Area Codes Classification.

**v** Forthcoming UNISDR summary report of national progress in implementing the HFA 2005-2013 (for publication in 2013).

**vi** Forthcoming UNISDR summary report of national progress in implementing the HFA 2005-2013 (for publication in 2013).

**vii** Government of Thailand, Board of Investment: <http://thailand-boi.com/investment-zones.html> (accessed 30-10-2012).

**viii** Data from Emerald Insight in: Community, Environment and Disaster Risk Management Journal, Vol. 8): <http://www.emeraldinsight.com/books.htm?issn=2040-7262&volume=8&chapterid=17000011&show=html>.

**ix** The disaster risk reduction allocations were calculated using embedded investment criteria developed by Dhar Chakrabarti, 2012; they are not to be considered official statistics of the Government of India.

**x** In Mexico, DRR is defined as prevention (to avoid new risks) and risk reduction (reduce existing risks).

**xi** Information directly contributed to UNISDR in support of the 2013 Global Assessment Report.

**xii** Chief of the National Agency for Disaster Management (BNPB) regulation No. 17/2011 on rehabilitation and reconstruction; the Disaster Management Plan 2010-2014 and National Action Plan for Disaster Risk Reduction 2010-2012.

## Chapter 15

# Anticipating Risk



Countries are yet to **embrace a forward-looking and proactive approach to disaster risk management**. A key component of such prospective risk management is the **identification of appropriate risk management and financing strategies for different layers of risk**. For events with low to medium-sized losses, it is **more cost-effective to reduce risks than to rely on risk transfer strategies**. And prospective risk management, involving **factoring risk reduction into investment planning is more cost-effective than having to correct risk levels once the investment is made**.

Many national risk-financing strategies still reflect **a vision of disasters as exogenous shocks rather than of risk as an endogenous characteristic of investment flows**. As such, the **cost of risk financing is likely to grow** except in countries that are making major investments in risk reduction.

## 15.1 How prospective is prospective enough?

**Without prospective risk management, countries will lose competitiveness and the inability to guarantee the infrastructure that business requires to be competitive itself. A number of nascent shifts in approach, however, are emerging from several countries that contribute to a move towards prospective disaster risk management—in the areas of legalisation, institutional arrangements and strategic programming.**

More than ever, it is recognised that ultimately, disaster risk will be reduced only if mechanisms are implemented to avoid risk accumulation in new public and private investment (Heitzmann et al., 2002; Blaikie et al., 2004; UNDP, 2004; UNISDR, 2007; DFID, 2006; Thomalla et al., 2006; UNISDR, 2011). Although the trend of growing investment in corrective risk management noted in the previous chapter is positive and encouraging, to be effective, it needs to be matched by prospective disaster risk management (UNISDR, 2011; Lavell, 2003), which means employing a truly anticipatory rather than reactive or corrective approach to disaster risk. Without prospective risk management, countries will lose competitiveness and the inability to guarantee the infrastructure that business requires to be competitive itself.

The Hyogo Framework for Action (HFA) identified several key components that contribute to a truly prospective approach, including understanding

the risk footprint of a country; providing full access to risk information; and addressing the underlying drivers of risk. Prospectively managing risks related to business investment, however, has not yet been given full consideration in the HFA.

Progress in adopting a prospective approach to disaster risk reduction is still limited. Costa Rica, Panama and Peru (Bernal, 2012), for example, have now incorporated an analysis of disaster risk into public investment planning (UNISDR, 2009; UNISDR, 2011).

These efforts, however, are still challenging. In Panama, disaster risk analysis applies only to large-scale projects and national investments.<sup>1</sup> This means that smaller-scale local level investment decisions are not included. And because most disaster losses in Panama are associated with damage to local infrastructure, this weakens the effectiveness of the measure.

Where political pressure exists in favour of investment in particular industries or regions of a country, these imperatives may override the risk and project analysis promoted by technical units of finance ministries (Orihuela, 2012). If systems of national investment planning are bypassed, disaster risk criteria lose their relevance, and investment projects may get the green light even without mandated risk assessments completed.

Land-use planning is another area with unresolved challenges. Few disaster risk management systems

have been able to employ land-use planning and management and influence investment policies to encourage effective disaster risk management (Johnson, 2011; UNISDR, 2011). Instead, different public and private institutions transform the landscape of city regions; they push different agendas and operate outside of an overall coherent risk management framework.

In Costa Rica, for example, for more than 44 years, successive governments have not been able to finalise and implement the National Land-Use Plan (Brenes and Bonilla, 2012). The Controller's office considers that the absence of this Plan contributes to development that is characterised by high social costs, deficient infrastructure and urban development in ecologically fragile and hazard-exposed areas. Unregulated urban development has increased flood risk in many areas and has been identified by the National Emergency Commission as a principal cause of the severe losses registered during the 2010–2011 ENSO episode in Costa Rica.

A number of nascent shifts in approach, however, are emerging from several countries that contribute to a move towards prospective disaster risk management—in the areas of legalisation, institutional arrangements and strategic programming.

For example, Colombia passed a new disaster risk management framework, including establishment of a multi-sector and multi-stakeholder national committee that will be in charge of both prospective and corrective risk management. Peru has moved responsibility for disaster risk management to a new agency located in the Ministry of the Presidency. Also, about 25 percent of countries that assessed their progress against the HFA in 2011–2013 reported that responsibility for oversight of disaster risk management was located in the highest office, i.e. of the Prime Minister or President. Another 13 percent reported that these functions reside in a central planning or coordination unit.

The 2011–2013 HFA review also highlights new policies, strategies and laws for disaster risk management; many provide for sharper focus on both prospective and corrective risk management and an integration of disaster risk management with climate change adaptation.

Ethiopia, for example, adopted policies for integrated environmental management and rural development, which include disaster risk reduction elements. One such policy, the five-year Growth and Transformation Plan, has integral elements on disaster risk reduction and climate change adaptation; the forthcoming DRM Strategic Programme and Investment Framework also integrates disaster risk reduction with climate change adaptation.

Namibia in 2012 passed a new Disaster Risk Management Act establishing a new National Disaster Fund that supports not only relief and recovery but also disaster risk management (Government of Namibia, 2012).

The United States of America recognizes that disaster resilience is an important aspect of overall economic health of the nation and sustainability of communities (National Academies, 2012). Community resilience indicators are being explored to help drive more effective integration of disaster risk considerations into sustainable development policies, planning and programming (CSRI, 2011).

In Vanuatu, the National Disaster Risk Management Office (NDMO) has been strengthened and new arrangements finalised for integrating governance of disaster risk reduction and climate change adaptation efforts. In addition, a new National Advisory Board for disaster risk reduction and climate change adaptation will soon be approved.

## 15.2 Growing commitment to risk financing

**As long as risk financing strategies reflect a vision of disasters as exogenous shocks rather than of risk as an endogenous characteristic of investment flows, the cost of risk financing is likely to grow—except in countries that are making major investments in risk reduction.**

In times of constrained public budgets, strengthening financial resilience is becoming a critical task for hazard-exposed economies worldwide (Government of Mexico and World Bank, 2012). As Figure 15.1 highlights, for events with low to medium-sized losses, it is more cost-effective to reduce risks than to rely on risk-financing strategies. And factoring risk reduction into investment planning is more cost-effective than having to correct risk levels once the investment is made (UNISDR, 2011).

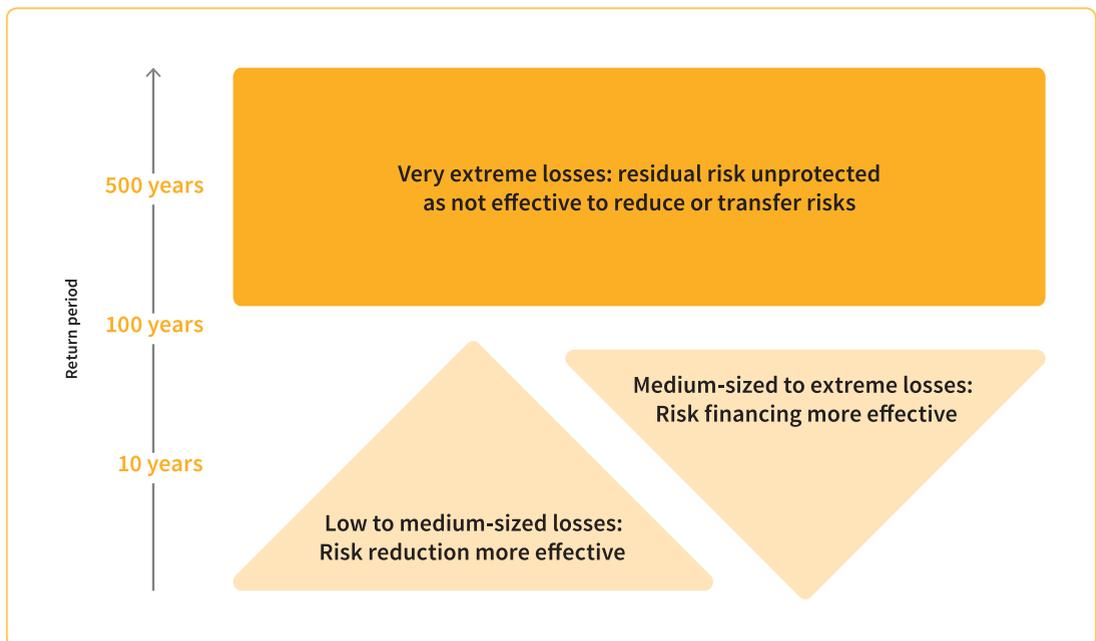
In the case of medium-sized to extreme losses, however, risk financing is essential to ensure macroeconomic stability and to facilitate financing of recov-

ery and reconstruction. As Chapter 4 of this report highlighted, many countries with high levels of disaster risk would face a serious financing gap in the event of a major disaster.

Table 15.1 shows the diversity of recent experience in risk financing. For example, Mexico is transferring risk to capital markets via catastrophe bonds. The parametric index used in this case allows prompt payment, made as soon as the predefined event occurs while ensuring relatively high levels of transparency (Swiss Re, 2011b; G20/OECD, 2012). Although the Caribbean Catastrophe Risk Insurance Facility was the first regional scheme to use a parametric mechanism, the Central America Natural Disaster Insurance Facility has introduced a new approach based on an estimation of the population normally affected by a disaster. This scheme is expected to be applied to more countries and beyond physical hazards (Swiss Re, 2011b).

There are other examples reported by countries through the HFA Monitor. The Government of Ethiopia has established robust mechanisms to finance

**Figure 15.1** Efficiency of risk management instruments and occurrence probability



(Source: Mechler et al., 2012)

**Table 15.1** Risk financing in selected countries

	Caribbean Catastrophe Risk Insurance Facility	MultiCat Mexico	Central America Natural Disaster Insurance Facility
<b>Established year</b>	2007	2009	2010
<b>Instrument</b>	insurance / reinsurance	Catastrophic Bond	insurance / reinsurance
<b>Insured risk</b>	Earthquake - Hurricane	Earthquake - Hurricane	Earthquake - Hurricane induced risks (eg: landslide)
<b>Policy coverage</b>	Country-specific, up to an aggregate US\$100 million per disaster	US\$290 million	Country-specific
<b>Index</b>	Modelled loss	Parametric index	Parametric index
<b>Trigger</b>	Pre-defined level of government loss	Quake magnitude, barometric pressure	Defined size of population affected by disaster
<b>Insured party</b>	16 CARICOM governments	Fund for Natural Disasters (FONDEN)	Country-specific captive insurance companies
<b>Sponsor</b>	World Bank	World Bank	Inter-American Development Bank

(Source: UNISDR, based on Swiss Re, 2011)

preparedness measures, including the National Disaster Prevention and Preparedness Fund and the Risk Financing Mechanism—the latter, a multi-million dollar contingent fund employed at the time of major droughts.

As highlighted in Chapter 7, the Pacific Catastrophic Risk Assessment and Financing Initiative (PCRAFI) is currently being developed and will be tested in the Marshall Islands. The PCRAFI assists the Pacific Island Countries (PICs) in shifting from post-disaster donor assistance to ex ante budget planning. The Pacific Disaster Reserve Fund is being established as a prototype risk pooling mechanism. This joint reserve mechanism would allow PICs to build up regional reserves against intensive disasters, supported by initial donor contributions and, if necessary, protected by global reinsurance. The Fund will provide incremental resources to restore essential services to countries after disasters and would help them in their recovery and reconstruction.

Colombia has emerged as a leader in its efforts to fully assess its contingent liabilities. It has begun to integrate liabilities emanating from disaster risk into its management of government liabilities; the effort

is led by the Deputy Directorate of Risk within its Ministry of Finance and Public Credit (MHCP) (Government of Mexico and World Bank, 2012). It is also developing a strategy to deal with fiscal vulnerability to disaster risk, which would align with existing risk management strategies related to contingent liabilities from credit operations, public-private partnerships (PPPs) and legal proceedings against the nation (Ibid.).

Although this momentum in selected countries is encouraging, the global debate still reflects a vision of disasters as exogenous shocks (G20/OECD, 2012) rather than of risk as an endogenous characteristic of investment flows. As such, the cost of risk financing is likely to grow except in countries that are making major investments in risk reduction. This highlights that while risk financing is an important component of a comprehensive disaster risk management strategy, to be successful, it depends on complementary efforts to reduce risks.

## 15.3 Expanded risk governance: integrating public and private approaches

**Governance structures, particularly at the local level, can build on the experience and vested interest of businesses with large fixed assets, such as real estate companies, developers, investment banks, large stores and property management firms to more effectively manage disaster risk. The successful partnering of such large companies, as well as small and medium suppliers, with public planning bodies should play an important role in reducing vulnerability and exposure to physical hazards.**

Progress in truly prospective disaster risk management may be incipient at best. However, disaster risk management and reduction is starting to gain some space on the competitiveness agendas of governments. Policy-makers responding to a recent survey on perceptions of disaster risk and future uncertainty noted the increasing interconnectedness of economies and resulting vulnerability to synchronous and cascading failures and shocks (Kent, 2013; Ipsos MORI, 2013). It is also increasingly recognised that the more long term the perspective is on risk and uncertainty, the more it becomes an international and trans-boundary concern and less a national capacity issue (Ipsos MORI, 2013).

The focus on longer-term risks in governments and many international organisations is still relatively

new (Kent, 2013). Countries are just beginning to develop a more strategic approach to planning for risks, and some are indicating that a cultural change is taking place in which awareness, supported by greater media coverage and open debate of disaster risk, is increasing (Box 15.1).

The impact of Hurricane Sandy in 2012 highlighted how risk governance frameworks need to consider these new dimensions of risk.

New York dealt comparatively well with the severe impacts of Hurricane Sandy, but the sheer scale of losses, such as the estimated US\$10 billion to the New York subway system alone—the worst damage in its history, confirm that new dimensions of risk and resilience may need to be considered, particularly in large urban areas with interconnected and interdependent infrastructure systems.<sup>ii</sup>

Both Super-storm Sandy in 2012 and the Great East Japan Earthquake in 2011 were characterised by the breakdown of electricity generation and supply systems. In today's global economy, almost all critical infrastructures, including ICT and transportation, depend on electricity (OECD, 2011). This corresponds with the survey conducted in six cities of the Americas, described in Chapter 10, where more than half of the 1,332 businesses identified business disruptions owing to power outages as a main concern when disasters hit (Sarmiento and Hoberman, 2012). Therefore, local and national governments need to identify key risk amplifiers

### Box 15.1 Making futures real – the importance of risk perceptions at senior policy levels

An innovative initiative looking at perceptions of current and long-term risks, conducted in partnership with two leading research institutes—Kings College and Ipsos MORI—and UNISDR, reached out to 30 senior policy-makers in planning and finance ministries of national governments and in relevant multilateral organisations. The initiative completed in-depth qualitative interviews that form the basis for a more systematic and regular assessment of changing risk perceptions among senior policy-makers.

Results from initial interviews mirror the findings of the HFA Monitor, and highlight the importance of continuing promotion of risk identification, data collection and risk assessment at the country level. Few country representatives reported engaging in a full risk identification process, meaning that their assessments and consequent decision-making are based mainly on known risks and uncertainty and future risks are not considered.

(Source: Kent, 2013; Ipsos MORI, 2012)

and understand the interdependencies of the many systems that carry today's societies (Menoni et al., 2012) and which create systemic vulnerabilities characterised by interconnectedness, lack of redundancy and transferability (Van der Veen and Logtmeijer, 2005).

For example, financial service organisations running business-critical applications need to ensure low latency for data transition, such as the sub-millisecond transactions required by the New York Stock Exchange. The closer the data centre is to the user, the faster data are transmitted. Thus these facilities tend to be heavily concentrated in or near urban areas. The impact of Sandy was a stark reminder that disasters can wreak havoc on these critical data centres and the companies that rely on them. In the United States of America, these facilities are all located in the same areas where over the last 50 years FEMA has declared a disaster at least once.<sup>iii</sup> Clearly, the need for backup strategies is crucial.<sup>iv</sup>

In Japan, during and after the 2011 Great East Japan Earthquake, several policies were reviewed, which resulted in changes to the existing risk governance structure. These have since been implemented (Box 15.2).

Changes such as these are occurring in other regions, based on experience of disasters and concerns about future uncertainty. The role of the private sector, both in response and recovery as well as in prospective disaster risk management, is gaining importance.

Local governments and in particular large municipalities can find strong allies among businesses with large fixed assets, such as real estate companies, developers, investment banks, large stores and property management firms to more effectively manage disaster risks (Elkin, 1987; Kataria and Zerjav, 2012; Johnson et al., 2012). 'Communities of interest' (Kataria and Zerjav, 2012) are being formed by businesses and local governments, which can

**Box 15.2** Rethinking governance structures during and after the 2011 Great East Japan Earthquake

The unprecedented scale of the disaster following the Great East Japan Earthquake of 2011 meant that not only national and local governments but also private sector and civil organizations participated in recovery. Lessons learned from this integrated approach are being fed into new policies.

1. **Strengthened Regional Cooperation:** The disaster overwhelmed the capacity of individual local governments, which received support from other less-affected municipalities. Partnerships between local governments from different provinces have since been formalised.
2. **Role of National Government to Support Local Government:** The disaster impacted directly on the functioning of local government and in many cities the subsequent lack of capacity, particularly of officials with experience in managing urban development projects, was an obstacle to recovery. In response, the national government mobilised experienced officials from all over Japan.
3. **Horizontal Cooperation at National Level:** The reconstruction process has also strengthened horizontal cooperation between all sectors. Established in February 2012, a Reconstruction Agency headed by the Prime Minister coordinates aligned activities as for example a joint effort of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of Education to develop schools as community centres and shelters for times of crisis.
4. **Public-Private Partnerships (PPPs):** Even the capital region of Tokyo faced challenges from the disaster. The government has amended legislation to allow Urban Renaissance Councils, consisting of national and local governments, real estate developers, railway companies and property owners, to develop plans for urban safety.
5. **Public Involvement:** The national government is also promoting transmission of disaster history and its lessons to future generations to decrease vulnerability; for example, through constructing archives in the National Diet Library.



play an important role in reducing vulnerability and exposure to physical hazards.

As identified in Chapter 14, however, the potential for prospective risk management is limited because those parts of government promoting investment rarely participate in national disaster risk management platforms or committees. Further, private sector participation is usually restricted to emergency management and preparedness (Johnson et al., 2012; IIHS, 2012).

Countries' self-assessments reflect this limitation, with only 36 countries out of 94 reporting on the number of private sector bodies represented in their national platforms. Of these 36, 19 countries have only 1-3 private sector representatives. Canada is a notable exception, with 20 private sector representatives; 24 academic institutions; 18 federal departments and agencies, including national finance and planning institutions; 9 provinces and territories; 15 municipalities and 2 representatives of the general public participating in its national coordination platform for disaster risk management.

In their self-assessment of progress against the HFA in 2011–2013, 52 percent of governments report on cooperation with the private sector in emergency preparedness and response. However, only a few describe a more proactive role of private businesses and ex-ante partnerships. Bangladesh, for example, reports investments to create new PPPs for integrated development with a focus on disaster risk reduction. Mauritius has made engagement in disaster risk management compulsory for businesses under a law on corporate social responsibility. Colombia has developed a new disaster risk management framework under which it explicitly sees the private sector as a strategic partner. The United States of America is addressing business interruption and helping to build resilience to disasters through a number of programmes, including 'Ready Business'.

Interestingly, the number of private sector entities included in national coordinating bodies is highest

in Africa. This means that governments are looking to the private sector for support in disaster risk management, where risk governance budgets are limited and capabilities are weakest.

## 15.4 Filling the information vacuum

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**Revealing the ownership of risk and taking on joint responsibilities among private and public actors is a key step towards effective risk reduction. However, this can only be achieved when disaster risk information is available and accessible to make visible the risks generated by the investment decisions of businesses, governments and households.**

The most important area for private sector engagement may be around hazard information and joint public-private risk assessments. PPPs to manage disaster risk will only be effective when underpinned by open and accessible risk information and disaster loss data. This is in the interest of both governments and businesses, particularly small and medium local enterprises that lack the capacity to undertake their own risk analysis (Marome, 2012).

Lack of visibility of disaster risk, and clarity over who owns what risk, remains a major barrier to taking risk into account in investment decisions. Disaster losses are often not systematically accounted for; disaster risk information is rarely available to guide either private or public decision-making; and transfer of risk between the private and public sectors and between both and civil society are rarely explicit (UNISDR, 2011; Kent, 2013). In the survey conducted among senior policy-makers in 2012, inadequate availability of disaster data was one of the most commonly stated barriers to risk assessment and planning at the national level (Kent, 2013).

Of the countries undertaking self-assessments of progress against the Hyogo Framework for Action in 2011–2013, less than half report that national and lo-

cal risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.<sup>v</sup> And only 44 of 94 countries assess future and probable risk, whereas 45 countries undertake multi-hazard risk assessments.

Only 40 percent of countries reporting through the HFA Monitor in 2011–2013 note that they have agreed national standards for multi-hazard risk assessments. However, this already represents progress compared with the last review cycle in 2009–2011 when only 25 percent confirmed having such standards in place. In 2013, 32 countries report they have a common format for risk assessments and 31 report the existence of risk assessment formats that are customised for users. Of all countries, only 18 report having both.

Although far from the majority of countries worldwide have mechanisms for collecting, storing and analysing disaster loss data regularly and systematically, a fast-growing number have recognised the

importance of this relatively low-cost, high-benefit strategy. Out of 94 countries, 73 report that they collect, monitor and analyse disaster loss data, and 58 countries confirm the existence and regular updating of national disaster loss databases. Of these, 46 make use of reports based on loss data for planning in finance, planning and sector line ministries.

Several low and middle-income countries report that systematic data collection and sharing depends on resources provided through bilateral and multilateral cooperation. Efforts in establishing systematic disaster information systems, therefore, are hampered by short-term, one-off project approaches, which are difficult to institutionalise and sustain (UNISDR, 2012).

Progress, however, is being made, as seen in Box 15.5, which provides examples on partnerships in building information bases for earthquake risk reduction.

**Box 15.5** Improving the information base on building vulnerability to earthquakes

Assessing the vulnerability of the built environment to earthquakes is extremely important in assessing potential consequences of an event, as well as mainstreaming earthquake risk reduction into the local development planning process. Understanding the response of existing structures to potential earthquakes requires the knowledge of building materials and engineering practices, which vary widely at the local level. This information base can only be reliably and sustainably developed at the local level; however, this is rarely done.

Buildings' exposure and vulnerability is an important part of the Rapid Earthquake Damage Assessment System (REDAS) developed by PHILVOLC, the Philippine Institute of Volcanology and Seismology. The Institute, in partnership with Geoscience Australia and supported by the Australian Agency for International Development (AusAID), has been developing the first national-scale building exposure database. Validation and enhancement of this database at the local level started with Iloilo City, facilitated by the Institute of Civil Engineering of the University of the Philippines Diliman (UPD-ICE) with the support of professional structural engineering societies in the Philippines. Through this engagement, the local engineering community agreed to deliver a building classification schema and corresponding earthquake vulnerability models.

Another example of successful and long-term partnership in enhancing the information base for earthquake risk reduction is the Australia Indonesia Facility for Disaster Risk Reduction (AIFDR).<sup>vi</sup> After the September 2009 earthquake that struck West Sumatra in Indonesia, AIFDR supported a team of Indonesian and international engineers and scientists who collected and analysed damage information. This team, co-led by Geoscience Australia and the Institute of Technology, Bandung, examined damaged buildings to identify the structural characteristics that may have contributed to their damage state, and provided a systematic survey of the complete populations of both damaged and undamaged structures. The project has provided a broad categorisation of the Indonesian building stock and it provides the basis for developing for a national model of the vulnerability of building structures in Indonesia.

(Source: Geoscience Australia)<sup>vii</sup>



Importantly, new initiatives bridging public and private risk assessment are emerging. Several new tools are now offered for business, including Swiss Re's Global Flood Zones component of its CATNet information platform or Maplecroft's Natural Hazards Risk Atlas.<sup>viii</sup> Although these are based on proprietary risk information and models, the insurance industry is now beginning to use public domain risk information, including information produced for the

GAR, to produce new applications for corporate clients (Box 15.6).

New PPPs are emerging for risk modelling, such as the Global Earthquake Model (GEM), which will generate common standards and platforms for both users and producers of risk information (Box 15.7).

In addition, also at local levels, alternative assess-

#### Box 15.6 Atlas empowers risk managers

Willis, one of the world's largest insurance brokers, has developed a unique risk management solution for company boards, CFOs and corporate risk managers. Atlas is a platform that assists clients to assess disaster risks across their asset base to limit their exposure to direct losses or business interruption. It gathers and interprets a range of open source and proprietary datasets, which are blended with a client's own risk information, to deliver deep insights into a company's risk profile around the world. In the development of Atlas, Willis worked closely with UNISDR and used information produced for the GAR by UNEP/GRID-Geneva from 2007 to 2011.

By using Atlas as part of their regular workflow, corporate risk managers can visualise how a range of risks can adversely affect their property and asset portfolios. The UNISDR data are used in Atlas to score each site location against a catastrophe risk index. The risk manager is also able to visually explore the sites and each global hazard within the Atlas map to quickly illustrate how, why and where the company is exposed, thereby enabling the identification of risk hotspots.

Atlas empowers risk managers to take proactive control of the risks they face. It highlights strengths, weaknesses and where improvements need to be made in a company's risk management programme. This helps a risk manager prioritise investments in risk reduction and improves business resilience and performance. At the same time, increased risk visibility and an enhanced risk management programme enables brokers, such as Willis, to secure more competitive insurance premiums from the commercial market.

(Source: Willis Re<sup>ix</sup>)

#### Box 15.7 Global partnership, forefront science and standardisation to characterise earthquake risk: the collaborative GEM initiative

The Global Earthquake Model (GEM) was launched in 2006 and has since brought together an extensive community of earthquake scientists, social scientists, including economists, as well as IT specialists, in consultation with the private sector and governments. Together they are developing a global model of earthquake hazard, exposure, vulnerability and risk, as well as tools and resources to use the model and its outputs. GEM is a non-profit initiative, driven by a PPP whose mission is to "raise risk awareness and promote preparedness" on earthquake risk.

The project is continuously evolving, and the outcome will include exposure databases containing information on socio-economic characteristics as well as physical features such as building types; an extensive catalogue of past earthquakes; and tools for characterising earthquake hazard, including modelling global stress, subduction zones and active faults, ground motion, etc. As these products become available through an open source and dynamic platform, they will be constantly updated as the science evolves and new data are collected. The GEM project further aims to develop and promote standards that will enable improved data and knowledge exchange.

(Source: GEM<sup>x</sup>)

**Box 15.8** A 'Public Hurricane Loss Model' for Florida

To address the challenge of limited access to proprietary risk models available from the insurance industry, Florida International University (FIU) in Miami has begun developing a public loss model to assess hurricane risk in Florida. The model provides results on expected annual insured losses for specific properties or by coverage, construction type, ZIP code and county for the state of Florida. It also calculates the probable maximum loss that should be insured for any specific property that can then be compared with results and premiums proposed by insurance companies.

This model does not compete with proprietary models, but instead seeks to complement them and provide additional sources of information. Thus, it was developed with the support of nine public institutions and private sector organisations and certified by the Florida Commission on Hurricane Loss Projection Methodology. Although the model already includes the quantification of economic benefits of hurricane mitigation, FIU is working to enhance the model with storm surge and flood hazard components.

(Source: Florida International University, Extreme Events Institute<sup>6</sup>)

ment instruments and risk models are being employed to provide checks and balances to proprietary models that for public entities, such as local governments or scientific institutions, can be a 'black box' (see Box 15.8). These new initiatives open the path to improved access to multi-dimensional risk information for a variety of stakeholders.

x Information provided directly to UNISDR by GEM in support of the 2013 Global Assessment Report. For more information on GEM, see: <http://www.globalquakemodel.org/>.

xi Submitted as an unpublished case study to the 2013 Global Assessment Report. For more information on the Model, see: <http://www.cis.fiu.edu/hurricaneloss/>.

## Notes

i For example, in Panama, the System for National Investment Planning (SNIP) regulation only applied to large-scale projects of more than US\$10 million (Orihuela, 2012).

ii The statement made by New York's Metropolitan Transit Authority chairman Joseph J. Lhota in the aftermath of Sandy could not be clearer. On the morning of 30 October 2012, he said: "The New York City subway system is 108 years old, but it has never faced a disaster as devastating as what we experienced last night. Hurricane Sandy wreaked havoc on our entire transportation system, in every borough and county of the region." ([http://live.reuters.com/Event/Tracking\\_Storm\\_Sandy/54277687](http://live.reuters.com/Event/Tracking_Storm_Sandy/54277687)).

iii <http://www.fema.gov/disasters/grid/year>.

iv <http://gigaom.com/2013/01/10/the-states-with-the-most-data-centers-are-also-the-most-disaster-prone-maps>.

v 41 of 94 countries, as of January 2013.

vi The Australia Indonesia Facility for Disaster Risk Reduction is a partnership between the Australian and Indonesian governments aiming to reduce the impact from natural disasters by "strengthening national and local capacity in disaster management in Indonesia, and promoting a more disaster resilient region".

vii Information provided directly to UNISDR by Geoscience Australia in Support of the 2013 Global Assessment Report.

viii [www.globalquakemodel.org](http://www.globalquakemodel.org).  
[http://www.swissre.com/reinsurance/insurers/property\\_casualty/Swiss\\_Re\\_Global\\_Flood\\_Zones\\_enabling\\_better\\_business\\_decisions.html](http://www.swissre.com/reinsurance/insurers/property_casualty/Swiss_Re_Global_Flood_Zones_enabling_better_business_decisions.html) and <http://maplecroft.com/themes/nh/>.

ix Information provided directly to UNISDR by Willis Re in support of the 2013 Global Assessment Report.





# Conclusion: From Shared Risk to Shared Value

As the ongoing global economic crisis has put a **spotlight on hidden risks** in the global economic system, **landmark disasters**, such as Hurricane Sandy in 2012 and the East Japan Earthquake and Chao Phraya river floods in Thailand in 2011, may have contributed to a **turning point in business awareness of disaster risks**.

Businesses and governments are beginning to recognise a **new category of toxic assets** as an unforeseen consequence of economic globalisation. While these toxic assets do not currently appear on their balance sheets, **embedding disaster risk management in business processes is increasingly seen as a key to resilience, competitiveness and sustainability: a business survival kit in an increasingly unpredictable, complex and fast-changing world**.

**But this change is recent, and there are few blueprints or well-worn paths to follow. In the coming years, as more businesses innovate and gain experience in this area, new paradigms will emerge that in turn will help to redefine the future of disaster risk reduction.**

The transformation of the global economy over the last 40 years has created unprecedented wealth: Global GDP grew by 75 percent between 1992 and 2011 and global GDP per capita by 40 percent, while the proportion of the world's population living in extreme poverty fell from 46 percent in 1990 to 27 percent in 2005. Global life expectancy increased by 3.5 years between 1990 and 2010, and an estimated 90 percent of the global population will have access to clean water by 2015, up from 77 percent in 1990 (United Nations Secretary General, 2012).

At the same time, and as demonstrated in this report, business practices that have accompanied economic globalisation have often led to an unsustainable accumulation of disaster risk. Large businesses felt the magnitude of this unrealised risk in the disasters associated with Super-Storm Sandy in 2012 and the East Japan Earthquake and Chao Phraya river floods in Thailand in 2011. Smaller businesses, particularly in low and middle-income countries, are reminded more regularly of the accumulation of extensive risk through recur-

rent disasters that damage the infrastructure on which they depend. As a result, both businesses and governments begin to recognise a new category of *toxic assets* as an unforeseen consequence of economic globalisation. These toxic assets do not currently appear on their balance sheets.

This recognition has yet to trigger a paradigm shift in the values that underpin business decision-making. Hazard-exposed locations offer comparative advantages, creating powerful imperatives to run the risk. But this risk is slowly but surely appearing on business radar screens, especially when assessing trade-offs between costs and opportunities involved in any new investment.

In recent years, intensive disasters have revealed disaster risks embedded in the contemporary economic landscape. As the ongoing global economic crisis has put a spotlight on hidden risks in the global economic system, these landmark disasters may have contributed to a turning point in business awareness of disaster risks. As such, disaster risk



management is being increasingly viewed less as an additional cost and more as an opportunity to enhance business resilience, competitiveness and sustainability.

But this change is recent, and there are few blueprints or well-worn paths to follow. As such, this concluding chapter offers a compass rather than detailed navigational charts. In the coming years, as more businesses innovate and gain experience in this area, a new practice will emerge that in turn will help to redefine the future of disaster risk reduction.

## 16.1 Intersecting global crisis

**Any economic system is underpinned by values (Castells et al., 2012). The increases in productivity and growth achieved during 40 years of economic globalisation have been nothing short of spectacular. But this growth has been achieved at the cost of an over-accumulation of shared risks that now threaten competitiveness and sustainability. Markets have placed greater value on short-term returns on capital than on sustainability and resilience. And businesses achieving these returns have been deemed competitive by investors.**

Evidence gathered for GAR13 attests that this veneer of competitiveness may often be illusory. Businesses have exploited comparative advantages of different locations by decentralizing and outsourcing production, and have accelerated turnover time by fine-tuning the efficiency of their supply chains. In the process, however, they have increased their own exposure and vulnerability to earthquakes, storms, tsunamis, floods and droughts. In many cases, they have also generated significant shared social and environmental risks and costs.

As a result, many apparently productive and profit-generating assets on business accounts may really be disaster-prone contingent and potential liabilities.

This contingent liability extends to (i) financial institutions—such as pension funds, sovereign wealth funds—that have invested significant parts of their portfolio in businesses whose assets are at risk; and (ii) cities and countries that have hidden and dissimulated their disaster risks to attract investment. Imagery used by cities and countries to highlight their comparative advantages is increasingly sophisticated and now relies as much on intangible values, related to quality of life, as on the basic conditions of competitiveness, such as infrastructure and the labour force. But in hazard-exposed locations, these comparative advantages are also illusory and can be dispelled with a single intensive disaster. GAR13 opened with the example of the decline of the Port of Kobe following the 1995 earthquake—once the spell is broken and business leaves, it may never return.

The global financial crisis that began in 2007 has metamorphosed into a broader economic, political and social crisis, particularly in Europe and the United States of America. One of the visible causes of the crisis was an over-accumulation of financial risk through large flows of capital into speculative, debt-financed urban development. This debt—and the risks it internalized—was then sold and shared through opaque investment vehicles that had not been assessed or valued.

The accumulation of disaster risk in recent decades is analogous. In many hazard-exposed countries, governments, institutional investors, businesses and households are now sitting on another mountain of hidden debt—the contingent liabilities represented by unrealized disaster risk. This disaster-prone capital stock, whether privately or publicly owned, represents another category of toxic assets, which do not appear on any balance sheets.

In addition, the contemporary world is characterized by unmitigated climate change, volatile energy markets, material resource, water and food scarcity, unequal wealth distribution, increasing consumption, increasing urbanization, ecosystem decline,

economic and political turmoil, rapid technological change and the increasing interconnectedness of global trade, financial markets, and supply chains (PwC, 2012, KPMG, 2012), among other factors. These processes interact with each other and are underlying drivers of disaster risk. In this context, the ripple effects of recent intensive disasters have contributed to a world viewed more and more as a set of intersecting crises where it is increasingly difficult to separate cause from consequence (Williams, 2012). Many future disasters will form part of a challenging terrain of improbable and unpredictable events.

The number of business surveys released in the last years (Deloitte, 2012; Ernst and Young, 2012; Forbes, 2012; Aon Benfield, 2011) all highlight that businesses perceive an increasingly riskier marketplace characterized by complexity, uncertainty, unpredictable events, and sudden change in which risks can manifest themselves swiftly and unexpectedly, with far-reaching ramifications.

In this environment of uncertainty and volatility, the values that underpin business are starting to change. Many businesses are becoming more risk averse and are strengthening their risk management capacities. Risk management is being increasingly perceived less as a cost and more as an opportunity and value proposition. Risk perception, therefore, seems to have gone through a point of inflection. Businesses are beginning to see effective risk management as a key competitive advantage that can enable long-term profitable growth and sustained future profitability. Many more large businesses report having a dedicated risk management department, and responsibility and accountability for risk management is increasingly being vested in the top layers of management (Deloitte, 2012).

Recent business surveys highlight the value of strong and effective risk management, including reduced operational, credit, or market losses, and improved reputation and analyst ratings (Accenture, 2011). There are at least three interrelated ways in

which investing in risk management generates results for businesses (Ernst and Young, 2012). First, identifying, assessing and addressing critical risks increases ownership and accountability, reducing uncertainty and strengthening confidence not only within the business but also among investors, analysts and regulators. Second, addressing critical risks also can lead to important cost reductions and savings, which are critical to business performance. These include avoided losses from business interruption, avoided costs of rehabilitation or relocation of damaged plant and facilities, as well as efficiencies gained from taking anticipatory or preventative actions. And third, risk management can also be key to value creation.

By analysing and valuing risks correctly, businesses can accept and own certain risks, which provide competitive advantage; savings from effective risk management can fund other strategic corporate activities; and investments in risk reduction may lead to higher returns.

Businesses that have invested the most in risk management may financially outperform their peers. A survey carried out among 576 companies and reviewing almost 3,000 analyst and company reports highlighted that the 20 percent of businesses that had invested most heavily in risk management had implemented on average twice as many key risk capabilities as the 20 percent that had least invested and on average had earnings three times greater (Ernst and Young, 2012). Embedding risk management in business processes is increasingly seen as a key to resilience, competitiveness and sustainability: a business survival kit in an increasingly unpredictable, complex and fast-changing world.

As highlighted in Chapter 11, although corporate risk management is usually focused on financial, economic, market and legal risks, there are signs that disaster risk management is becoming a real concern. One business survey now lists disaster risk as the 16th most important out of the top 50 risks, and as the 6th most important driver strengthening

risk management (Aon Benfield, 2011). Some large global consultancies and brokers are investing to develop decision platforms for disaster risk management for the business sector<sup>i</sup>, highlighting that this will be a growing market as businesses increase their investments in disaster risk management.

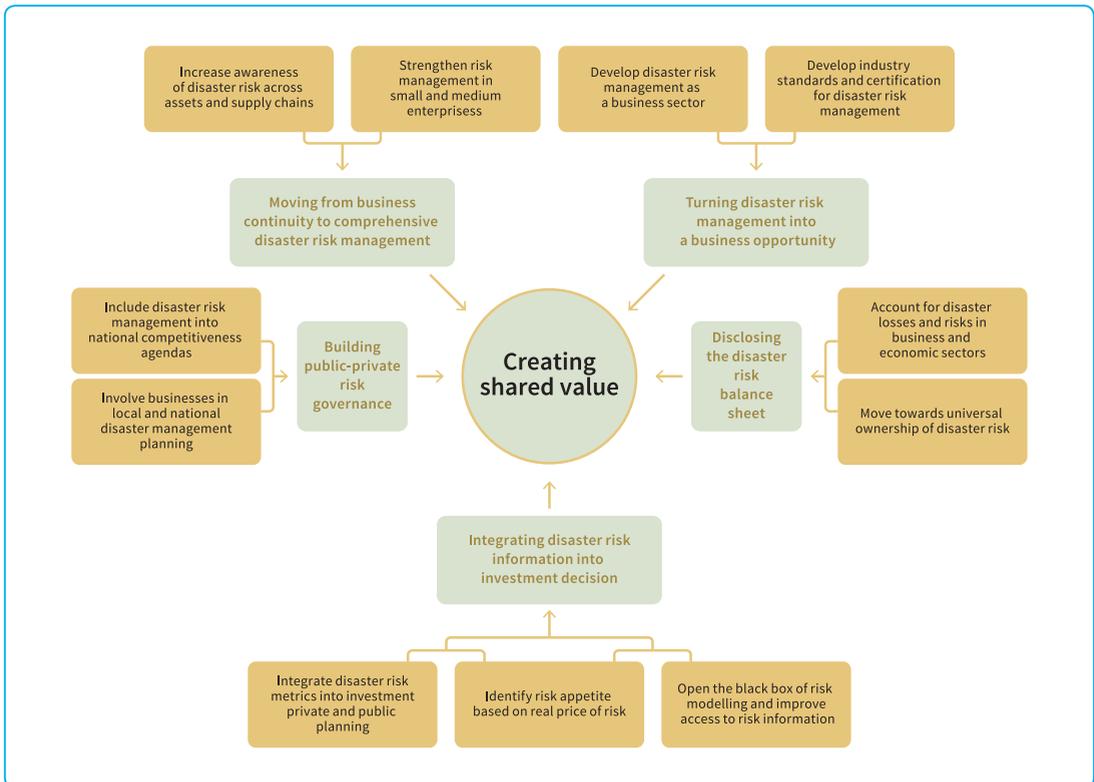
Businesses and their investors, therefore, are just starting to perceive disaster risk as a critical threat and the need to include disaster risk management as an integral component of corporate risk management. Evidence showing that investing in disaster risk management can give business a competitive edge is mounting. At the same time, as the market for corporate disaster risk management begins to develop, it creates major multiplier effects, as more and more business take investment decisions that reduce rather than increase disaster risk. In the same way that individual business investments over time can accumulate to generate systemic disaster

risk, risk-informed investments can over time reduce that systemic risk.

Global foreign direct investment (FDI) is projected to reach US\$1.8 trillion in 2013 and US\$1.9 trillion in 2014 (UNCTAD, 2012). In 2011, 46 percent of this investment went into manufacturing and another 40 percent into services, including infrastructure. And approximately US\$777 billion or half of all FDI flowed into low and middle-income countries<sup>ii</sup>. Whether or not these trillions of dollars of new investment flow into hazard-exposed areas and how the resulting disaster risks are managed will have a decisive impact on the future of disaster risk.

Businesses able to estimate and manage their disaster risks will be less likely to invest in hazard-prone areas. And if they do, they will more likely invest in measures to reduce the vulnerability of their plants and facilities. The same businesses will be

**Figure 16.1** Key areas for the future of risk governance



(Source: UNISDR)

more likely to have addressed disaster risks in their supply chains and to have increased their resilience. And the disaster risks they have decided to accept will be explicit rather than hidden on their balance sheets. More importantly, they will have recognised that investing to avoid shared risks and costs and to address the underlying risk drivers, in partnership with the public sector and civil society, is not only good but essential for business itself. Unless those shared risks are transformed into shared values future business will be neither competitive and sustainable nor resilient.

Already, nascent practices are starting to bring this emerging paradigm shift from generating shared risks to creating shared value into focus, opening new doors, encouraging further questioning, exploratory practices and innovative research. As Figure 16.1 shows, these practices suggest five broad areas of opportunity for business that in time may redefine the practice of disaster risk management.

## 16.2 Putting the disaster into corporate risk management

**As business awareness of disaster risk grows, more and more businesses will expand their existing risk management strategies to include disaster risk. While they are currently addressing disaster risk through the lens of business continuity planning, several businesses are gradually shifting their focus from preparing for and responding to disasters to identifying, analysing and managing disaster risks.**

### From business continuity planning to disaster risk management

As discussed in Chapter 11, most businesses are currently addressing disaster risk through the paradigm of business continuity planning. Analogous to emergency preparedness and response approaches in the public sector, business continuity planning enables businesses to identify potential threats to their operations and supply chains and to develop

contingency plans that enable business to be resumed quickly and with minimal disruption. By offering immediate and visible benefits, in terms of predictability and reduced losses, business continuity planning is essential to any corporate risk management strategy.

But while essential, it is only a part and not the whole. Businesses not only need to strengthen their resilience when disasters occur but also measure how their investment decisions are modifying the levels of disaster risk they face. By shifting their focus from exogenous threats to how risks are constructed through investment decisions, firms will achieve a major conceptual shift in business culture with implications for where risk management functions are located in an organisation and the profile of risk managers.

As Chapters 11 and 15 highlighted, investments are currently being made in developing new applications and platforms for visualizing and managing the disaster risks businesses face. As these and other platforms are brought to the market, corporate risk managers will have access to tools that can enable disaster risk to be integrated into broader risk management efforts, beyond the narrow focus on business continuity planning. Such frameworks and platforms can also facilitate knowledge networking with peers, scientific institutions and the public sector.

The conceptual shift from managing disasters to managing risks will be facilitated in businesses where risk management is already viewed as an integral part of investment planning and corporate strategy rather than as a specialised department that helps the business plan and manages contingencies. The shift will also be facilitated in those businesses where the risk management function includes staff with a broader understanding of the dynamics of risk rather than staff with a security and emergency management background.



### Increasing awareness of disaster risks

One obstacle to integrating disaster risk considerations into broader corporate risk management is a lack of awareness of its critical importance among corporate leaders and senior executives. Until there is greater awareness of the risks that they currently face and that may have been created through uninformed investment decisions, businesses will continue to be surprised by disasters.

At present, disaster risk management is not explicitly included in the risk management curriculum of a majority of business schools and is rarely featured in leading business journals. By adding risk management to existing business school curricula, the way that risks are managed in businesses could begin to shift.

If levels of disaster risk and its management were included systematically as an indicator in surveys of risk and business performance, and in analyst forecasts and reports, this would equally provide a strong incentive for businesses to strengthen their disaster risk management function. As further explored below, it would also encourage governments to invest in more effective disaster risk management.

### Strengthening disaster risk management in small and medium enterprises (SMEs)

As Chapter 11 highlighted, although large global corporations have risk management departments, few SMEs have the capacities to analyse or address their disaster risk. However, the growing concern of large businesses with supply chain vulnerability and resilience may provide a vehicle to support and strengthen disaster risk management in SMEs.

Rapid progress is currently being made in analysing and modelling supply chain risks. Businesses are examining different strategies to reduce supply chain risk including adding inventories; shortening supply chains and increasing supply chain visibility; design information portability; diversifying risks by creating redundancy; defining alternative distribu-

tion channels and suppliers; enhancing relationships with supply chain partners; relocating or protecting high-risk facilities; and working closely with the public sector. For example, sourcing from only one supplier can reduce production costs, but increases risk if that supplier is affected in a disaster. Although having multiple suppliers in different locations may raise transaction costs, it reduces the risk of disruption by securing supply substitutes. Similarly, businesses are now increasingly selecting suppliers on the basis of risk criteria rather than purely on cost minimization.

SMEs play a critical role in most supply chains. Large businesses have a vested interest in ensuring that their supply chain partners, including SMEs, are managing their disaster risks. Supply chain risk management may therefore become a vehicle through which large businesses with the necessary capacities can strengthen disaster risk management in SMEs, which lack those capacities.

## 16.3 Eyes wide open: integrating disaster risk information into business investment decisions

**Businesses will continue to invest in hazard-exposed locations given the comparative advantages that many of these places offer and because infrastructure and supply chains are already in place. Often, accepting a certain level of risk in a location can give a business a competitive advantage. But by integrating disaster information into a broader analysis, using appropriate risk metrics and open access information can mean that investment decisions are taken with eyes wide open.**

### Identifying risk appetite

Businesses in the tourism sector will continue to invest in SIDS; in the agribusiness sector, in countries with large areas of potentially productive farmland; and in the urban development sector, in rapidly expanding cities in low and middle-income countries.

But some businesses are now starting to include disaster risks when considering the costs and benefits and trade-offs implicit in these investment decisions.

Integrating disaster risk estimates into a broader analysis, which takes into account other considerations such as labour costs, access to markets, stability and infrastructure, would enable businesses to identify which risk layers can be reduced (for example, through investments in strengthened building or protective measures); which risks cannot be reduced; and which would have to be managed through other mechanisms, such as insurance, or those that can neither be reduced nor shared. By analysing the cost-effectiveness of these different disaster risk management strategies, businesses can decide how much disaster risk to accept and how much to invest in reducing or sharing that risk; in other words, businesses can now identify how much risk appetite is appropriate for their goals and objectives.

### **Integrating disaster risk metrics into investment planning**

To factor disaster risks into their investment decisions, businesses need access to risk information and up-to-date estimates that can be easily integrated into planning and decision-making. As a first step, this may consist of horizon scanning of the countries and cities they are considering for their investment. Developing such disaster risk profiles requires risk information and metrics at an appropriate scale and format.

At present, the growing volume of risk information being produced at different scales—by universities, scientific and technical institutions and others—is rarely standardised, compiled or aggregated in a way that can be used by corporate risk managers, finance or planning ministries or by city planners and administrators.

But this scenario is changing rapidly. As highlighted in Chapter 15, new efforts are stimulating interac-

tion and convergence between private and public risk modelling, as evidenced by the Understanding Risk conferences organised by the World Bank in 2010 and 2012<sup>iii</sup> and new platforms such as the Willis Re. Atlas platform (see Chapter 15). The GAR global risk model and national disaster loss databases, now being published by an increasing number of countries, are helping to provide open access risk metrics that can be used for business investment decisions.

The integration of disaster risk metrics into analytical business forecasts will be another critical path for improving the availability of risk information, particularly for businesses that are not able to manage their own risk identification and estimation platforms.

### **Opening the black box: open source and open access disaster risk information**

Proprietary risk models produced by the risk modelling industry are designed to provide detailed information to value the prime of specific portfolios of assets for the insurance industry and to identify potential risks of insolvency. These models are not necessarily designed to support investment decisions by businesses or governments. As highlighted in Chapter 13, this contributes to an information asymmetry in which purchasers of insurance, including businesses and governments, do not have access to the information that the insurance industry is using to determine pricing levels.

As open source and open access risk information becomes more readily available and improved, the situation may begin to change. Increased risk information availability will facilitate a healthy debate between businesses, governments and insurers regarding risk levels, patterns, trends and pricing. It may also encourage governments to develop more appropriate regulatory frameworks for the insurance industry.

Most important, it will enable a greater social awareness of disaster risks, which in turn may lead to



greater investments in disaster risk reduction from all levels—businesses; local and national governments; communities; and households.

## 16.4 Towards public-private risk governance

**As businesses start to scrutinize the levels of disaster risk internalised in cities and countries before making investment decisions, this will change their investment behaviour over time. In turn, risk-sensitive business investment will provide an important incentive for improved disaster risk management and increased investment in risk reduction by national and local governments.**

### Managing risks to strengthen competitiveness

At present, hazard-exposed cities and countries often hide or dissimulate their disaster risk to attract investment. There is only anecdotal evidence that cities and countries that effectively manage their disaster risk are more successful at attracting investment than those who understate and underplay their risk levels. However, as open access risk information becomes increasingly available to business, and as business becomes more aware of disaster risk, competitiveness strategies based on risk denial will become less effective.

As disaster risk starts being factored into business investment decisions, countries with lower risks or which can demonstrate that their disaster risks are effectively managed will have a comparative advantage to attract investment. From this perspective, attracting continued investment is likely to become one of the primary motivations for strengthening disaster risk management at the national and local levels.

Some governments are already beginning to include disaster risk management as part of their competitiveness agenda. This implies that disaster risk management will have to be integrated into the

work of trade and investment boards and ministries. For example, information should be provided on disaster risks and how they are being managed to potential investors and that information needs to be factored into the planning vehicles aimed at attracting investment in manufacturing and services, such as special economic zones, and into the granting of concessions for mining, oil and gas, timber and agriculture.

Risk-sensitive business investment will also generate a demand for analysis and forecasts that include rather than ignore disaster risk. And as that analysis is generated, it will encourage countries to invest further in disaster risk management. If, at the same time, disaster risk management is integrated into the many different competitiveness indices,<sup>iv</sup> this will provide further incentives, generating a virtuous circle in which countries and cities invest in disaster risk management to enhance their competitiveness, and businesses invest more in those countries that can demonstrate effective risk management.

In the case of some very high-risk countries, such as SIDS, strengthening disaster risk management may be the most effective way to increase competitiveness. As highlighted in Chapter 7, given their geography and small size of their economies, SIDS have many constraints to enhancing competitiveness. Precisely because such a large proportion of their capital and investment is at risk, reducing that risk can be their best chance to strengthen competitiveness and attract investment.

### New approaches to risk governance

GAR11 laid out the case for integrating disaster risk management into public investment planning and called for the strengthening of risk governance in which finance and planning ministries play a key role. This built on the findings of GAR09, which highlighted the need for strengthened partnerships between national and local governments and local communities.

Evidence presented in this report shows that risk

governance at the national and local levels is unlikely to be effective without the involvement of business. Ineffective land-use planning, vulnerable infrastructure and environmental degradation erode business competitiveness. SMEs in particular are heavily dependent on publicly managed and regulated infrastructure and services. At the same time, public regulation alone is rarely effective to regulate business investment in a way that contributes to risk reduction. Businesses, therefore, have a vested interest in the effective management of disaster risks in the city regions where they are located. And to manage those risks, national and particularly city and local governments need the participation of business.

Examples of successful coordination between public administrations and small and large businesses abound (Wedatta et al., 2012; Ingirige and Amaratunga, 2012). However, as highlighted by the national HFA reports, there is still an enormous gap between policy and strategy, on the one hand, and between implementation and accountability, on the other hand, which needs to be bridged. At the same time, many public-private partnerships (PPPs) are still limited to emergency response, reflecting the current focus on disasters rather than on risks in both public and private sectors.

Actions by the public sector are critical to all sectors. They include creating conditions for a well-structured and functioning local insurance market; producing and making available accurate, up-to-date and relevant risk information; and working jointly with business and civil society on regulating land-use, building and ecosystem services. Given its role in providing employment, public sector action to reduce risks faced by SMEs are particularly important.

The counterpart to these actions would be business participation in national and local risk governance frameworks on a strategic basis that goes beyond collaborating in emergencies through the corporate social responsibility function. This participation

could include, for example, reaching consensus on land-use planning and zoning decisions in a way that commits both business sectors and local and national governments; providing technical support to designing and implementing disaster risk management strategies and plans; and investing in risk reduction measures that benefit both business and the wider community.

## 16.5 Disclosing the disaster risk balance sheet

**Reporting on disaster risk by business is currently largely unregulated, but will become increasingly important in future. Businesses begin to undertake integrated reporting that includes information on sustainability and risks in the full picture of business performance. As disaster risks become factored into the decisions of investors, businesses will then have powerful incentives to invest in effective disaster risk management.**

### Reporting risks

As highlighted in Chapter 12, increasing pressure from government regulators is likely to provide a powerful incentive for businesses to identify, estimate and disclose both their internal and shared risks. These regulators are confronting businesses with additional sustainability-related legislation and fiscal instruments. At present, these additional regulatory requirements are largely focused on climate change. However, the scope of these instruments could easily be expanded to address other kinds of disaster risks, including those associated with geological and not just weather-related hazards. Increasingly, business, investors and governments are recognizing that more transparency is good for business. Image is improved and reputational risk diminished, which is critical given the increasing sophistication of the global media in exposing practices that increase or share disaster risk. Also the risk or litigation from those sharing the disaster risks generated by business would be



reduced. This is particularly important give new and emerging perspectives on claims and compensation.

If both disaster risks internalised in a business's own assets and operations as well as shared risks that are transferred to others are accounted for and reported, then investors would be able to factor these risks into their investment decisions, avoiding businesses with high and unmanaged disaster risk. Improved reporting would also encourage disaster risk to be factored into analyst and credit ratings, which would further encourage businesses to invest in effectively managing their disaster risks.

Similarly, improved reporting may contribute to more sensitive insurance pricing. Insurance pricing could then become another important catalyst for greater transparency in equity markets and more prudent investment practices (Stahel and Orié, 2012).

One issue that needs to be addressed is agreement on common standards and metrics for measuring and quantifying disaster risks. Estimating the cost of shared risks is not a trivial exercise, particularly when it comes to valuing natural capital. As a result, performance criteria for investment contracts and loans that take natural capital—and disaster risk considerations—into account have yet to be identified (Cambridge Programme for Sustainable Leadership, 2011b). Recent initiatives are now addressing this gap (TEEB, 2010) although there is still a need to link the real costs of externalities, such as environmental pollution or destruction of natural capital, to the cost of increased shared disaster risk.

### Universal ownership of disaster risks

Other concepts such as 'universal ownership' have the potential to encourage risk-aware investing by large institutional investors, such as pension funds and sovereign wealth funds. Given that these funds have a fiduciary responsibility to their beneficiaries for prudence and to provide sustainable long-term

income, there is a strong incentive to make investments that avoid the generation of shared disaster risks.

In principle, fund beneficiaries can gain from reduced environmental costs associated with fund investments, i.e. by reducing the corporate externalities of business investments, the value of the funds can increase, and costs—such as higher taxes to compensate for externalities—can be significantly reduced (UNEP FI and PRI, 2011).

The effectiveness of universal ownership will depend on overcoming information asymmetry, in which providers of investment opportunity know more than investors and control the information of those whose money they manage. Although fund managers may have fiduciary responsibility for prudence, this will be reinforced if beneficiaries actively encourage investments that do not lead to increasing disaster risk.

Given the volume of capital under the management of large pension and sovereign wealth funds, the effective application of the principal of universal ownership could provide a major incentive for businesses to manage their disaster risks more effectively and to ensure that their investments are risk-neutral. Stronger emphasis and direction of asset owners to their managers to integrate disaster risks into their investment strategies across all asset classes could generate significant change (IIGCC et al., 2010).

## 16.6 The business of managing disaster risks

**The size of the market for disaster risk reduction is potentially huge. The World Bank, for example, estimates that climate change adaptation will require investments of US\$75–US\$100 billion annually between 2010 and 2050 (World Bank, 2010). The costs of corrective disaster risk management may be similar. But in reality, the market is much greater. If all the US\$1.9 trillion of**

**FDI foreseen for 2014 were disaster-risk sensitive, this would represent an enormous business opportunity. And FDI is only a small proportion of total investment in produced, natural and intangible capital.**

### **Disaster risk management as a business sector**

Many businesses now see disaster risk management as both an opportunity and a key sector for development. Among companies polled by the Economist Intelligence Unit, 63 percent saw opportunities to generate value from disaster risk reduction (for example, developing new crop-insurance products or designing more resilient structures) and 20 percent had already generated new revenue (UKTI, 2011).

As highlighted in this report, these opportunities include the development of applications to provide risk estimates and information and platforms for corporate risk management. They will also increasingly embrace the design of infrastructure and buildings, of ecosystem approaches to disaster risk management, and the provision of advice and technical assistance to the public sector.

But the scope is not restricted to those activities explicitly labelled disaster risk management. A large and growing number of business initiatives are unfolding in all regions. They are creating value from the sustainable management of natural capital and the environment, from reducing energy consumption and investing in renewable energy and from involving and benefiting local communities and households.

Although many of these initiatives contribute to climate change mitigation and adaptation, environmental sustainability and increasing local incomes and employment, some already generate co-benefits vis-à-vis reduced disaster risk. The green building movement is a good example of a new business area that generates benefits in all these domains. The vast scope of these initiatives not only includes businesses but designers<sup>v</sup> and others that stimulate business innovation.

Many of these initiatives are now being driven under the sustainability agenda of businesses rather than through the risk management agenda. However, to the extent that they address underlying drivers of disaster risk—such as declining ecosystem services and badly planned and managed urban development—they will also have a major impact on the future of disaster risk. They often reflect a change of core values in a new generation of professionals entering business, which are more likely to embrace concepts such as sustainability and equity more than their peers of previous generations. But they also recognise that change requires investment and investment can mean business opportunity.

Businesses investing in these initiatives often recognise that the creation of shared value rather than shared risk is essential for longer-term business resilience, competitiveness and sustainability, while presenting immediate opportunities to generate revenue and new business opportunities.

### **Certification and standards**

The development of disaster risk management as a business sector that creates shared value will be stimulated by the introduction or adoption of certification or similar types of ‘seals of approval’ (Johannesson et al., 2013; FM Global, 2010; Mahon et al., 2012). This may include the development of international standards, such as ISO, but also voluntary industry sector-specific certification programmes.

Certification programmes already exist in a number of sectors, for example, in sustainable tourism and forestry and in energy-efficient building. At present, these programmes rarely make explicit mention of disaster risk management, though reducing disaster risks may be an important co-benefit. For example, certification of sustainable urban development can be adapted to include assessment of drainage and run-off capacity, flood risk and heat absorption.

The benefits of certification are that businesses investing in hazard-resistant building or infrastructure, for example, would probably see higher growth and



returns than those that do not, as certification is increasingly recognised and valued by consumers. This would provide a tangible incentive for businesses to invest in a way that reduces rather than creates shared disaster risks.

## 16.7 Epilogue

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This report has made the business case for disaster risk reduction. The factoring of disaster risk considerations into business investment decisions is critical to achieve more resilient, competitive and sustainable economies and societies. And creating shared value through investing in disaster risk reduction can itself be a huge business opportunity. Perhaps the most important achievement of the HFA is an enhanced global understanding of the principal pillars of disaster risk management, particularly among national and local governments and civil society. This now has to mature into a real understanding of disasters not as exogenous threats to an otherwise functioning economic and social system, but as a material expression of serious fissures in our approach to economic growth and development.

This report highlights that unless this understanding is now integrated into business investment, the possibility that the HFA goal will be achieved is remote. The future of disaster risk hinges on the extent to which business embraces disaster risk reduction.

As we now approach 2015, international efforts are intensifying to formulate a new framework for disaster risk reduction: HFA2. Ensuring that the business case for disaster risk reduction is explicitly included in that framework will provide a critical incentive for the constructive engagement by business, on which future resilience, competitiveness and sustainability depend.

### Notes

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- i PwC and Willis Re., for example.
- ii The UNCTAD report refers to developing countries, which are low and middle-income countries.
- iii <https://www.understandrisk.org>.
- iv WEF competitiveness index; UN HABITAT urban prosperity index and UNCTAD FDI attractiveness index.
- v <http://inhabitat.com/how-americas-infrastructure-can-be-strengthened-against-future-natural-disasters/3/>, <http://www.worldchanging.com/cities/>, <http://www.ecogeek.org/>, <http://greenopolis.com/>.



# Glossary

GAR13 uses an expanded set of terms and definitions building on those included in GAR09 and GAR11.

**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, injury or destroyed or damaged capital stock in a given period of time. Generic definitions of these and other terms are available in the UNISDR Glossary.<sup>1</sup> The way these terms are used in GAR13 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; therefore, 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 and number of people, factories, offices or other business assets in hazard-prone areas. **Vulnerability** is used to refer to the degree of susceptibility of these assets to suffer damage and loss, for example, due to inadequate design and construction, lack of maintenance, unsafe and precarious living conditions, lack of access to emergency services etc. **Resilience** is used to refer to the capacity of systems (ranging from national, local or household economies to businesses and their supply chains) 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, mid to 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. Geomagnetic storms, for example, have always occurred, but the associated risks are now magnified by the growing dependence of modern societies on vulnerable energy and telecommunications networks. **Underlying risk drivers** are development-related processes such as badly planned and managed urban and regional development, environmental degradation, poverty, climate change and weak governance, which shape risk patterns and trends.

In this report, data on **direct disaster losses** refer to damage to human lives, buildings, infrastructure and natural resources. Direct disaster losses to business refer to the damages to factories, offices, equipment and stocks. **Indirect disaster losses** are declines in business output or revenue incurred owing to business interruption, as a consequence of direct losses or owing to impacts on a business' supply chain. **Wider impacts** refer to, for example, loss of market share or damage to a business reputation as clients take their business to competitors, skilled workers move to other employers and relationships with suppliers are severed. **Macroeconomic effects** can be felt as a consequence of all three types of losses and impacts and can in turn negatively affect business performance through a constrained enabling business environment. **Shared risks or costs** refer to risks that are transferred in time or space to other sectors or to the wider economy. They can also be referred to as externalised social and environmental costs.

The risk assessment for GAR13 uses a **probabilistic** approach. **Probability** is defined as the likelihood of an event occurring compared to all the possible events that might occur. The **exceedance probability** is the likelihood of one event of a given magnitude occurring or being exceeded within a defined time span. **Frequency** is the expected number of times that a particular event occurs in a defined time span. **Return period** is the average frequency with which a particular event is expected to occur. It is usually expressed in years, such as 1 in X number of years. This does not mean that an event will occur once every X numbers of years, but is another way of expressing the exceedance probability: a 1 in 200 years event has a chance of 0.5 percent to occur or be exceeded every year.

**Annual average loss (AAL)** is the estimated average loss per year over a long time period considering the range of loss scenarios relating to different return periods. The **probable maximum loss (PML)** is the maximum loss that could be expected for a given return period, for example of 250 years.

**Capital stock** is made up of **produced capital**, **natural capital** and **intangible capital**.<sup>ii</sup>

**Produced capital** is the total value of machinery, equipment, structures (including infrastructure) and urban land. GAR 13 analyses **urban produced capital**, defined as the produced capital in urban areas with more than 2,000 inhabitants. Exposed produced capital refers to the urban produced capital stock that is exposed to natural hazards. **Natural capital** is the total value of existing non-renewable resources (including oil, natural gas, coal and mineral resources) as well as cropland, pastureland, forests and protected areas. **Intangible capital** includes values such as human capital, institutional infrastructure and social capital.

**Gross fixed capital formation** is the total value of capital investment by the private and public sectors in a given year. In GAR13, relative disaster risk is estimated by comparing the **AAL** for earth-

quakes and tropical cyclones with urban produced capital and gross fixed capital formation. In the case of tsunamis, relative disaster risk is estimated using the proportion of urban produced capital exposed to tsunamis.

**Disaster risk reduction (DRR)** describes the policy objective of reducing risk. **Disaster risk management (DRM)** describes the actions that aim to achieve this objective. Actions 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 that shares and spreads risks; and **disaster management** measures such as business continuity planning, preparedness and response. Risk governance is used to describe how national or local governments work with business, civil society and other actors to organize DRM, including, for example, through institutional arrangements, legislation, policies and strategy.

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i See UNISDR, 2009. Terminology on Disaster Risk Reduction. Geneva, Switzerland: UNISDR.

ii Based on a definition developed by the World Bank to estimate the wealth accumulated historically in a country (World Bank, 2010a).

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Vilayphong, Bouasy Thammasack, Thitiphon Sinsupan, Hang Thi Thanh Pham, Thanongdeth Insisiengmay, Somvath); **Lebanon:** Office of the Prime Minister and UNDP (Nathalie Zaarour, Lama Tabbara, Bilal El-Ghali); **Mali:** Protection Civil du Mali (Mamadou Traore, Diawoye Konte, Aboudra Koungoulba, Savane Foulematou SY); **Mexico:** La Red de Estudios Sociales en Prevención de Desastres - LA RED (Elizabeth Mansilla); **Mozambique:** Instituto Nacional de Gestão de Calamidades -INGC and UNDP (Dulce Chilundo, Eunice Mucache, Antonio Queface); **Nepal:** National Society for Earthquake Technology -NSET (Amod Dixit, Gopi Bashal); **Nicaragua:** Sistema Nacional para la Prevención, Mitigación y Atención de Desastres - SINAPRED (Ana Isabel Izaguirre, Mercedes Martínez, Gisela Guevara, Carlos Olivares, Noé Ubau, Ernesto González); **Orissa:** State Disaster Management Authority (Kalika Mohapatra, Ambika Prasad); **Pacific Islands:** SPC/SOPAC (Jutta May, Nicole Daniels, Litea Biukoto); **Panamá:** Sistema Nacional de Protección Civil - SINAPROC (Eric Reyes, Kenat Saarim Camaño Guerra); **Perú:** Centro de Estudios de Prevención de Desastres - PREDES (José Sato Onuma, Alfonso Diaz Calero, Julio Meneses Bautista, Yeselin Díaz Toribio, Ingrid Azaña Saldaña); **Sri Lanka:** Ministry of Disaster Management (Dinesh Rajapaksha); **Syrian Arab Republic:** Ministry of Local Administration (Kinda Muhana, Claude Amer); **Timor Leste** National Disaster Operation Centre - NDOC, Ministry of Social Solidarity (Lourenco Cosme Xavier, Maarten Visser); **Uganda:** Office of the Prime Minister, Department of Disaster Preparedness and Management (Samuel Akera, Charles Odok); Uruguay: Sistema Nacional de Emergencias de la Presidencia de la República - SINAE (Virginia Fernandez, Sabrina Pose, Soledad Camacho, Ana Maria Games, Pablo Capurro); **Venezuela:** Dirección Nacional de Protección Civil y Administración de Desastres - DNPCAD (Jairo Sanchez, José Scire); **Vietnam:** Ministry of Agriculture and Rural Development and UNDP (Ian Wilderspin, Miguel Coulier, Oanh Luong Nhu, Nguyen Thi Thu Thuy); **Yemen:** Ministry of Environment (Majed Alrefai).

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# Index

## UN list of country names and territories

### A

Albania	88
Algeria	88, cclv
Americas	iv, v, xviii, 29, 184, 228, cclxxiii
American Samoa	65, 76, 107
Angola	88
Anguilla	88, 150, 222, ccliii
Antigua and Barbuda	88,
Argentina	88, 156, ccliii
Armenia	ccliii
Aruba	88
Australia	50, 64, 65, 88, 94, 95, 160, 200, 220, 231, 233, ccli, cclii, ccliii, ccliv, cclv, cclvi, cclxv, cclxxvii
Austria	ccli, cclv

### B

Bahrain	222, ccliii
Bangladesh	48, 126, 127, 129, 212, 230, ccliii
Barbados	109, 143, ccl, ccliii
Belarus	ccliii
Belgium	40, 88, 104
Belize	61, 88
Bhutan	80, 138, 139
Bolivia	76, 88, ccliii
Bolivia (Plurinational State of)	76, 88
Bosnia and Herzegovina	96
Brazil	
British Virgin Islands	88, ccliii
Brunei Darussalam	88
Bulgaria	ccliii
Burkina Faso	212, ccliii
Burundi	88

### C

Cambodia	ccliii, cclx
Canada	viii, 35, 159, 189, 194, 220, 230, cclii, ccliii
Cape Verde	69, 88, 143
Cayman Islands	88, 106, cclx
Central African Republic	88
Chile	35, 128, 189, ccliii, cclxxv
China	iv, vi, 30, 31, 35, 44, 48, 56, 57, 58, 61, 62, 63, 80, 81, 88, 104, 123, 142, 158, 174, 202, 204, 213, 216, 217, 221, ccli, ccliii

Colombia	28, 29, 35, 69, 70, 76, 80, 81, 82, 94, 133, 189, 222, 225, 227, 230, ccl, ccliii, ccliv
Comoros	88, ccliii
Cook Islands	65, 76, 150, ccliii
Costa Rica	29, 33, 35, 76, 189, 218, 224, 225, ccl, ccli, cclii, ccliii, cclv
Croatia	ccliii, ccliv
Cuba	88
Czech Republic	88, ccliii

### D

Democratic Republic of the Congo	88
Djibouti	xviii, 72, 76, 88, ccliii
Dominica	88, 106
Dominican Republic	80, ccliii

### E

East Timor	76
Ecuador	76, 88, 138, cclii, ccliii
Egypt	164, 165, cclxxvii
El Salvador	71, 76, 81, 88, ccli, cclii, ccliii
Ethiopia	vii, xviii, 72, 76, 88, 98, 102, 161, 162, 165, 167, 212, 225, 226, ccl, ccliii

### F

Fiji	76, 113, 144, 145, 147, 148, 149, 150, ccliii
Finland	ccliii
France	ii, 182, 206, ccli, ccliii, cclv
French Polynesia	64, 76, 88

### G

Georgia	65, 88, ccli, ccliii
Germany	31, 88, 186, 213, ccli, ccliii, ccliv
Ghana	69, 88, 161, 162, ccli, ccliii
Gibraltar	88
Greece	88, 98, ccliii
Grenada	88, 144, 147
Guadeloupe	61, 88, 106
Guam	65, 76
Guatemala	75, 76, 88, 218, 220, ccliii, Guyana xviii, 72, 76, 88, ccliii

<b>H</b>	
Haiti	46, 57, 58, 88, 195
Honduras	v, xviii, 72, 73, 75, 76, 81, 82, 83, 85, 87, 88, ccliii
Hong Kong	57, 58, 61, 63, 88, 104, 216
Hungary	ccliii
<b>I</b>	
Iceland	30
India	iv, vii, 30, 48, 65, 87, 94, 123, 131, 134, 142, 158, 164, 170, 174, 213, 217, 218, 219, 222, ccl, ccli, cclii, ccliii, cclv
Indonesia	30, 62, 64, 88, 166, 195, 218, 221, 222, 231, 233, ccliii
Iran	56, 57, 58, 88, ccliii, cclv
Iraq	88
Ireland	63, 88, ccliii
Israel	ccliv
Italy	88, 98, 118, 129, ccl, ccli, cclii, ccliii, ccliv, cclv
<b>J</b>	
Jamaica	35, 72, 76, 111, 112, 189, ccliii
Japan	ii, iii, iv, vii, xv, xx, 23, 24, 25, 26, 30, 31, 32, 33, 35, 48, 50, 52, 55, 56, 57, 61, 62, 63, 64, 81, 87, 133, 135, 183, 189, 196, 201, 204, 217, 220, 228, 229, 235, ccl, ccliii, ccliv, cclv, cclvi
Jordan	ccliii
<b>K</b>	
Kazakhstan	156, ccliii
Kenya	xviii, 69, 72, 76, 97, 98, 99, 100, 102, 166, 167, 168, 195, ccli, cclii, ccliii, ccliv, cclv
Kiribati	76, ccliii, cclxxxi
Korea, Republic of	24, 88, 139, ccliii
<b>L</b>	
Lao People's Democratic Republic	xviii, 72, 73, 74, 76, 88, ccliii, cclxx, cclxxxi
Lebanon	xviii, 72, 73, 74, 76, cclii, ccliii, cclv
Lesotho	213, ccliii
Liberia	161, 162
Libya	88
Liechtenstein	88
<b>M</b>	
Macao (Special Administrative Region of China)	62
Macedonia (The former Yugoslav Republic of)	98, ccliv, cclxxxi
Madagascar	46, 83, 84, 87, 161, 162, cclxvii
Malawi	88, 98, 167, ccliii
Malaysia	30, 35, 88, ccliii
Maldives	63, 106, 107, 143, 144, 147, 149, ccliii
Mali	xviii, 72, 76, 88, 100, 161, ccliv
Mariana Islands	65, 76,
Marshall Islands	76, 227, ccliii,
Martinique	61, 88,
Mauritius	230, ccliii
Mayotte	88
Mexico	viii, 61, 75, 80 - 82, 85, 88, 91, 159, 184, 204, 206, 218, 220 - 222, 226, 227, ccl-cclv
Micronesia	76, 88, 104, ccliii,
Monaco	88, ccliii,
Mongolia	88,
Montenegro	88,
Morocco	ccliii,
Mozambique	v, 69, 73, 78, 81, 88, 98, 102, 103, 161, ccliv
Myanmar	88, 213, ccliii,
<b>N</b>	
Namibia	88, 225
Nauru	65, 76, ccliii
Nepal	85, 88, cclii, cclv
Netherlands	65, 133, 140, 203, ccliii
New Caledonia	76, 88
New Zealand	iii, viii, 30, 32, 33, 50, 139, 203, 204, ccli-ccliii
Nicaragua	xviii, 72, 76, 81, 88, cclv
Niger	88, 98, 102 - 104, 166, 167, ccliii
Nigeria	93, 127, 166
Niue	65, 76, 213, ccliii
Northern Mariana Islands	65, 76
Norway	2, 204, ccli-ccliii, cclvi
<b>O</b>	
Oman	63, 88
<b>P</b>	
Pakistan	iii, 26, 87, 94, 213, ccliii
Palau	76, 88, ccliii
Panama	88, 134, 135, 140, 218, 220, 224, 233, cclii, ccliii, ccliv
Papua New Guinea	56, 76, 88, 212, ccliii,
Peru	76, 218, 222, 224, 225, ccliii, cclxxiii,
Philippines	30, 52, 56, 57, 61, 80, 85, 87, 218, 221, 231
Pitcairn Islands	76
Poland	ccliii

Portugal	98, ccliii
Puerto Rico	52, 61, 88, 104, 109

## R

Réunion	88
Romania	65, ccliii
Russian Federation	88, 156, 159, 160, ccliv
Rwanda	88, 212, ccliii

## S

Saint Kitts and Nevis	ccliii
Saint Lucia	88
Samoa	61, 76, 88, 106, 107, 144, ccliii
San Marino	88
Sao Tome and Principe	88
Saudi Arabia	88
Senegal	69, 88, 222, cclii
Serbia	88, 98, 128, ccliii
Sierra Leone	46
Slovenia	ccliii
Solomon Islands	57, 63, 76, 88, 106, 107, 110, ccliii
South Africa	198
South Sudan	161
Spain	57, 58, 88, 98, 101, ccl
Sri Lanka	76, 145, 220, ccliii, ccliv
State of Palestine	212, ccliii
Sudan	88, 98, 161
Suriname	88
Swaziland	88
Sweden	88, 139, 194, 220, ccliii
Switzerland	ii, 31, 88, 222, ccl - ccliii, cclv
Syrian Arab Republic	88, 102, ccl, ccliv

## T

Taiwan (Province of China)	88, cclv
Tajikistan	88
Thailand	iii, vi, xv, 25, 30, 31, 33, 35, 49, 50, 54, 149, 165, 195 - 198, 204, 214 - 216, 222, 235, cclii
Timor-Leste	xviii, 65, 72, 76, cclv
Togo	ccliii
Tokelau	65, 76
Tonga	76, 88, 107, 110, 150, ccliii
Trinidad and Tobago	111, ccliii
Tunisia	88
Turkey	88, 98, 129, ccliii
Turkmenistan	88
Turks and Caicos Islands	88, 106, ccliii

Tuvalu	76, ccliii
--------	------------

## U

Uganda	xviii, 72, 73, 76, 98, 100, 104, ccliii, ccliv
Ukraine	88, 156
United Arab Emirates	88
United Kingdom of Great Britain and Northern Ireland	30, 63, 88, 129, 130, 134, 197, ccl, ccli, ccliii
United Republic of Tanzania	69, 88, ccliii
United States of America	xv, 27, 30, 35, 44, 48, 52, 56, 57, 61, 63, 64, 81, 87, 88, 94, 95, 127, 137, 144, 148, 158 - 160, 166, 189, 192, 194, 201, 206, 219, 222, 225, 229, 230, 236, ccliii, cclvi
United States Virgin Islands	88
Uruguay	xviii, 72, 76, 88, 213, ccliii, ccliv
Uzbekistan	88

## V

Vanuatu	56, 76, 88, 106, 225, ccliii
Venezuela	76, 88, ccliv
Viet Nam	72, 76, 88, 128, 146, 147, ccliv

## W

Wallis and Futuna Islands	76
---------------------------	----

## Y

Yemen	88, ccliv
-------	-----------

## Z

Zambia	161
Zimbabwe	88

agribusiness	vii, xix, 34, 50, 90, 94, 104, 118, 119, 151-154, 160, 162-165, 168, 170-173, 197, 240
annual average loss (AAL)	53, 54, 55, 56, 57, 58, 59, 60, 61, 75, 76, 79, 80, 81, 98, 106, 107, 108, 109, 110, 113, 122, 217, ccxlix
business continuity	v, ix, 183-187, 189, 200, 204, 239, ccxlix
capital stock	25, 35, 39, 42, 45, 52, 63, 80, 81, 114, 236, ccxlviii, ccxlix
climate change	iii, xiii, xv, xvii, 48, 49, 50, 90-92, 100, 101, 106, 109, 112, 113, 130, 135, 136, 138, 143, 162, 163, 165, 186, 193, 195, 197, 203, 221, 225, 236, 243-245, ccxlviii
corrective risk management	222, 224, 225, ccxlix
cyclone wind (see also cyclonic wind)	v, vii, 45, 52, 58-61, 65, 79, 80, 81, 91, 92, 106, 107, 109-111, 122

Disaster Deficit Index (DDI)	84, 85	probability	49, 52, 53, 57, 62, 64, 78, 98, 102-104, 130, 195, 207, 226, ccxlviii, ccxlix
direct losses	iv, 23-30, 34, 35, 38, 39, 78, 86, 87, 90, 102, 109, 118, 136, 139, 143, 144, 162, 185, 221, 232, ccxlviii	produced capital	42-47, 52, 53, 55-58, 60-63, 65, 69, 80, 90, 93, 94, 106-109, 111, 122, 148, ccxlix
drought	v, vii, 34, 35, 39, 68, 90-92, 94, 97-104, 109, 152, 159-167, 170, 172, 194, 195, 197, 218, 221, 227, 236, ccxlviii	prospective (disaster) risk management	188, 210, 218, 220, 224, 225, 228, 229, 230, ccxlix
earthquake	iii-vii, xv, xvi, 23-26, 30-34, 39, 42, 44, 46, 47, 52, 53, 55-58, 61, 62, 64, 79-81, 85, 106-113, 118, 122, 131, 132, 135, 137, 139, 183, 187, 189, 198, 201-204, 206, 207, 222, 227-229, 231, 232, 235, 236, ccxlviii, ccxlix	resilience	vi-ix, xv-xix, 29, 34, 39, 49, 69, 77-81, 106, 109, 112, 114, 124, 135, 138, 142, 148, 149, 152, 160, 166, 168-173, 178, 179, 183, 195, 200, 220, 225, 226, 228, 230, 232, 235-237, 239, 240, 245, 246, ccxlviii
economic resilience	78, 81, 106, 109, 112, 138	return period	45, 53, 55, 58-60, 62-65, 68, 71, 75, 80, 83, 84, 98, 108, 109, 114, 125, 130, 131, 133, 147, 150, ccxlix
extensive risk	26, 34, 39, 68-76, 122, 133, 179, 235, ccxlviii	risk financing	78, 82, 84, 202, 219, 224, 226, 227
financing gap	v, 81-86, 112, 226	risk governance	viii, ix, xiv, 135, 177, 179, 182, 186, 202, 209, 210, 216, 217, 228-230, 238, 242, 243, ccxlix
flood	iii, v, vi, xv, xviii, 24-28, 30, 31, 33, 34, 39, 44-46, 48-50, 54, 55, 58, 65, 68, 69, 83, 85, 91, 106-109, 114, 127-140, 144-147, 160, 162, 164, 165, 169, 170, 178, 186, 187, 195-198, 200-204, 206, 215-218, 220, 221, 225, 232, 233, 235, 236, 245, ccxlviii	Risk Reduction Index (RRI)	46, 93, 104
food security	90, 119, 151-153, 156, 163, 165-169	risk transfer	xvi, 49, 82, 90, 91, 113, 131, 165, 219, 224
foreign direct investment (FDI)	xix, 33, 43, 44, 196, 204, 214-217, 238, 245, 246	Special Economic Zone (SEZ)	vi, 216, 242
global risk model	iii, xvii, 34, 39, 45, 52-60, 63, 79, 80, 106-108, 110, 111, 241	shared risk	xv, xvi, xix, 49, 50, 90, 91, 118, 126, 127, 133-135, 179, 185, 194, 235, 236, 239, 243-245
gross capital fixed formation	xiv, xx, 25, 35, 65, 75, 76, 78, 79, 81, 86, 88, 110, 111, 217, ccxlix	shared value	xiii, xv-xvii, xix, 34, 50, 119, 170, 171, 178, 179, 235, 239, 245, 246
Hyogo Framework for Action (HFA)	xiii, xiv, xviii, 46, 129, 150, 153, 210-214, 217-222, 224-226, 228, 230, 231, 243, 246	small and medium enterprise (SME)	25, 26, 28, 31-34, 49, 76, 118, 130, 145, 184, 186, 189, 230, 240, 243
hidden risks	vi, 41, 192-194, 197, 235	tourism	vii, xix, 34, 35, 44, 109, 118, 142 - 150, 162, 215, 240, 245
indirect losses	23-27, 29, 30, 33, 35, 39, 52, 56, 69, 76, 78, 86, 102, 109, 143, 144, 185, 221	toxic assets	v, 235, 236
intangible capital	42, 245, ccxlix	tsunami	iii, iv, xvi, 24, 25, 30 - 34, 39, 42, 44, 52, 55, 61 - 65, 106 - 108, 113, 114, 122, 133, 139, 143 - 145, 147, 149, 150, 198, 204, 206, 236, ccxlviii, ccxlix
intensive risk	51, 52, 68, 73, 75, 122, 125, 133, 204, 206, ccxlviii	underlying risk drivers	xiii, xiv, xvii, 46, 68, 163, 213, 239, ccxlviii
land degradation	v, 33, 39, 90, 94, 96, 98, 101, 102, 158, 162, 163	urban development	xv, xix, 34, 43, 46, 49, 50, 68, 92, 118, 122 - 131, 133 - 135, 139, 162, 221, 225, 229, 236, 240, 245
landslide	v, xv, 25, 39, 68, 69, 71, 129, 198, 227, ccxlviii	urban produced capital	52, 53, 55 - 58, 60, 61, 63, 65, 106 - 109, 122, ccxlix
macroeconomic effects	23, 24, 35, 56, 78, 86, 88, ccxlviii	value chain	119, 153, 154, 170, 192, 193
Millennium Development Goals (MDGs)	xiii, xx, 114, 133	virtual water	164, 174
national revenue	80, 88	vulnerability	xvii, 30, 42, 45, 46 - 48, 50, 52, 53, 54, 56, 57, 58, 61, 63, 68, 69, 80, 83, 85, 90, 92, 112, 113, 119, 136, 142, 143, 150, 166, 167, 170, 183, 186, 202, 221, 227 - 232, 236, 238, 240, ccxlviii
natural capital	v, 34, 39, 42, 88, 89-98, 101, 102, 104, 162, 163, 171, 198, 216, 244, 245, ccxlix	water risks	ccxxxiii
probable maximum loss (PML)	52, 53, 54, 57, 58, 60, 61, 80, 85, 107, 233, ccxlix	wider impacts	23, 24, 31, 33, 35, 78, 87, 144, 200, ccxlviii
public-private partnership (PPP)	133, 134, 139, 140, 162, 170, 182, 201, 203-205, 227-230, 232, 243	wild (land) fires	v, 34, 39, 68, 90 - 92, 94 - 97, 102



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Interactive main report in English

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Interim national progress reports on the implementation of the Hyogo Framework for Action

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