2009 Global Assessment Report on Disaster Risk Reduction

Risk and poverty in a changing climate

Invest today for a safer tomorrow

United Nations

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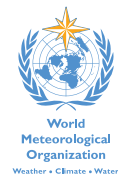

The Kingdom of Bahrain, the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the Government of Norway, the Government of Switzerland, the ProVention Consortium and the Gesellschaft für Technische Zusammenarbeit (GTZ) contributed financial resources that enabled the successful development of this first biennial Global Assessment Report on Disaster Risk Reduction.

The following organisations, among others, have provided substantive inputs to the Report's analysis.

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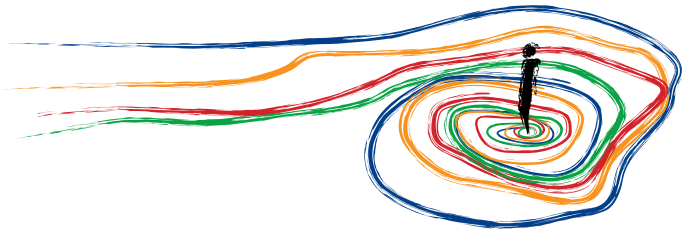

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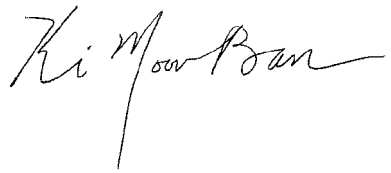
Foreword

This first edition of the United Nations *Global Assessment Report on Disaster Risk Reduction* is not only a comprehensive review and analysis of the natural hazards menacing humanity. It also provides new and arresting evidence on how, where and why disaster risk is increasing globally. That risk is highly concentrated in middle- and low-income countries, and is felt most acutely by people living in poor rural areas and slums. But of course, wealthier countries are not immune, as bush fires in Australia reminded us so tragically at the start of this year. The risk of disaster touches every woman, man and child on Earth.

Drawing on detailed studies, this *Global Assessment* urges a radical shift in development practices, and a major new emphasis on resilience and disaster planning. Floods, droughts, storms, earthquakes, fires and other events, when combined with 'risk drivers' such as increasing urbanization, poor urban governance, vulnerable rural livelihoods and the decline of ecosystems, can lead to massive human misery and crippling economic losses. The risks posed by global climate change and rising sea levels carry additional grave implications for how we will live in the near future.

While we cannot prevent natural phenomena such as earthquakes and cyclones, we can limit their impacts. The scale of any disaster is linked closely to past decisions taken by citizens and governments – or the absence of such decisions. Pre-emptive risk reduction is the key. Sound response mechanisms after the event, however effective, are never enough.

The current rate of progress is inadequate if we are to achieve, by 2015, the substantial reduction of disaster losses called for in The Hyogo Framework for Action and in the Millennium Development Goals. Fortunately, we know what to do. This Report sets out a range of much-needed action and provides compelling evidence that investing in disaster risk reduction is a cost-effective means to protect development, reduce poverty and adapt to climate change. I commend this important and impressive collaborative effort by the UN International Strategy for Disaster Reduction system to policymakers and all others involved in the essential quest to build a safer world.



Ban Ki-moon
Secretary-General of the United Nations

Preface

Development efforts are increasingly at risk. A faltering global economy, food and energy insecurity, conflict, global climate change, declining ecosystems, extreme poverty and the threat of pandemics are amongst the factors challenging progress towards improving social welfare and economic stability in many developing countries. As a series of catastrophes in 2008 yet again reminded us, disaster risks associated with hazards such as tropical cyclones, floods, earthquakes, droughts and other natural hazards form a critical part of this interlocking constellation of threats and constitute a critical challenge to development.

The *2009 Global Assessment Report on Disaster Risk Reduction* focuses attention on this challenge. The Report identifies disaster risk, analyses its causes and effects, shows that these causes can be addressed and recommends means to do so. The central message of the Report is that reducing disaster risk can provide a vehicle to reduce poverty, safeguard development and adapt to climate change, with beneficial effects on broader global stability and sustainability.

The *2009 Global Assessment Report on Disaster Risk Reduction* is the first biennial global assessment of disaster risk reduction prepared in the context of the International Strategy for Disaster Reduction (ISDR). The ISDR, launched in 2000, provides a framework to coordinate actions to address disaster risks at the local, national, regional and international levels. The Hyogo Framework for Action (HFA), endorsed by UN member states at the World Conference on Disaster Reduction, Kobe, Japan, in 2005, commits all countries to make major efforts to reduce their disaster risk by 2015. It is expected that this Report will help focus international attention on the problem of disaster risk and to consolidate political and economic support and commitment to disaster risk reduction.

The focus of this Report is the nexus between disaster risk and poverty, in a context of global climate change. Both mortality and economic loss risk are heavily concentrated in developing countries and within these countries they disproportionately affect the poor. Disaster impacts have persistent, long-term negative impacts on poverty and human development that undermine the achievement of the Millennium Development Goals (MDGs). The Report identifies underlying risk drivers such as vulnerable rural livelihoods, poor urban governance and declining ecosystems that shape the relationship between disaster risk and poverty. It also shows how climate change will magnify the uneven social and territorial distribution of risk, increasing the risks faced by the poor and further amplifying poverty.

The Report argues the need for an urgent paradigm shift in disaster risk reduction. Current progress in implementing the HFA is failing to address these underlying risk drivers and the translation of disaster impacts into poverty outcomes. Efforts to reduce disaster risk, reduce poverty and adapt to climate change are poorly coordinated. At the same time, however, innovative approaches and tools, in areas such as urban governance, ecosystem management, sustainable rural livelihoods, risk transfer and local and community-based approaches, exist and are being applied creatively at the local level and in different sectors throughout the developing world. The challenge identified by the Report is to link and focus the policy and governance frameworks for disaster risk reduction, poverty reduction and climate change adaptation in a way that can bring these local and sectoral approaches into the mainstream. This will not only facilitate the achievement of the HFA: it will contribute towards poverty reduction and the achievement of the MDGs. Importantly, it also provides a vehicle to enable countries to adapt to global climate change.

The *2009 Global Assessment Report on Disaster Risk Reduction* is a collaborative effort of the ISDR system. The Report has been prepared and coordinated by UNISDR in partnership with

the United Nations Development Programme (UNDP), the World Bank, United Nations Environment Programme (UNEP), World Meteorlogical Organization (WMO), United Nations Educational, Scientific and Cultural Organization (UNESCO), the ProVention Consortium, regional intergovernmental and technical institutions, national governments, civil society networks, academic institutions and many other ISDR system partners. A number of parallel activity streams, undertaken over an 18-month period, have contributed to the Report:

- A global disaster risk analysis was carried out involving a major global effort by a large number of scientific and technical institutions. Major methodological innovations have enabled a more accurate characterization of global mortality and economic loss risk for natural hazards such as floods, tropical cyclones and landslides, the identification of key risk drivers and trends and an initial characterization of economic resilience. Each of the hazard updates was reviewed by a panel of international scientists.
- An analysis of disaster risk at the local level was similarly based on a major coordinated effort by a large number of institutions to compile, update and validate data from national disaster databases in 12 countries. This analysis sheds light on the emergence of patterns and trends of extensive disaster risk, affecting wide areas and manifested as frequent, but relatively low-intensity, losses. In addition, empirical research was conducted to examine disaster risk–poverty interactions at the local- and household levels.
- Specialized international research institutes were commissioned to produce a series of issue papers that provided the basis for an analysis of the underlying risk drivers that configure the disaster risk–poverty nexus in both rural and urban contexts.
- A review of progress towards the achievement of the HFA was completed by 62 countries (as of February 2009), against 22 core indicators and 5 benchmarks, using an on-line 'HFA Monitor' tool. Thematic practice reviews were also produced for the Report on early warning systems, financial mechanisms, local- and community-level approaches, urban disaster risk reduction, environmental management, disaster risk reduction governance, climate change adaptation and sustainable livelihoods. Other partners contributed case studies and practice reviews across a wide range of disaster risk reduction practice areas. The review process not only highlighted the progress being made against the HFA but also a range of innovative approaches and practices that address the underlying risk drivers.

The Report has been drafted to inform the Second Session of the Global Platform for Disaster Risk Reduction to be held in Geneva on 16–19 June, 2009. As such its principal audience is national-level policy makers in disaster prone countries as well as the regional and international organizations that support such countries.

While the Report addresses the relationship between disaster risk and poverty in a context of climate change, its central focus is on disaster risk reduction. It has not been possible, nor was it intended, to provide a comprehensive review of policies, research and practice in poverty reduction and climate change adaptation. Nevertheless, disaster risk reduction is a key paradigm through which both poverty reduction and climate change adaptation can be addressed. One of the key messages of the Report is that by addressing the underlying drivers of disaster risk it is possible to reduce poverty and to adapt to climate change.

The Report builds on conceptual frameworks and terminology developed over the years by the disaster risk reduction community. This is an important point given that both the poverty reduction and climate change communities assign different meanings to terms such as hazard, vulnerability, risk and mitigation. Unless otherwise stated, the terminology used in this report is that contained in a glossary recently published by UNISDR[1]. The Report is presented in three different formats for different audiences:

A short **Summary and Recommendations document** provides an overview of the key findings and recommendations of the Report for

national governments, regional and international organizations as well as for policy makers from civil society and the private sector.

The main body of **the Report** is structured around seven chapters and provides technical information for disaster risk reduction policy makers, practitioners and researchers:

- Chapter 1: *The global challenge: disaster risk, poverty and climate change* provides an overview of the key policy issues addressed in the Report.
- Chapter 2: *Global disaster risk: patterns, trends and drivers* presents the findings of the global risk analysis.
- Chapter 3: *Deconstructing disaster: risk patterns and poverty trends at the local level* presents an analysis of national level disaster and poverty data.
- Chapter 4: *The heart of the matter: the underlying risk drivers* analyses the role of vulnerable rural livelihoods, poor urban governance, declining ecosystems and global climate change in configuring disaster risk.
- Chapter 5: *Review of progress in the implementation of the Hyogo Framework for Action* presents an overview and analysis of the progress reports prepared by countries, a desk review of the integration of disaster risk reduction into poverty reduction strategies and climate change adaptation policy, and a review of progress in thematic areas such as early warning.
- Chapter 6: *Addressing the underlying risk drivers* identifies and examines best practice for addressing the disaster risk–poverty nexus in areas such as good urban and local governance, strengthening rural livelihoods, ecosystem management, innovative financial mechanisms and local- and community-level disaster risk reduction.
- Chapter 7: *Investing today for a safer tomorrow* presents the conclusions and recommendations of the Report.

A series of **Appendices**, as well as background papers commissioned for the Report, are available in the accompanying CD-Rom and also online at PreventionWeb [2]. These are made available for specialists who wish to have a more in-depth exploration of the issues addressed in the Report. The quantitative data used to produce the Report are also available as an online Global Risk Data Platform at PreventionWeb, allowing researchers to perform their own analysis. It is expected that this will encourage innovative new research that in turn will feed back into future iterations of the ISDR Global Assessment Report on Disaster Risk Reduction.

While a considerable body of evidence has been produced to support the recommendations of the Report, it is also necessary to highlight areas that have not been addressed. Constraints in data and methodology have not allowed the modelling of drought risk or an adequate characterization of losses in the agricultural sector and rural areas. Qualitative evidence from case studies and the results of empirical microstudies of disaster risk–poverty interactions provide insights into the impacts of drought on rural livelihoods. However, drought risk is a major gap in the report, in particular for regions such as sub-Saharan Africa where it is associated with major disaster impacts and poverty outcomes.

Data constraints also limit the global relevance and representativeness of the disaster risk and poverty analysis at the local level. Progress in compiling national disaster loss data has been largely limited to Asia, Latin America and the Caribbean. Similarly, poverty panel data that include modules on natural hazards and with a local-level resolution are not widely available in most countries. As such the empirical evidence linking disaster risk to poverty is limited to microstudies from particular countries. While this evidence in itself is compelling, with existing data it is not possible to generate comparable findings across countries and regions.

The HFA progress review is based on information provided by national governments, normally from the organization or focal point responsible for disaster risk reduction. It was not possible in this exercise to systematically review progress being made by regional or international organizations or by other national stakeholders such as the private sector or civil society. The findings, therefore, do not necessarily reflect a complete picture of the progress being made in each HFA Priority Area.

Finally, the focus of this Report is on the disaster risk and poverty nexus in a context of global climate change. It does not address in-depth issues of disaster risk in other development sectors such as health, education, transport and energy.

It is hoped that the publication of this Report will stimulate improved data collection and research which can enable these gaps to be addressed in future iterations of the ISDR Global Assessment Report on Disaster Risk Reduction.

Endnotes

1 UNISDR, 2009
2 www.preventionweb.net/gar09

Acknowledgements

The *2009 Global Assessment Report on Disaster Risk Reduction* is the first biennial report of the International Strategy for Disaster Reduction (ISDR) system. The Report is a result of collaborative multi-stakeholder efforts among a large number of ISDR system partners that has been ongoing since July 2007.

The development of the Report was coordinated by UNISDR in collaboration with the World Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the ProVention Consortium, the World Meteorological Organization (WMO) and the United Nations Education and Scientific Cultural Organization (UNESCO).

Regional facilitation support was also extended by the following inter-governmental organizations and specialized centres: African Union (AU), Association of Southeast Asian Nations (ASEAN), Caribbean Disaster Emergency Response Agency (CDERA), Centro de Coordinación para la Prevención de Desastres Naturales en América Central (CEPREDENAC), League of Arab States, Organization of American States, Pacific Islands Applied Geoscience Commission (SOPAC), Apoyo a la Prevención de Desastres en la Comunidad Andina (PREDECAN) on behalf of the Comité Andino para la Prevención y Atención de Desastres (CAPRADE), South Asian Association for Regional Cooperation (SAARC). As of February 2009, over 62 national governments had prepared progress reports on implementation of the Hyogo Framework of Action (HFA)[1].

The Kingdom of Bahrain, the Global Facility for Disaster Reduction and Recovery (GFDRR), UNDP, UNEP, the Government of Norway, the Government of Switzerland, the ProVention Consortium and the Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation) (GTZ) contributed financial resources that enabled the successful development of this first biennial Global Assessment Report on Disaster Risk Reduction.

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UNISDR team

The preparation of the Report was coordinated and supervised by a team at UNISDR Geneva: Andrew Maskrey (coordinator and lead author), Shefali Juneja (coordinator of the HFA progress reporting and co-author), Pascal Peduzzi (coordinator of the global risk analysis and co-author) and Carolin Schaerpf (editorial assistant). Invaluable guidance was provided by Margareta Wahlstrom, Salvano Briceno and Helena Molin-Valdes.

UNISDR regional offices coordinated the regional and national HFA progress reporting: Seth Vordzorgbe, Pedro Basabe, Rhea Katsanakis and Helene Lafferty (Africa); Jerry Velasquez, Angelika Planitz, Madhavi Ariyabandu and Abhilash Panda (Asia and Pacific); Paola Albrito (Europe); Dave Zervaas, Haris Sanahuja

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Reviewers

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Acknowledgements for chapter contributors and co-authors are presented at the start of each chapter.

Endnote

1 See Appendix 3 for a list of countries that submitted HFA progress reports.

Contents

Appendices and background papers for this Report can be found on the accompanying CD-ROM and are also available online at PreventionWeb: www.preventionweb.net/gar09

Chapter 1

The global challenge: disaster risk, poverty and climate change

Another crop of disasters

In 2008, numerous major disasters provided a stark reminder of the massive concentrations of disaster risk that threaten human development gains across the world. In May, the tropical cyclone Nargis caused an estimated 140,000 mortalities in Myanmar, primarily due to a storm surge in the low-lying, densely populated Irrawaddy River delta.

In May, China's most powerful earthquake since 1976 affected Sichuan and parts of Chongqing, Gansu, Hubei, Shaanxi and Yunnan killing at least 87,556 people, injuring more than 365,000[1] and affecting more than 60 million people in ten provinces and regions. An estimated 5.36 million buildings collapsed and more than 21 million buildings were damaged. Figure 1.1 shows the locations of large and medium urban centres in areas that experienced strong earthquake intensities.

Also in August 2008, the Kosi River in Bihar, India, broke through an embankment and changed its course 120 km eastwards, rendering useless more than 300 km of flood defences that had been built to protect towns and villages. Flowing into supposedly flood safe areas, the river affected 3.3 million people in 1,598 villages located in 15 districts[2]. It was characterized as the worst flood in the area for 50 years, prompting the Prime Minister of India, Manmohan Singh, to declare a "national calamity" on 28th August.

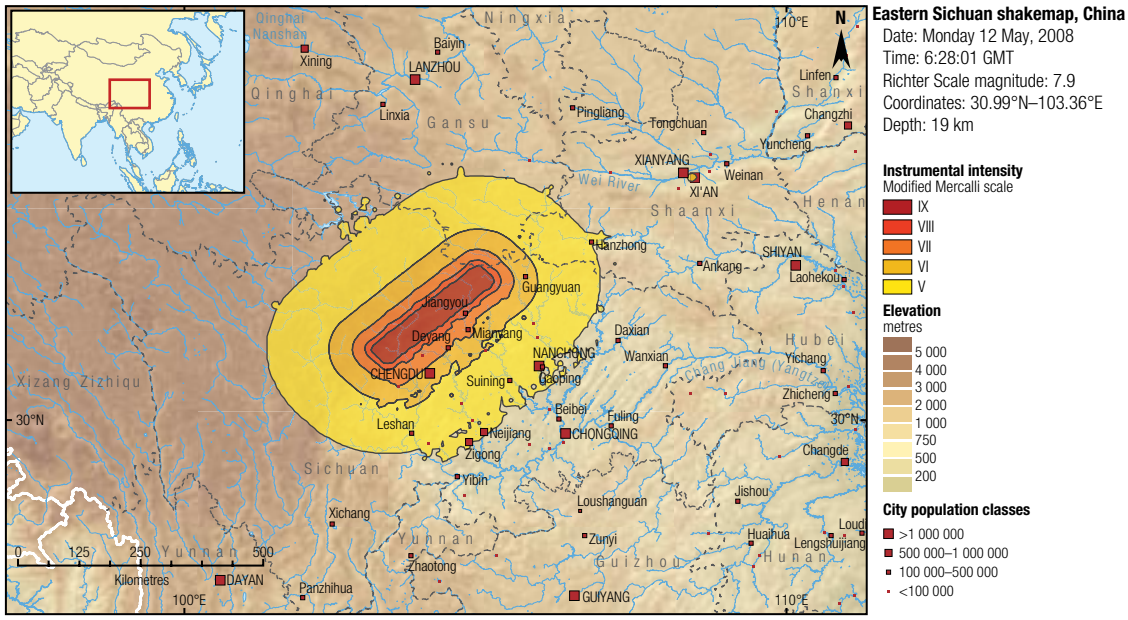


Figure 1.1: Earthquake intensities and location of cities, China, 12 May, 2008

Source: Cartography: United Nations Environment Programme/Global Resource Information Database-Europe (UNEP/GRID-Europe); data sources for Sichuan earthquake in Modified Mercalli Intensity (MMI), courtesy of United States Geological Survey (USGS), shakemap.

1.1 Intensive and extensive disaster risk

Internationally reported disaster loss is heavily concentrated in a small number of infrequently occurring events. Between January 1975 and October 2008 and excluding epidemics, the International Emergency Disasters Database EMDAT recorded 8,866 events killing 2,283,767 people. Of these, 23 mega-disasters (listed in Table 1.1) killed 1,786,084 people, mainly in developing countries. In other words, 0.26% of the events accounted for 78.2% of the mortality[3].

In the same period, recorded economic losses were US$ 1,527.6 billion. Table 1.2 lists 25 mega-disasters that represented only 0.28% of the events, yet accounted for 40% of that loss, mainly in developed countries.

Of the ten disasters with the highest death tolls since 1975, no fewer than half (highlighted in Table 1.1) have occurred in the five year period between 2003 and 2008. Table 1.2 likewise indicates that four of the ten disasters with the highest economic losses occurred in the same period.

Nationally reported disaster loss is similarly highly concentrated. Losses reported between 1970 and 2007 at the local government level in a sample of 12 Asian and Latin American countries[5] showed that 84% of the mortality and 75% of the destroyed housing was concentrated in only 0.7% of the loss reports. Destruction in the housing sector usually accounts for a significant proportion of direct economic loss in disasters.

At whatever scale disaster losses are viewed, therefore, mortality and direct economic loss appear to be highly concentrated geographically and associated with a very small number of hazard events. These are areas where major concentrations of vulnerable people and economic assets are exposed to very severe hazards. In this report the term *intensive risk* is used to refer to these concentrations.

In contrast, and at whatever scale disaster losses are viewed, wide regions are exposed to more frequently occurring low-intensity losses. These widespread low-intensity losses are associated with other risk impacts such as a large number of affected people and damage to housing and local infrastructure, but not to major mortality or destruction of economic assets. For example, 99.3% of local loss reports in the 12 countries mentioned accounted for only 16% of the mortality but 51% of housing damage. These losses are pervasive in both space and time. In the country sample, 82% of local government areas

Table 1.1: Disasters with more than 10,000 fatalities, January 1975 – June 2008[4]

(Highlighting denotes disasters within the five-year period, 2003–2008.)

Source: EMDAT; Analysis by ISDR, 2008 (data as of September 2008)

Year	Country	Disaster	Fatalities
1983	Ethiopia	Ethiopian drought	300,000
1976	China	Tangshan earthquake	242,000
2004	South Indian Ocean	Indian Ocean tsunami	226,408
1983	Sudan	Sudan drought	150,000
1991	Bangladesh	Cyclone Gorky	138,866
2008	Myanmar	Cyclone Nargis	133,655
1981	Mozambique	Southern Mozambique drought	100,000
2008	China	Sichuan earthquake	87,476
2005	India, Pakistan	Kashmir earthquake	73,338
2003	Europe	European heat wave	56,809
1990	Iran	Manjil-Rudbar earthquake	40,000
1999	Venezuela	Vargas floods	30,000
2003	Iran	Bam earthquake	26,796
1978	Iran	Tabas earthquake	25,000
1988	Soviet Union	Spitak earthquake	25,000
1976	Guatemala	The Guatemala earthquake	23,000
1985	Colombia	Nevado Del Ruiz volcano	21,800
2001	India	Gujarat earthquake	20,005
1999	Turkey	Izmit earthquake	17,127
1998	Honduras	Hurricane Mitch	14,600
1977	India	Andhra Pradesh cyclone	14,204
1985	Bangladesh	Bangladesh cyclone	10,000
1975	China	Haicheng earthquake	10,000

Table 1.2: Disasters leading to losses of more than US$ 10 billion, January 1975 – June 2008

(Highlighting denotes disasters within the five-year period, 2003–2008.)

Source: EMDAT; Analysis by ISDR, 2008 (data as of September 2008)

Year	Country	Hazard	Total loss (billion US$)
2005	United States of America	Hurricane Katrina	125
1995	Japan	Kobe earthquake	100
2008	China	Sichuan earthquake	30
1998	China	Yangtze flood	30
2004	Japan	Chuetsu earthquake	28
1992	United States of America	Hurricane Andrew	26.5
1980	Italy	Irpinia earthquake	20
2004	United States of America	Hurricane Ivan	18
1997	Indonesia	Wild fires	17
1994	United States of America	Northridge earthquake	16.5
2005	United States of America	Hurricane Charley	16
2004	United States of America	Hurricane Rita	16
1995	Democratic People's Republic of Korea	Korea floods	15
2005	United States of America	Hurricane Wilma	14.3
1999	Taiwan (China)	Chichi earthquake	14.1
1988	Soviet Union	Spitak earthquake	14
1994	China	China drought	13.8
1991	China	Eastern China floods	13.6
1996	China	Yellow River flood	12.6
2007	Japan	Niigataken Chuetsu-oki earthquake	12.5
1993	United States of America	Great Midwest flood	12
2002	Germany	River Elbe floods	11.7
2004	United States of America	Hurricane Frances	11
1991	Japan	Typhoon Mireille	10
1995	United States of America	Major west coast wind storm	10

reported disaster losses at least once between 1970 and 2007, 48% reported disaster losses six or more times and there was an average of nine local loss reports per day.

This geographically dispersed exposure of vulnerable people and economic assets to mainly low or moderate intensity hazard is described as *extensive risk* in this report. Intensive and extensive risk, therefore, refer to the relative concentration or spread of disaster risk in space and time, at whatever scale risk is observed.

1.2 The configuration of disaster risk

Disasters are often viewed as exogenous shocks that destroy and erode development gains. Disaster risk, however, is far from exogenous to development. It is configured over time through a complex interaction between development processes that generate conditions of exposure, vulnerability and hazard.

Globally, disaster risk is increasing for most hazards, although the risk of economic loss is increasing far faster than the risk of mortality. For example, assuming constant hazard it is estimated that global flood mortality risk increased by 13% between 1990 and 2007, while economic loss risk increased by 33%. The main driver of this trend is rapidly increasing exposure. As countries develop, and both economic conditions and governance improve, vulnerability decreases but not sufficiently rapidly to compensate for the increase in exposure, particularly in the case of very rapidly growing low-income and low- to middle-income countries. When economic development stabilizes and slows down, the rate

of increase in exposure may decelerate and be overtaken by reductions in vulnerability, leading to a lowering of risk.

Extensive risk patterns, associated with weather-related hazards, are also expanding rapidly in the sample of low- and middle-income countries in Asia and Latin America examined in this Report. Part of this expansion can be explained by improved disaster reporting. Similarly, climate change is altering hazard patterns. However, the principal risk drivers are locally specific increases in exposure, vulnerability and hazard in the context of broader processes of urbanization, economic and territorial development, and ecosystem decline (see Box 1.1).

Box 1.1: Components of disaster risk

Exposure

People and economic assets become concentrated in areas exposed to severe hazards through processes such as population growth, migration, urbanization and economic development. This process operates over time, and risk in these areas therefore becomes more intensive, as more people and assets are exposed. Many hazard prone areas, such as coastlines, attract economic and urban development or offer significant economic benefits. The rich alluvial soils in the regularly flooded river deltas of South Asia, for example, support intensive agriculture and the livelihoods of millions of rural households.

At the same time as risk becomes more intensive in some areas, it also spreads out extensively as cities expand into their hinterlands and as economic and urban development transform previously sparsely populated areas.

Vulnerability and resilience

The degree to which exposed people or economic assets are actually at risk is a function of their vulnerability. Vulnerability refers to a propensity or susceptibility to suffer loss and is associated with a range of physical, social, political, economic, cultural and institutional characterisitcs. For example, unsafe poorly built housing, schools, hospitals and lifeline infrastructure are characteristics of physical vulnerability. The difficulty faced by poor households without a car in evacuating New Orleans during Hurricane Katrina was a characteristic of both social and institutional vulnerability.

Resilience refers to the capacity of people or economies to absorb loss and recover. Poor households often have low resilience to loss due to a lack of savings, reserves or insurance. However, social factors such as extended families and community networks increase resilience. Vulnerability is sometimes used in a wider sense to encompass the concept of resilience[6]. Vulnerability and resilience also change over time. For example, if due to rapid urban growth an increasing proportion of a city's population lives in unsafe housing, vulnerability will increase; conversely, if more rural families have access to crop insurance, their resilience will increase.

Hazards

Patterns of geological hazard are mainly determined by the location of seismic fault lines, the presence of active volcanoes or tsunami-exposed coastlines and are relatively static. However, environmental change and urbanization are changing the magnitude, spatial distribution and frequency of floods, droughts, tropical cyclones, landslides and other weather-related hazards. The decline in the regulating services provided by many ecosystems has been observed in the 2005 Millennium Ecosystem Assessment[7] as a factor that increases flood and drought hazard. In urban areas flooding is often caused by a combination of more intense run-off during heavy rainfall events due to an increase in the built area; inadequate drainage; the disappearance of wetlands that traditionally absorbed and moderated peak flooding; and the encroachment of housing on floodplains.

On a global scale the Intergovernmental Panel on Climate Change (IPCC) has confirmed that climate change is now altering the predictability, intensity and geographical distribution of many weather-related hazards through increased intensity of the water cycle and other effects such as glacial melt and sea level rise.

1.3 The disaster risk–poverty nexus

The fact that disasters have a disproportionate impact on the poor in developing countries has been highlighted in research for at least 30 years[8]. The 2004 UNDP/Bureau for Crisis Prevention and Recovery (BCPR) report *Reducing Disaster Risk: a Challenge for Development*[9] highlighted the fact that while only 11% of those exposed to hazards live in low human development countries, 53% of disaster mortality is concentrated in those countries. The present Report has assembled a considerable body of empirical evidence that confirms that disaster risk is fundamentally associated with poverty at both the global and local levels.

1.3.1 At the global level

This Report confirms that poorer countries have disproportionately higher mortality and economic loss risks, given similar levels of hazard exposure. For example, globally, high-income countries account for 39% of the exposure to tropical cyclones but only 1% of the mortality risk. Low-income countries represent 13% of the exposure but no less than 81% of the mortality risk.

For example, gross domestic product (GDP) per capita in Japan is US$ 31,267 compared to US$ 5,137 in the Philippines, and Japan has a human development index of 0.953 compared to 0.771 in the Philippines[10]. Japan also has about 1.4 times as many people exposed to tropical cyclones than the Philippines. However, if affected by a cyclone of the same magnitude, mortality in the Philippines would be 17 times higher than that in Japan (see Figure 1.2).

Countries with small and vulnerable economies, such as many Small Island Developing States (SIDS) and Land-Locked Developing Countries (LLDCs) not only suffer higher relative levels of economic loss, with respect to the size of their GDPs. They also have a particularly low resilience to loss, meaning that disaster losses can lead to major setbacks in economic development. The countries with the highest economic vulnerability to natural hazards

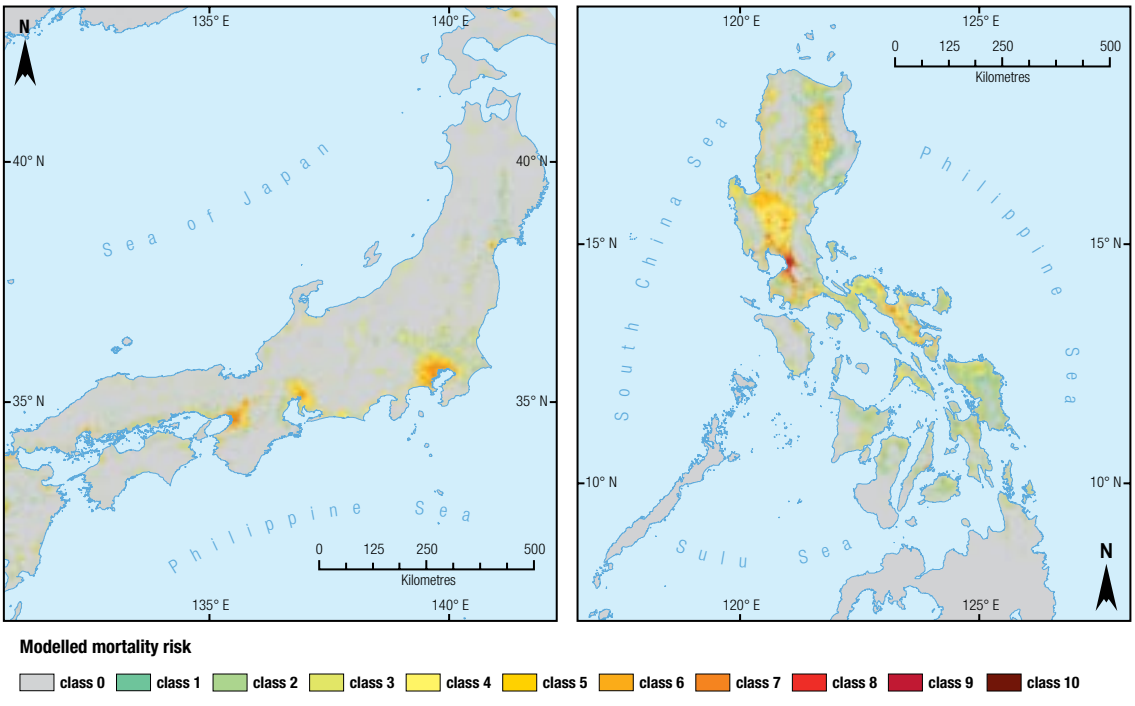


Figure 1.2: Mortality risk for tropical cyclones in two countries with similar exposure: Japan and the Philippines

Note: Classes as defined in Box 2.2, p.21

Source: Cartography and geographic information system (GIS) analysis: UNEP/GRID-Europe 2008

and the lowest resilience are also those with very low participation in world markets and low export diversification.

1.3.2 At the local level

At the local level, there is also empirical evidence to show that poor areas suffer disproportionately high levels of damage in disasters and that this is related to factors such as unsafe housing.

Case study evidence from particular cities also shows that both disaster occurrence and loss are associated with processes that increase the hazard exposure of the poor – for example, the expansion of informal settlements in hazard prone areas.

Considerable empirical evidence from all regions shows that while disaster losses lead to measurable decreases in income, consumption and human development indicators, these effects are far more accentuated in poor households and communities. The evidence points to increases in the depth and breadth of poverty, long-term difficulties in recovery and very negative human development impacts in areas such as education and health, which also have long-term consequences.

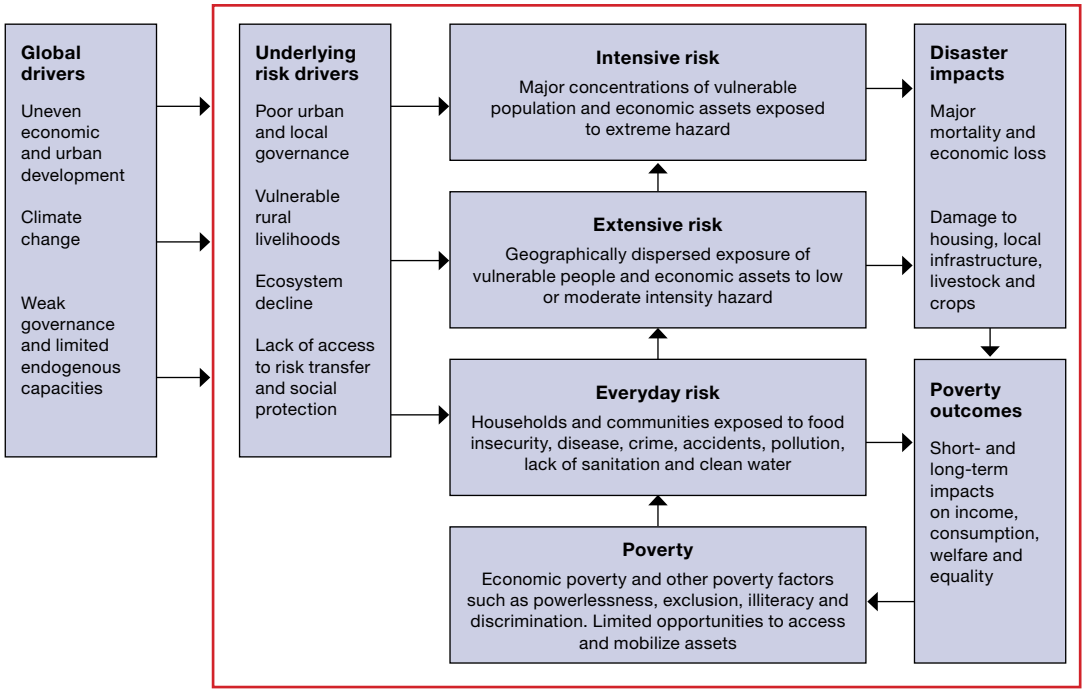
1.4 Interpreting the disaster–risk poverty nexus

At the global level, drivers such as economic development and urbanization, climate change and the strength or weakness of a range of endogenous capacities condition the landscape of both poverty and disaster risk in any given country. Figure 1.3 illustrates schematically some of the key interactions between disaster risk and poverty analysed in this Report.

1.4.1 The translation of poverty into disaster risk

Poverty [11] and associated conditions of everyday risk underpin the configuration of patterns of extensive and intensive risk. In general, both the urban and rural poor face very high levels of everyday risk, associated with traffic and occupational accidents, malaria and health

Figure 1.3: The disaster risk–poverty nexus



hazards associated with a lack of clean water, sanitation or pollution, crime, unemployment and underemployment, and other factors. For example, under-five mortality rates in many developing country cities are typically in a range of 80–160 per thousand live births while in most developed country cities they are under 10 per thousand live births.

A range of underlying risk drivers, such as poor urban governance, vulnerable rural livelihoods and declining ecosystems, contribute to the translation of poverty and every day risk into disaster risk, in a context of broader economic and political processes.

The livelihoods of the urban poor often do not cover the costs of housing, transport, education and health. But at the same time it is the low institutional capacity of city governments to provide land and services to the poor that has led to a model of urban growth characterized by the expansion of informal settlements in hazard prone areas. At least 900 million people now live in informal settlements in developing country cities. Many of these are in hazard prone areas. Urban hazards, such as flooding, are exacerbated by lack of investment in infrastructure. Households live in structurally weak and badly built housing and with deficient infrastructure and services. Unsurprisingly, the urban poor often have high levels of disaster risk.

In poor rural areas, poverty is translated into disaster risk through the vulnerability of rural livelihoods. A constrained access to productive land, technology, credit and other productive assets means that poor rural households are largely dependent on rain-fed agriculture for their livelihoods and subsistence, and thus are highly vulnerable to even small seasonal variations in weather. Difficulties in accessing markets, adverse trade policies and a lack of investment in infrastructure compound this vulnerability. In sub-Saharan Africa alone, 268 million people in rural areas live below a poverty line of US$ 1.25 per day. The absence of safe housing, infrastructure and public services in poor rural areas that could protect households from earthquakes, cyclones and major floods also increases mortality risk.

In rural and urban areas, the disaster risk–poverty nexus is further fuelled by environmental degradation. The 2005 Millennium Ecosystem Assessment [12] highlighted significant declines in many key ecosystems. Natural ecosystems such as wetlands, forests, mangroves and watersheds fulfil an essential function in regulating the frequency and intensity of hazards, such as flooding and landslides. They also often provide important additional sources of income for the poor. When ecosystems decline, their capacity to provide these services decreases and both hazard and vulnerability increase. Poor communities in developing countries are usually disproportionately dependent on ecosystem services. According to the last UNEP Atlas over Africa [13], deforestation is one the most significant environmental issues in 35 African countries. In Cameroon alone, for example, 200,000 ha are deforested every year, as shown in Figure 1.4.

1.4.2 From disaster risk to poverty outcomes

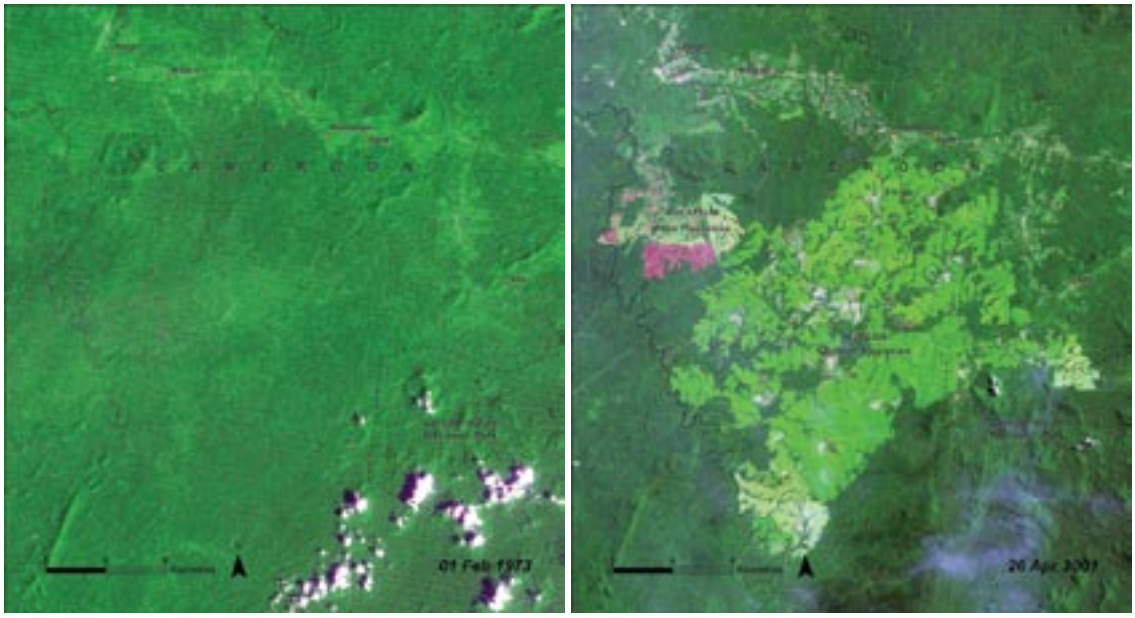
Poor households often have a very limited capacity to access and use assets in order to buffer disaster losses. These losses include both infrequently occurring major mortality, and economic loss from concentrations of intensive risk, as well as the lower intensity patterns of damage associated with the spread of extensive risk.

The low resilience of the poor is further undermined by risk drivers, including weak or absent social protection measures and the low penetration of catastrophe insurance in most developing countries, which contribute to the translation of disaster impacts into poverty outcomes. While the losses associated with intensive risk often overwhelm household, local and even national coping capacities in poor countries, the more frequent and low-intensity losses associated with extensive risk undermine resilience over time. Both kinds of risk, therefore, have a critical influence.

The resulting poverty outcomes include reductions in income and consumption as well as both short- and long-term negative impacts in human development, welfare and equality. As a consequence, following disasters economic

Figure 1.4: Deforestation in Cameroon between 1973 and 2001

Source: UNEP DEWA, 2008



Box 1.2: The impact of the 2001 El Salvador earthquakes on poverty[14]

In El Salvador, the 2001 earthquakes killed more than 1,200 people, affected approximately 300,000 houses (or 32% of the stock) and caused US$ 1.6 billion in direct and indirect damage (12% of GDP in 2000). Between 2000 and 2002, average household income per capita actually increased in El Salvador, while extreme poverty rates fell from 33.8% to 26.6%. In poor rural households affected by the earthquakes, however, average household income per capita was reduced by approximately one third. Those most affected by the earthquakes suffered higher loss of housing, land, livestock, farm machinery and other physical capital, reducing their future earning capacity.

poverty may increase in incidence and depth, while welfare indicators of human development tend to decrease. But disasters do not make everyone poorer; their impact is highly unequal. Poor households tend to be far less resilient to loss than wealthier households, are pushed deeper into poverty, and have more difficulty recovering. Furthermore, disasters have long-term impacts (Box 1.2) on the poor, particularly on vulnerable groups like young children and women. While normally only the short-term impacts of disasters, such as mortality or direct economic loss are highlighted, disaster impacts may impair the long-term health, human development and productivity of the poor, exacerbating chronic poverty.

1.5 Global climate change

Climate change is perhaps the greatest global outcome of environmental inequity, since it is driven by the emissions that have brought benefits to affluent individuals and societies yet most of the burdens fall on poorer individuals and societies, with developing countries and their poorest citizens being the most vulnerable[15].

The IPCC Fourth Assessment Report has emphasized that if the planet's surface temperature increases by 2°C above pre-industrial levels, then a catastrophic collapse of ecosystems becomes possible with unforeseen, non-linear impacts on poverty and disaster risk[16]. The IPCC has also confirmed that the geographic

distribution, frequency and intensity of these hazards are already being altered significantly by climate change [17]. Changes are occurring in the amount, intensity, frequency and type of precipitation. This is associated with increases in the extent of the areas affected by drought, in the numbers of heavy daily precipitation events that lead to flooding, and increases in the intensity and duration of certain kinds of tropical storms.

As outlined above, the concentration of disaster risk in poor communities in developing countries and the translation of disaster impacts into poverty outcomes are configured by drivers such as vulnerable rural livelihoods, poor urban governance, declining ecosystems and an absence of social protection. Unless those drivers are addressed the poor will continue to suffer disproportionately from disaster loss whether the climate changes or not. For example, it is estimated that the global population living in urban informal settlements, many of which are in hazard prone locations, is increasing by 25 million per year. This increase in itself is a key driver of disaster risk.

However, climate change magnifies the interactions between disaster risk and poverty. On the one hand it magnifies weather-related and climatic hazards. On the other hand, it will decrease the resilience of many poor households and communities to absorb the impact and recover from disaster loss, due to factors such as decreases in agricultural productivity, increases in disease vectors and shortages of water and energy in many disaster prone regions. Climate change, therefore, is now a key global driver of disaster risk.

Globally, disaster risk is increasing for weather-related hazards such as floods and tropical cyclones, even if hazard levels remain constant. Locally, the rapid expansion of weather-related extensive risk documented in this report is particularly dramatic. Even small increases in hazard levels due to climate change will have an enormous magnifying effect on disaster risk.

Critically, these increases will magnify even further the uneven distribution of risk between wealthier and poorer countries and between the wealthy and the poor in those countries. For example, if mortality levels relative to hazard exposure to tropical cyclones are currently 200 times greater in low-income countries than in Organization for Economic Cooperation and Development (OECD) countries, then the consequences of increasing cyclone severity due to climate change will also be unequally distributed. Climate change, therefore, will turbo-charge the disaster risk–poverty nexus, drastically increasing disaster impacts on the poor and resulting poverty outcomes.

1.6 Interlocked global risks

Disaster risk is now widely recognized as an integral part of a wider constellation of risks related to food and energy insecurity, financial and economic instability, global climate change, environmental degradation, disease and epidemics, conflict and extreme poverty.

Recent global reports by the United Nations Centre for Human Settlements (UN HABITAT) [18] and UNEP [19] have stressed the threat posed by disaster risk in the urban and environmental sectors. Other reports by the United Nations Department for Social and Economic Affairs (UNDESA) [20] and by the World Economic Forum [21] have argued that different kinds of risk now form an interlocked system, implying that impacts in one sphere spill over into other areas, and that actions to reduce one risk may imply trade-offs in reducing others. The IPCC Fourth Assessment Report [22] in 2007 dispelled any remaining doubt that climate change is a catastrophic threat on a global scale.

These interlinkages are becoming increasingly visible. In 2008, successive global crises hit the headlines as the prices of grain and energy sources fluctuated wildly and the global financial system threatened to collapse,

all in the context of ongoing concerns about global climate change, conflict, security and extreme poverty. These systemic risks now pose a very serious threat to global security and sustainability. Ongoing disaster losses undermine resilience to other kinds of threats, while major impacts in mega-disasters can trigger reactions in other risk spheres.

The way disaster risk is magnified by other kinds of global risk, and in turn feeds back into them, can be illustrated by a hypothetical but plausible example. If global climate change magnifies the severity of drought in a key grain producing region causing harvest failure, this could feed back into speculative increases in food prices. The most affected will not only be those living in the region but poor households in other parts of the world who spend a large proportion of their income on food. Faced with chronic food insecurity and with their resilience undermined by other hazards such as poor health or conflict, poor rural households may then migrate to urban areas. In many towns and cities across developing countries migration from rural areas is absorbed through the growth of informal settlements in areas prone to hazards such as floods. Flood risk in turn may also be further magnified by climate change.

Other examples of the interlocked nature of risk include the increase of oil prices when hurricanes threaten the Gulf of Mexico at the same time as conflict threatens oil production in Nigeria. As the credit crisis in developed countries is pushing economies into recession, the construction boom in the Persian Gulf is faltering, leading to a decrease in remittances from migrant workers to relatives in the Indian sub-continent. This in turn may lead to decreasing economic resilience in poor households in that region, increased rural–urban migration and subsequent increases in the population exposed to weather-related hazards in cities.

The linkages between disaster risk, poverty and climate change, described above, form a particularly tightly interlocked group of global challenges, in which impacts in any one sphere spill over into the other two and which have to be addressed in a way that recognizes their inter-connectedness.

1.7 Reducing disaster risk and poverty in a context of global climate change

Globally, efforts to address climate change through reductions in greenhouse gas emissions and energy consumption are of critical importance if potentially catastrophic increases in weather-related and climatic hazard are to be avoided in the future. In the meantime, existing hazard levels and increases that are taking place due to already committed climate change are essentially locked in to the disaster risk equation. Major concentrations of both people and economic assets exposed to hazard are similarly difficult to address given the economic advantages offered by many hazardous locations such as coastlines and fertile floodplains.

Wealthier countries have lower risk levels than poorer countries. Economic growth may reduce poverty. But economic growth per se does not lead to reduced disaster risk: as economies grow, exposure tends to increase at a faster rate than vulnerability can decrease, particularly in economically dynamic low- and low-to-middle income countries. The principal opportunities, therefore, for reducing disaster risk are to be found in addressing the different factors that characterize a country's vulnerability and lack of resilience.

This Report shows that by addressing the underlying risk drivers that translate poverty into disaster risk, such as poor urban governance, vulnerable rural livelihoods and ecosystem decline, it is possible to develop in a way that does not lead to increased risk. Similarly, by addressing

the underlying risk drivers that translate disaster impacts into poverty outcomes, such as the lack of access to social protection and risk transfer, it is possible to ensure that continuing disaster losses do not feed back into worsening poverty. If these drivers are addressed then it is possible for even poor countries to reduce their vulnerability in a way that outweighs increases in exposure and hazard.

Addressing these drivers, therefore, would not only contribute to reducing disaster risk – it would also contribute to poverty reduction. Importantly, it also offers the best opportunity to adapt to climate change. If disaster risk can be reduced, then the magnifying effect of climate change on risk will also diminish. In contrast, if these drivers are not addressed, disaster risk will continue to grow due to increasing hazard and exposure. If disaster risk continues to increase, it will seriously compromise efforts to reduce global poverty and countries with increasing disaster risk and poverty will be progressively less adapted to climate change.

1.7.1 Progress in disaster risk reduction

In 2005, 168 member states of the United Nations agreed the Hyogo Framework for Action (HFA) that called for building the resilience of nations and communities to disasters with the objective of reducing disaster risk by 2015. As Box 1.3 indicates the HFA forms part of a growing number of international declarations, frameworks and agreements, which indicate both a recognition of the links between disaster risk reduction, poverty reduction and climate change, and a growing political commitment to address these issues.

Interim national reports were completed by 62 countries in 2008, describing progress in achieving the strategic goals of the HFA. These indicate that many countries are making very good progress in developing institutional systems, legislation, policy and plans to improve disaster preparedness, and response and early warning. Due to such efforts, many low-income countries have dramatically reduced their mortality risk to hazards such as tropical cyclones and floods.

Box 1.3: International commitments to addressing the disaster risk–poverty nexus

In 1994, at the first World Conference on Disaster Reduction, the Yokohama Declaration and Plan of Action for a Safe World provided guidelines for national and international action on natural disaster prevention, preparedness and mitigation. Ten years later, in 2005, the HFA called for building the resilience of nations and communities to disasters. Other international declarations on poverty, social and sustainable development have also recognized the disaster risk–development linkages.

At the World Summit on Sustainable Development in Johannesburg in 2002 the Johannesburg Plan of Implementation[23] stated: *"An integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery, is an essential element of a safer world in the twenty-first century."*

The formulation and adoption of the Millennium Development Goals (MDGs) was a watershed in mobilizing international commitment to poverty reduction. While there was no specific MDG addressing disaster risk, many of the MDGs refer to actions that will address the underlying risk factors[24]. Subsequently, developing countries have reaffirmed their commitment to reducing poverty through the achievement of the MDGs.

The United Nations Framework Convention on Climate Change was signed in 1992. While originally focused on mitigating climate change through agreements to reduce greenhouse gas emissions, momentum has gathered to support the efforts of developing countries to adapt to climate change. The IPCC Fourth Assessment stressed that climate change will erode nations' capacities to achieve the MDGs, measured in terms of reduced poverty, particularly in Africa and parts of Asia[25]. Subsequently, the Bali Action Plan[26] reaffirms that economic and social development and poverty eradication are global priorities.

Bilateral agencies, such as the UK's Department for International Development (DFID)[27] and Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation) (GTZ)[28], have recently produced policy statements that specifically address the disaster risk–poverty nexus. The World Bank has recently also made climate change an important part of its policy agenda, by adopting a Strategic Framework for Development and Climate Change in October 2008. Major attention is given to climate risk management and adaptation, which is a top climate-related priority in most developing countries[29].

However, reported progress in addressing other underlying risk drivers is less encouraging. Many of the institutional and legislative systems created for disaster risk reduction have had little influence on development sectors, due to a lack of political authority and technical capacity, particularly in countries where much development is unregulated and occurs in the informal sector. Progress in addressing issues of social equity and gender through disaster risk reduction has been similarly elusive. Few countries have mechanisms in place to protect the most vulnerable social groups from the long term impacts of disaster on poverty and human development.

Many Poverty Reduction Strategy Papers (PRSPs) acknowledge the impact of disaster loss on poverty and a significant number include a section on disaster risk reduction. PRSPs and other poverty reduction instruments clearly have enormous potential to address the underlying risk drivers highlighted above. However, there is little evidence of real synergy between policies and strategies on poverty and disaster reduction, which may undermine the effectiveness of PRSPs as disaster risk reduction instruments.

With respect to climate change adaptation, in some countries planning tools such as National Adaptation Programmes of Action (NAPAs) have facilitated integration between disaster risk reduction and climate change adaptation. NAPAs focus on *urgent and immediate* adaptation needs, and disaster risk reduction provides a good entry point to immediately address climate-related risks. In general, however, the institutional frameworks for adaptation are also still largely divorced from those for disaster risk reduction, and are more focused on specific measures such as climate proofing infrastructure than on addressing the underlying risk drivers. Planning instruments, such as NAPAs, and funding mechanisms for adaptation have been created which offer tremendous potential. However, at present, the funding and implementation mechanisms necessary to unlock that potential have yet to fully unfold.

1.7.2 Addressing the underlying risk drivers

Fortunately, considerable progress in addressing the underlying risk drivers is already being made in specific sectors and localities. Many of the tools and approaches required to address these drivers are already being successfully applied in many developing countries both at the local and sectoral levels.

Successful cases abound of strengthened livelihoods reducing vulnerability, poverty and disaster risk in rural areas. Many cities have applied innovative methods to provide access to secure land tenure, infrastructure and services for the urban poor. Improvements in environmental management are demonstrating ways to simultaneously regulate hazard and support livelihoods. Examples of innovative financial mechanisms, such as index-based crop insurance, catastrophe pools and applications of microfinance and microinsurance are gaining momentum. In practice, many local initiatives to adapt to climate change also address the underlying risk drivers. Many of the above approaches build on community and local-level participation in a way that reduces costs, builds social capital and enhances the relevance and sustainability of investments.

1.7.3 The missing link

To summarize, there is a growing international commitment to addressing disaster risk, poverty and climate change. At the national level good progress is being made in strengthening some disaster reduction capacities, particularly those associated with disaster preparedness, response and early warning. The fact that many low-income countries, from Bangladesh to Cuba, have been able to achieve quite dramatic reductions in mortality risk to some hazards is proof that progress is being made.

Similarly, progress is being made in addressing the underlying risk drivers in many localities and sectors in developing countries, highlighting the effective approaches and tools that exist and are already being applied.

There is, however, a gap between the international frameworks and commitments on the one hand, and local and sectoral good practice on the other. At both the international and national levels, the policy and strategy frameworks for disaster risk reduction, poverty reduction and climate change adaptation are not effectively integrated, are not focused on addressing the underlying risk drivers and are insufficiently articulated to and supportive of effective local and sectoral actions. This is the missing link that is holding back progress in addressing the disaster risk–poverty nexus in the context of climate change.

1.8 The way forward

Given the urgency posed by climate change, a business as usual approach to disaster risk reduction, poverty reduction and climate change adaptation will not lead to the achievement of the HFA or the MDGs. On the contrary both disaster risk and poverty may be pushed to new, more extreme levels. This Report concludes that more drastic measures are required.

Given the strong interlinkages between disaster risk, poverty and climate change, the principal recommendation of the Report is that countries need to adopt overarching policy and strategy frameworks for risk reduction, focused on addressing the underlying risk drivers described above, and supported by both resources and political authority. In risk prone countries, the implementation of such frameworks must be the key development priority of the state as a whole, rather than of a particular department or ministry.

In practical terms, the adoption of an overarching policy framework for risk reduction should provide a vehicle for a closer integration of existing policy and strategy instruments such as PRSPs, NAPAs and action plans to implement the HFA, thus improving coherence and gaining synergy. In turn this will be facilitated if the plethora of planning, reporting and funding mechanisms at the international level is streamlined.

It should also facilitate a more inclusive approach to addressing the underlying risk drivers that is supportive of the many local and sectoral initiatives already underway and that builds on innovative partnerships with civil society. This Report stresses that such partnerships are essential to ensure that risk reduction measures are appropriate, cost effective and sustainable.

A further challenge is to incorporate innovations into the governance arrangements for disaster risk reduction that ensure that risk reduction considerations are factored into all investments to address the underlying risk factors. Illustrative good practices exist. Many governments have put in place striking innovations, for example, incorporating disaster risk reduction into national development plans and budgets; using cost–benefit analysis to factor disaster risk reduction into public investment systems; creating harmonized platforms for hazard and risk information to support decision-making; or addressing the issue of accountability and enforcement. Enhancing policy and governance in this way can defuse the disaster–risk poverty nexus and facilitate climate change adaptation. At the same time it can be cost effective.

Since the early 1980s, the World Bank alone has provided 528 loans for disaster recovery and reconstruction purposes for a total disbursement of more than US$40 billion[30]. Disbursement on humanitarian aid in 2007 was more than US$ 120 billion[31]. Other estimates indicate that international assistance for recovery and reconstruction only covers 10% of the real costs. These amounts are high and becoming unsustainable, diverting resources that could have been used for poverty reduction and development.

Data put together for the Millennium Project[32] provides an indicative estimate of some of the costs required to address the

underlying factors that underpin disaster risk. Some of these costs can be drastically reduced by adopting participatory approaches to project and programme implementation but there is no getting round the fact that several hundred billion dollars are required. Incorporating risk reduction measures into such investments is usually seen as an additional cost. However, many investments in disaster risk reduction produce benefits in terms of reduced future losses and avoided reconstruction that considerably outweigh the costs, even without accounting for indirect benefits to health, human development and productivity. Innovative ways of financing risk reduction, through mechanisms such as catastrophe pools and payment for ecosystem services, can reduce the costs and enhance the benefits further still.

In other words, it costs far less to avoid the configuration of risk in the first place than to correct it once it exists, or to compensate for it once it is realized. For example, it is generally cheaper and easier to correct newly arising extensive risk than major historical concentrations of intensive risk. The emphasis of policy therefore should be on factoring disaster risk reduction considerations into new development and during periodic renewal or upgrading of building stock and infrastructure, which provides opportunities to reduce risks. Similar opportunities arise in recovery and reconstruction after old concentrations of risk have been swept away in a disaster. Seen in this way investment in disaster risk reduction is actually a way of dramatically reducing the cost of achieving the MDGs and of adapting to climate change.

Resources are also required to build the capacities necessary to put in place the policy and governance frameworks that can allow the investment described above to be organized, coordinated and sustained. As described above this is essential if future growth is not to lead to increasing risk. However, the major investment required now is political rather than financial. It is hoped that the evidence presented in this Report contributes to building that political capital.

Endnotes

1 EMDAT: The OFDA/CRED International Disaster Database: www.emdat.net
2 EMDAT: The OFDA/CRED International Disaster Database: www.emdat.net
3 EMDAT does not register reports of small-scale disasters below its threshold of 10 deaths, 100 affected people, or a call for international assistance.
4 EMDAT, 2008; Analysis by ISDR (data as of September 2008)
5 Argentina, Bolivia, Colombia, Costa Rica, Ecuador, India (States of Orissa and Tamil Nadu), Iran, Mexico, Nepal, Peru, Sri Lanka and Venezuela
6 The interpretation of the term vulnerability varies widely between different academic disciplines, including within the disaster risk reduction community.
7 Millennium Ecosystem Assessment, 2005
8 Wisner, et al., 1976
9 UNDP/BCPR, 2004
10 UNDP, 2007
11 In general terms an individual, household or community is said to be poor when it falls, in absolute or relative terms, short of a minimum level of welfare, often referred to as the poverty line. However, economic poverty (where a lack of assets, income, endowments and capital means that people are unable to make the minimum expenditures required for food, housing, health, education, energy and transport etc.) only partially describes the experience of poverty. It is usually accompanied by lack of access to health, education and other services, powerlessness and isolation, gender discrimination, social exclusion, illiteracy, poor sanitation, livelihood vulnerability and others.
12 Millennium Ecosystem Assessment, 2005
13 UNEP DEWA, 2008
14 Baez and Santos, 2008
15 IPCC, 2007a
16 IPCC, 2007a
17 IPCC, 2007b
18 UN-HABITAT, 2008
19 UNEP, 2007
20 UNDESA, 2008
21 World Economic Forum, 2008
22 IPCC, 2007a
23 UNDESA Division for Sustainable Development, 2002
24 UNDP/BCPR, 2004, Chapters 1 and 4.
25 Parry, et al., 2007
26 UNFCCC, 2007a
27 DFID, 2006
28 Schmidt et al., 2005
29 World Bank, 2008a
30 Cummins and Mahul, 2009
31 Data from OECD Development Assistance Committee (DAC) Query Wizard for International Development Statistics: http://stats.oecd.org/qwids/OFDA/CRED
32 Sachs and UN Millennium Project, 2005

Chapter 2

Global disaster risk: patterns, trends and drivers

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The chapter was developed in collaboration with the UNDP led Global Risk Identification Programme (GRIP), the World Bank Global Facility for Disaster Reduction and Recovery, UNEP/GRID Europe PREVIEW (Project for Risk Evaluation Vulnerability Information and Early Warning), the Norwegian Geotechnical Institute and the Earth Institute at Columbia University. Close coordination was maintained with a study on Risk Assessment and Mitigation Measures for Natural- and Conflict-Related Hazards in Asia–Pacific, undertaken by the United Nations Office for Coordination of Humanitarian Affairs (OCHA), Regional Office for Asia and the Pacific. Both that study and the present analysis are underpinned by common hazard data sets, in order to avoid duplication and enable comparability.

The mortality risk analysis was developed and coordinated by Pascal Peduzzi and the economic loss risk analysis by Uwe Deichmann. The advisory group included: Maxx Dilley and Carlos Villacis (UNDP/BCPR); Hy Dao (UNEP/GRID-Europe); Oddvar Kjekstad and Farrokh Nadim (Norwegian Geotechnical Institute); Art Lerner-Lam and Brad Lyon (Earth Institute at Columbia University); Uwe Deichmann, Andrew Maskrey and Pascal Peduzzi.

The population distribution (1975–2007) used in this chapter was prepared by Hy Dao, based on the Landscan™ population model, kindly provided by the Oak Ridge National Laboratory[1]. The GRUMP population distribution was also tested. It was generated by Greg Yetman (Columbia University) and used to compute the GDP raster distribution (1975–2007) prepared by Uwe Deichmann, Siobhan Murray and Mahyar Eshragh-Tabary (World Bank).

Social and economic indicators were compiled by Hy Dao, Andrea De Bono (UNEP/GRID-Europe) and Uwe Deichmann. The historical disaster loss data used was from EMDAT: the OFDA/CRED International Disaster Database. Munich Reinsurance provided economic loss data aggregated at the country level. Maryam Golnaraghi and Jean Baptiste Migraine (WMO) coordinated the scientific peer review of the hazard models for tropical cyclones, floods and droughts. Badaoui Rouhban, Takashi Imamura and Juliana Chaves Chaparro (UNESCO) coordinated the scientific peer review of the hazard models for landslide, earthquake and tsunami.

The tropical cyclones hazard model was developed by Bruno Chatenoux (UNEP/GRID-Europe) and Pascal Peduzzi, based on previous work by Christian Herold, Frédéric Mouton, Ola Nordbeck and Pascal Peduzzi (UNEP/GRID-Europe). Events in the EMDAT database were geo-referenced by Andrea De Bono and human and economic asset exposure was calculated by Bruno Chatenoux. The cyclone storm surge hazard model was developed and exposure calculated by Andrea De Bono. The vulnerability and risk analysis and models were done by Pascal Peduzzi (for human losses) and Uwe Deichmann (for economic losses) with Michael M. Lokshin (World Bank). Scientific peer review of the hazard models was carried out by Koji Kuroiwa and Taoyong Ping (WMO) with Jim Davidson (Bureau of Meteorology, Queensland, Australia), Woo-Jin Lee (Korean Meteorological Administration) and Linda Anderson-Berry (Bureau of Meteorology, Melbourne, Australia).

The hazard model for floods was developed by Christian Herold and Frédéric Mouton (University of Grenoble, Institut Fourier) with code contributed by James and Kristin Verdin (US Geological Service). All information associated with flood events was processed by Christian Herold based on floods detected by remote sensing by Bob Brackenridge and his team at the Dartmouth Flood Observatory. Disaster losses and exposure were geo-referenced and calculated by Christian Herold. The vulnerability and risk analysis and models were done by Pascal Peduzzi (for human losses) and Uwe Deichmann (for economic losses). Advice on development of the flood hazard model was given by James and Kristin Verdin, Bob Brackenridge and Wolfgang Grabs (WMO). Scientific peer review of the hazard models was carried out by Ayinash Tyagi (WMO) and Wolfgang Grabs with Zhiyu Liu (Bureau of Hydrology, Ministry of Water Resources, China).

The hazard model for drought was developed by Brad Lyon, Greg Yetman, Maria Muniz, Liana Razafindrazay and Vilentia Mara (Columbia University). Drought exposure was calculated by Gregory Guiliani (UNEP/GRID-Europe) and Andrea De Bono. Scientific peer review of the hazard model was carried out by Mannaya Sivakumar and Robert Stefanski (WMO) with Simone Orlandini (Department of Agronomy and Land Management, University of Florence, Italy), Harlan D. Shannon (US Department of Agriculture, World Agricultural Outlook Board), Mark Svoboda (National Drought Mitigation Center, School of Natural Resources, University of Nebraska-Lincoln, USA) and Orivaldo Brunini (Instituto Agronomico, Sao Paulo, Brazil).

The landslide hazard model was developed by Helge Smebye and Bjorn Kalsnes (International Centre for Geohazards, Norwegian Geotechnical Institute, Norway) and Pascal Peduzzi calculated exposure. The vulnerability and risk analysis and models were done by Pascal Peduzzi (for human losses) and Uwe Deichmann (for economic losses). Scientific peer review of the hazard models was carried out by Kyoji Sassa (University of Kyoto, Japan), Nicola Casagli (University of Firenze, Italy), Lynn Highland (USGS), Dwikorita Karnawati (Gadjah Mada University, Indonesia) and Alexander Strom (Institute of Geospheres Dynamics, Russia).

The intensities and spatial extent of past earthquake events were compiled from the ShakeMap Atlas[2] developed under the auspices of the US Geological Survey's Prompt Assessment of Global Earthquakes for Response (PAGER)[3], kindly provided for the project by USGS. Losses were geo-referenced by Andrea De Bono. Human and economic exposure was computed by Bruno Chatenoux. The vulnerability and risk analysis and models were done by Hy Dao and Pascal Peduzzi (for human losses) and Uwe Deichmann (for economic losses). The global intensity hazard earthquake distribution was developed by Arthur Lerner-Lam and Liana Razafindrazay. Scientific peer review of the hazard models was carried out by Avi Shapira (Israel Geophysical Institute), Kunihiko Shimazaki (University of Tokyo, Japan), Giuliano Panza (University of Trieste, Italy) and Mihail Garevski (Institute of Earthquake Engineering and Engineering Seismology, Former Yugoslav Republic of Macedonia).

The tsunami hazard model was developed by Finn Løvholt, Natalia Zamora, Sylfest Glimsdal and Helge Smebye (International Centre for Geohazards, Norwegian Geotechnical Institute, Norway) with Greg Yetman. Exposure was calculated by Hy Dao. Scientific peer review of the hazard models was carried out by Jörn Behrens and Alfred Wegener (Institute for Polar and Marine Research, Germany), Stefano Tinti (University of Bologna, Italy) and Kenji Satake (University of Tokyo, Japan).

The study on economic resilience was carried out by Felipe Barrito, Werner Corrales and Tanya Miquelena (independent consultants).

Introduction

An observation of disaster risk patterns and trends at the global level allows a visualization of the major concentrations of risk described in the previous chapter and an identification of the geographic distribution of disaster risk across countries, trends over time and the major drivers of these patterns and trends.

The analysis presented in this chapter, developed by a large, interdisciplinary group of researchers from around the world, makes global disaster risk more visible – a key step towards mobilizing the political and economic commitment needed to reduce it.

Given the growing influence of climate change, the centrepiece of this chapter is an analysis of the mortality and economic loss[4] risk for three weather-related hazards: tropical cyclones, floods and landslides. In addition new insights have been gained into other hazards such as earthquakes, tsunami and drought.

Summary of findings

1. Risk concentration

Disaster risk is geographically highly concentrated. A very small portion of the Earth's surface contains most of the risk and most future large-scale disasters will occur in these areas. Risk will increase further if exposure continues to increase, for example in tropical cyclone prone coastal cities.

2. The uneven distribution of risk

Disaster risk is very unevenly distributed. Hazards affect both poorer and richer countries. For example, tropical cyclones hit both Japan and Bangladesh. Severe earthquakes occur in the United States and in India. However, for hazards of a similar severity, countries with higher incomes and, importantly, higher human development levels generally experience lower mortality and smaller losses when measured against the country's total wealth. In absolute terms economic losses are higher in richer countries, but less so once they are seen as a share of overall wealth.

3. Risk drivers

In addition to hazard severity and exposure a range of other risk drivers related to economic and social development play a crucial role in the configuration of disaster risk. These include not only income and economic strength, but also governance factors such as the quality of institutions, openness and government accountability. Income is a driver in its own right, but also conditions other drivers. Wealthier countries tend to have better institutions, more effective early-warning, and disaster preparedness and response systems, and more open government that tends to be more supportive of disaster risk reduction.

4. Disaster risk is increasing

Risk levels for most of the hazards are increasing over time, even assuming constant hazard frequency and severity. Economic loss risk is increasing faster than mortality risk. These increases in risk are being driven by the growing exposure of people and assets, for example through rapid economic and urban growth in cyclone prone coastal areas and earthquake prone cities. Vulnerability decreases as countries develop, but not enough to compensate for the increase in exposure.

5. Climate change

Weather-related hazard is critically important in the configuration of global risk patterns. Two of the principal global datasets on disaster losses[5] agree that more than two thirds of the mortality and economic losses from internationally reported disasters is associated with meteorological, climatological and hydrological hazard.

The IPCC has confirmed that the geographic distribution, frequency and intensity of these hazards is already being altered significantly by climate change[6]. Changes are already occurring in the amount, intensity, frequency and type of precipitation. This is associated with increases in the extent of the areas

affected by drought, in the numbers of heavy daily precipitation events that lead to flooding, and increases in the intensity and duration of certain kinds of tropical storms.

Individual events, such as recent large tropical cyclones in the United States and Myanmar, cannot be attributed to climate change. However, given the concentration and uneven distribution of risk described above, the impact of any increases in weather-related hazard will be highly asymmetric. Poorer countries that concentrate most existing risk will be disproportionately affected by climate change.

6. Economic resilience, vulnerability and development constraints

A group of developing countries, including many SIDS, LLDCs and others with small and weak economies are particularly vulnerable to economic loss, have low resilience to that loss and are particularly exposed to climate change. Disaster impacts compromise their prospects for economic growth, poverty reduction and development at large, to the extent that the capacity of the most vulnerable countries to benefit from their insertion in the global economy is severely constrained.

2.1 Method and data[7]

Improvements in methodology and data now enable a much more accurate characterization of disaster risk than was possible when comprehensive global assessments were published by the UNDP and the World Bank[8] five years ago. Several factors have contributed to these improvements, outlined in Box 2.1.

Box 2.1: Innovations in data and methodology

Improved estimates of global disaster risk have been made possible by:

- Higher resolution and more complete data on geographic and physical hazard event characteristics, especially for floods, tropical cyclones and earthquakes.
- Improved high resolution exposure data on population and economic assets (sub-national GDP).
- Enhancements in geographic and physical modelling of hazard extent, frequency and severity – especially for floods, landslides and tsunamis – allowing hazard intensity or severity to be calculated.
- Explicit linking of hazard event outcomes (i.e. losses) with the geographic and physical characteristics of the event. This permits *event-level* analysis of the influence of exposure, vulnerability and hazard severity and the imputation of disaster losses for events for which no loss data were recorded.
- Incorporation of new global data sets on social, economic and other vulnerability factors, such as governance and corruption.

Following the basic risk model that guides this Report (Box 1.1), disaster risk for a given location is determined by the probability that a hazard event of a given magnitude will occur, the number of exposed people or the value of exposed assets, and the level of vulnerability. The latter refers to characteristics of the exposed population, public infrastructure and economic assets that increase or decrease the likelihood of damages when a hazard event occurs, as well as factors such as effective governance and higher levels of social coherence, which influence and condition those characteristics.

Analysing the mortality and economic loss experienced in past disasters permits an assessment to be made of the role played by each of the three main risk factors – hazard event characteristics, exposure and vulnerability – in configuring risk. With data for each of these risk factors for many individual disaster events, their relative importance can be statistically analysed. For instance, controlling for the magnitude of a tropical cyclone and the size of the population or economy in the affected area, it is possible to measure how vulnerability factors (such as a country's institutional quality) affect mortality or the size of economic losses. Box 2.2 presents the methodology that was followed for each hazard type.

Box 2.2: Risk analysis procedure

The application of the risk model involved the following steps for each hazard type:

1. Compile geographical and physical information on specific hazard events such as tropical cyclone track data, areas of flood extent, or earthquake location and magnitude.
2. For each hazard event, determine the footprint or area of impact, such as the area where a tropical storm exceeded tropical cyclone-force wind speed. See Figures 2.1, 2.2 and 2.3.
3. For each impact area, compute exposure as the number of people and economic assets within that area.
4. Link available loss information for each hazard event (sourced from EMDAT) to the hazard event information (hazard severity and exposure).
5. Add information on vulnerability. Since global data on direct vulnerability factors such as building quality are unavailable, this analysis uses country-level indicators for the year in which the event occurred, such as government accountability or per capita income.
6. Estimate empirical loss functions that relate event mortality or economic losses to risk factors (hazard characteristics, exposure and vulnerability) using statistical regression techniques.
7. Derive an estimate of expected average annual losses and exposure. The estimated loss functions are used to impute disaster outcomes for all recorded events, whether or not a loss estimate is available in EMDAT or not. This is done using data on exposure and vulnerability for 2007 such that annualized average estimates reflect current conditions.
8. Apply estimates to all pixels in a geographic grid. The loss estimates are aggregated at different levels (1 km x 1 km cells; sub-national administrative areas; countries) allowing the identification of geographic concentrations of risk. Mortality risk is classed in deciles using a logarithmic index with values ranging from 1 = negligible to 10 = extreme risk (see below). Economic loss risk is calculated for World Bank regions and country income groups.

Classes	Absolute risk (average killed per year)	Relative risk (killed per million peryear)	Mortality Risk Index (average of both indicators)
10	>3 000	>300	Extreme
9	1 000–3 000	100–300	Major
8	300–1 000	30–100	Very High
7	100–300	10–100	High
6	30–100	3–10	Medium high
5	10–30	1–3	Medium
4	3–10	0.3–1	Medium low
3	1–3	0.1–0.3	Low
2	0.3–1	0.03–0.1	Very Low
1	>0–0.3	>0–0.03	Negligible
0	0	0	Unknown exposure

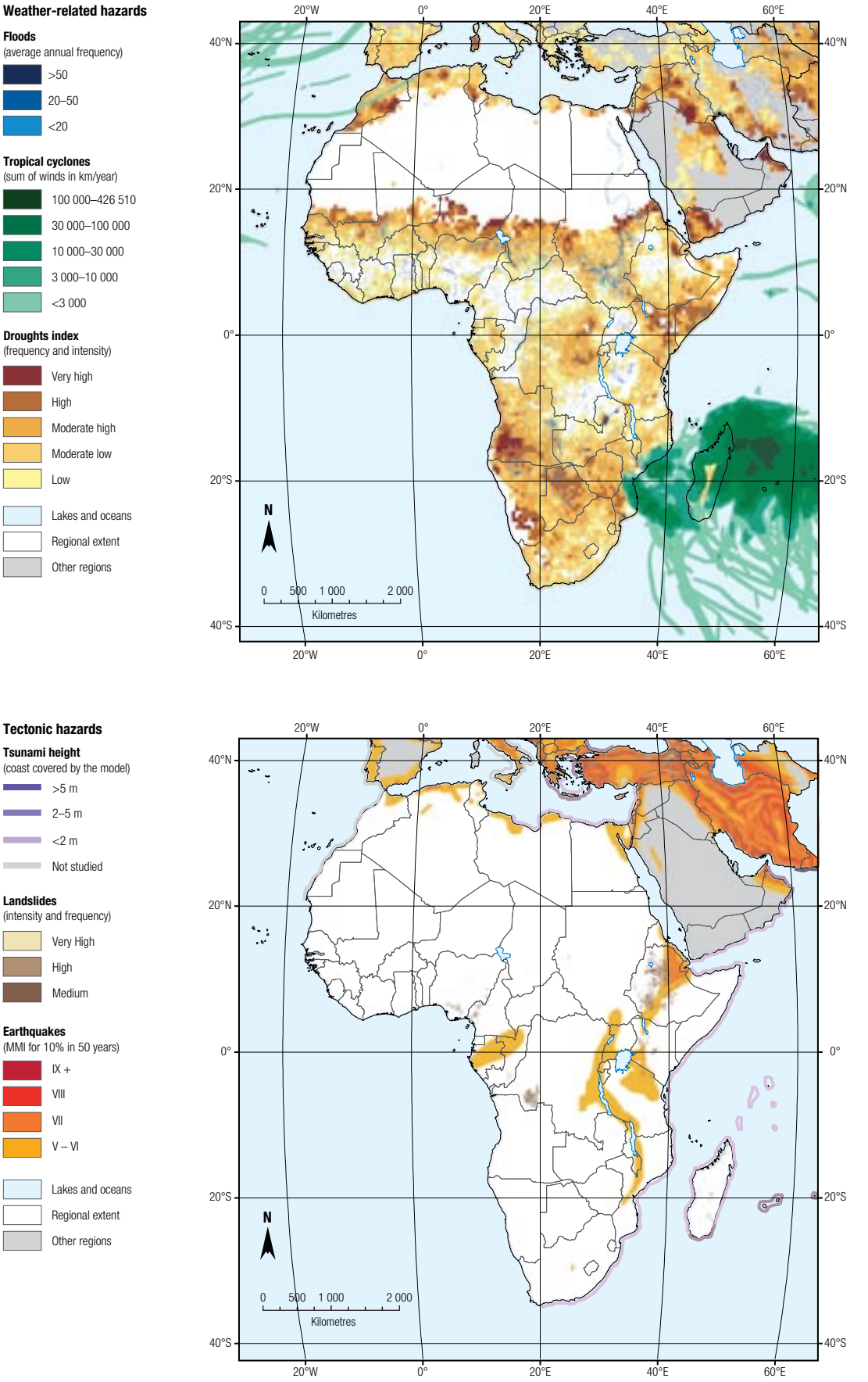
9. The above procedure differed slightly between hazards. A full description of the methodology is given in Appendix 1, Technical Note 1.1: Methodology.

While understanding of disaster risk has increased steadily, data limitations combined with the unpredictable and unique nature of hazard mean that much uncertainty remains. Rapid increases in vulnerability and in the exposure of population and economic assets, as well as the possibility of shifting climatic conditions affecting hazard location, frequency or magnitude, imply that risk cannot be modelled deterministically. Despite improvements in disaster reporting, loss information for individual events is incomplete and suffers from inconsistent measurement of damages and broader losses, particularly in the case of economic losses. Box 2.3 illustrates the difficulties in obtaining accurate data. While disaster mortality data are considered to be better recorded and more robust than economic loss data, uncertainties still exist.

Sub-national data on the exposure of economic assets and vulnerability factors are scarce or non-existent, meaning that proxies have to be used. Higher resolution data on disaster impacts that capture smaller-scale events and locally specific hazards are not globally available. Steady improvements in data collection will address these shortcomings and national data collection efforts will filter up to provide better global information, but these processes will take time.

Figure 2.1: Multi-hazard map of Africa

Data sources: Tropical cyclones: UNEP/GRID-Europe; Floods: UNEP/GRID-Europe + observerd from Dartmouth Flood Observatory and frequency from Flood PREVIEW UNEP/GRID-Europe; Droughts: IRI, Columbia University; Landslides: Norwegian Geotechnical Institute; Earthquakes: GSHAP transformed into MMI by IRI, Columbia University; Tsunami: compiled from various sources by the Norwegian Geotechnical Institute; *Cartography:* P. Peduzzi, UNEP/GRID-Europe, 2009.



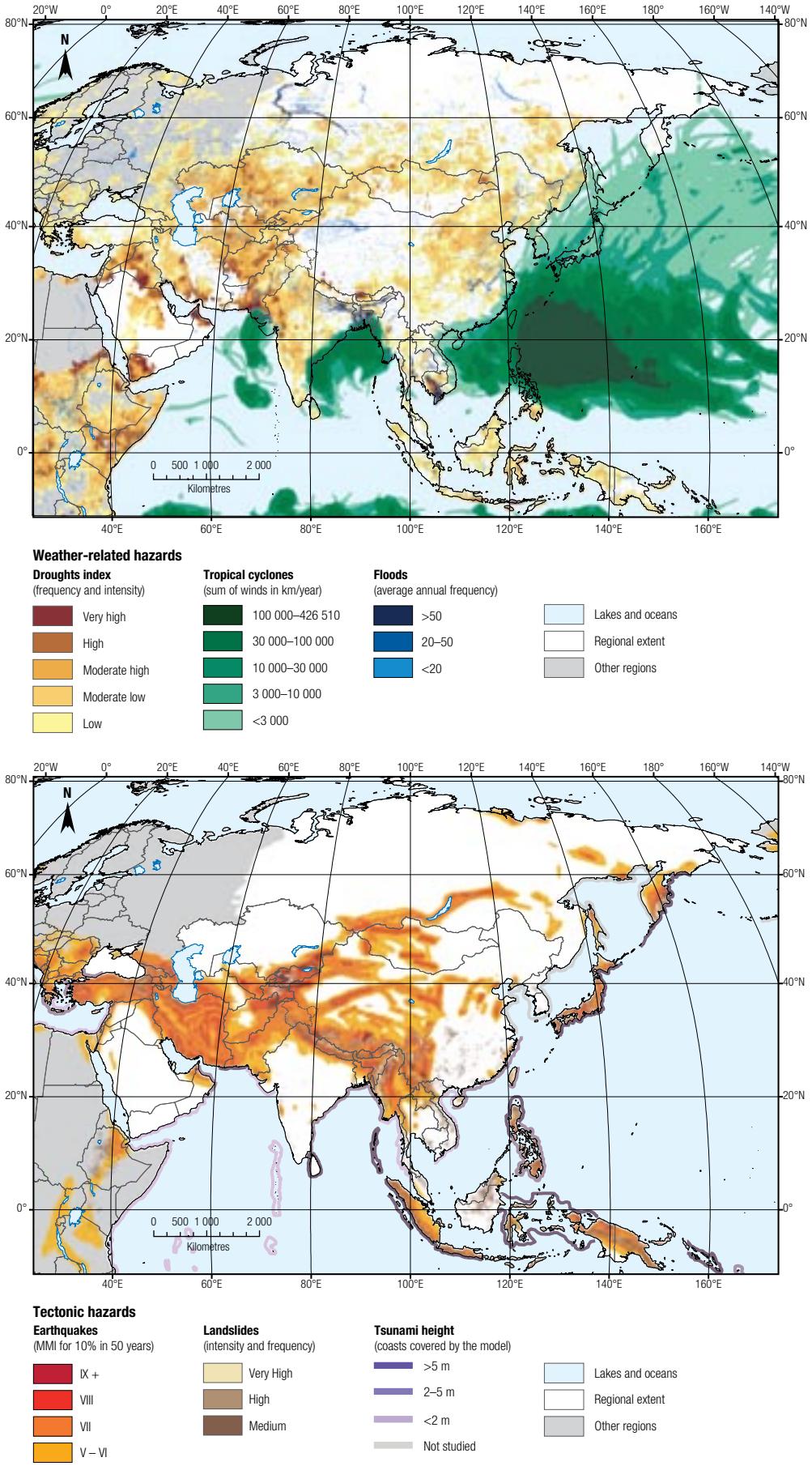
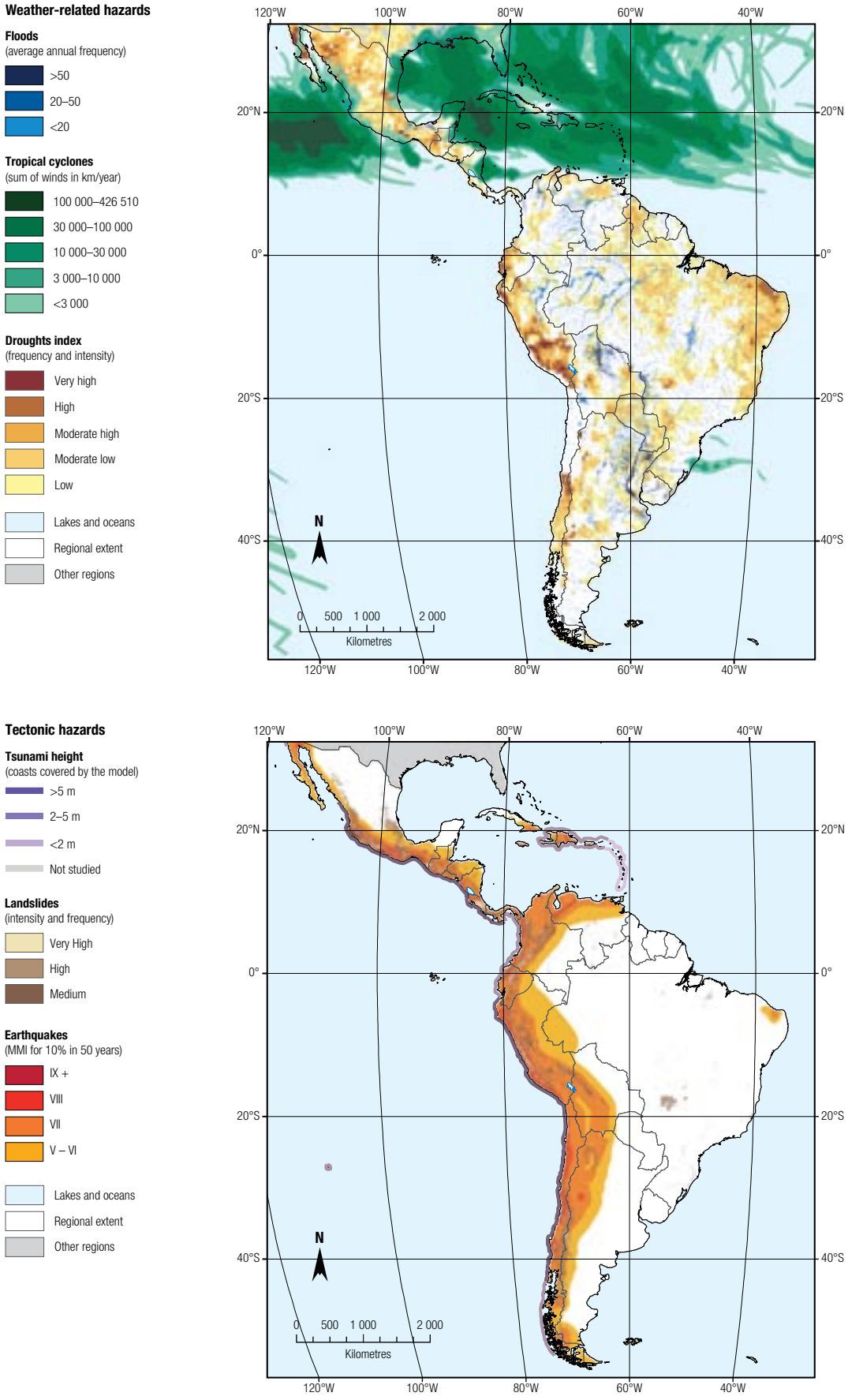


Figure 2.2: Multi-hazard map of Asia

Data sources: Tropical cyclones: UNEP/GRID-Europe; Floods: UNEP/GRID-Europe + observerd from Dartmouth Flood Observatory and frequency from Flood PREVIEW UNEP/GRID-Europe; Droughts: IRI, Columbia University; Landslides: Norwegian Geotechnical Institute; Earthquakes: GSHAP transformed into MMI by IRI, Columbia University; Tsunami: compiled from various sources by the Norwegian Geotechnical Institute; *Cartography:* P. Peduzzi, UNEP/GRID-Europe, 2009.

Figure 2.3: Multi-hazard map of Latin America and the Caribbean

Data sources: Tropical cyclones: UNEP/GRID-Europe; Floods: UNEP/GRID-Europe + observerd from Dartmouth Flood Observatory and frequency from Flood PREVIEW UNEP/GRID-Europe; Droughts: IRI, Columbia University; Landslides: Norwegian Geotechnical Institute; Earthquakes: GSHAP transformed into MMI by IRI, Columbia University; Tsunami: compiled from various sources by the Norwegian Geotechnical Institute; *Cartography:* P. Peduzzi, UNEP/GRID-Europe, 2009.



Box 2.3: Disaster mortality data – when the dead go missing

In 2000, the World Bank, describing the impact of natural catastrophes in 1999, stated that *"the landslides in Venezuela alone caused 50,000 fatalities"* [9]. The EMDAT database records 30,000 deaths due to the same set of floods, mudslides and landslides, which occurred in December 1999 and affected 11 states of Venezuela, mostly the State of Vargas but also Miranda and the country's capital, Caracas.

Research by anthropologist Rogelio Altez[10] of the Universidad Central de Venezuela puts forward a very different picture. After a forensic investigation into the deaths occurred in Vargas state, Altez documented a total of only 521 corpses attributed to the disaster, including 290 that had never been identified. In addition only 331 people had been reported missing. Given the likelihood that some of those reported missing were amongst the 290 unidentified corpses, Altez concluded that *"the total number of deaths does not exceed 700"*.

After flying over the affected area, the then Secretary General of the International Federation of Red Cross and Red Crescent Societies (IFRC) had declared that Venezuela's disaster was *"certainly at least two or three times worse than Mitch as far as the death toll is concerned"* and that *"as many as 50,000 people may have been killed"* [11]. According to Altez, statements of this kind began to be quoted as objective data and later became accepted international statistics.

The key message from Altez's study is that there are still major deficiencies in the way corpses are dealt with after many large natural disasters around the world, with documented cases of mass cremations and burials without an adequate process of identification or even quantification of the victims, often due to unjustified fear of epidemics. While the Venezuelan case may be unique, it does highlight the need for a critical approach when dealing with disaster mortality data.

Common statistical techniques, as employed in this study, are suitable for estimating average patterns and trends but are not able to predict extreme events, given the data limitations described (in particular limitations in the use of country-level vulnerability indicators) and the unpredictability of individual hazard events. This means that if the models in this analysis predict an annual average of 1,000 people killed by a given hazard type globally, there could be one event killing 10,000 people followed by 9 years of almost no casualties.

A number of hazard types have been left out or covered less comprehensively in this global analysis. Most importantly, although new indicators of drought occurrence have been developed and are discussed, the analysis did not yield sufficiently accurate estimates of global risk. This is a significant gap especially for sub-Saharan Africa, where drought is a major hazard facing rural populations. As a slow onset hazard, drought impacts are very different from those in sudden impact disasters such as earthquakes or storms. Many droughts with very severe social and economic consequences do not, in fact, show recorded mortality in international disaster databases [12].

The Report looks briefly at forest and other biomass fires, which account for a mere 0.1% of the fatalities recorded in EMDAT, but have major impacts on climate change, deforestation, soil productivity and biodiversity. This hazard is both exacerbated by and influences climate change, and is the second largest source of human-related greenhouse gas (GHG) emissions.

Given these limitations and uncertainties the estimates of exposure and risk provided can only be taken as indicative. They do not describe and cannot predict disaster risk in specific locations. As such, while many of the results can be displayed at quite high geographic resolutions, these should not be used for planning or decision making at the national or local levels. The purpose of this global risk analysis is to decipher global patterns and trends in risk and it does not and cannot substitute for detailed national and local-level risk assessments.

2.2 Weather-related disaster risk

2.2.1 Tropical cyclones

Tropical cyclones, also called typhoons and hurricanes, are powerful storms generated over tropical or sub-tropical waters. They have multiple impacts including extremely strong winds, torrential rains leading to floods or landslides, high waves and damaging storm surge, leading to extensive coastal flooding. Tropical cyclone risk has been modelled using the procedure described in Box 2.2 and further elaborated in Appendix 1.

Disaster risk for tropical cyclones has been calculated taking into account hazard associated with both wind speed and storm surge for different categories of cyclones on the Saffir–Simpson scale.

Figure 2.4 shows the geographic distribution of mortality risk for 10 km × 10 km squares in Asia, Africa and the Americas. Figure 2.5 shows the distribution of both absolute and relative mortality risk from all categories of tropical cyclones aggregated at the country level. Absolute risk is the average annual expected mortality; relative risk describes the average annual expected number of deaths as a proportion of national population. The statistical level of confidence in the model is good, particularly for Category 4 and 5 cyclones[13]. However, these are average annual estimates and cannot be used to predict specific events.

The top ten countries on the Mortality Risk Index and their respective values are Bangladesh (8.5), the Philippines (6.5), India (6), Madagascar (6), the Dominican Republic (6), Haiti (6), Myanmar (5.5), Vanuatu (5.5), Mozambique (5) and Fiji (5).

Geographically, tropical cyclone mortality risk is highly concentrated. For example, 75.5% of the expected mortality is concentrated in Bangladesh and 10.8% in India. There are also large differences in risk between different groups of countries. Relative mortality risk is approximately 200 times higher in low-income countries than in OECD countries and approximately 30 times greater in low human development countries than in high human development countries.

Economic loss risk due to tropical cyclones can be estimated using a model similar to that for mortality. However, the results tend to be less reliable because loss estimates are available for fewer events. There are also difficulties in defining and estimating losses, and there is an incentive to exaggerate damages in anticipation of greater external support. Because of these data constraints this chapter reports economic loss risk aggregated by broad regions and categories of countries.

As Table 2.1 shows, OECD countries including those prone to tropical cyclones such as Japan, the United States of America and Australia, account for almost 70% of estimated annual economic losses in absolute terms, followed by East Asia and the Pacific, and Latin America and the Caribbean. Sub-Saharan African countries, such as Madagascar and Mozambique, suffer the highest relative economic loss risk as a proportion of the size of the affected economy. Across all regions, estimated economic losses are highly concentrated in a few countries. The top five countries account for 80% of all estimated losses, with the remainder spread over more than 50 countries and areas.

When expressed as a proportion of exposed GDP, estimated losses in East Asia and the Pacific, Latin America and the Caribbean, and South Asia are between 5 and 7 times higher than those of the OECD countries, indicating a far higher vulnerability of their economic infrastructure.

Risk drivers and vulnerability factors

Tropical cyclone hazard (for each category of cyclone) is shown for each region in the regional multi-hazard maps presented presented in Figures 2.1, 2.2 and 2.3.

Figure 2.4: Distribution of mortality risk associated with tropical cyclones (10 × 10 km)

GIS and cartography: P. Peduzzi, ISDR, UNEP/GRID-Europe, 2009.

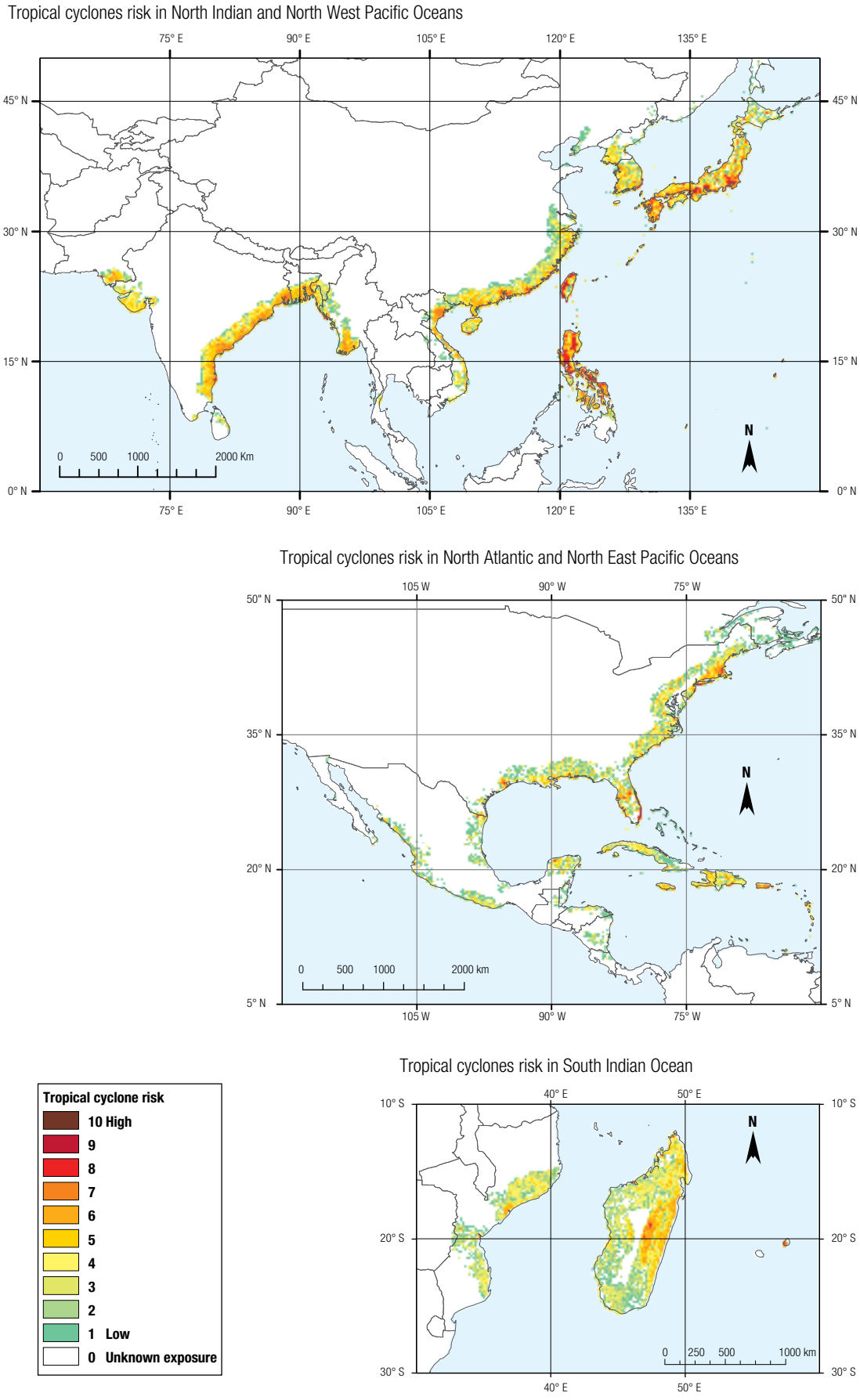


Figure 2.5: Absolute and relative mortality risk for tropical cyclones

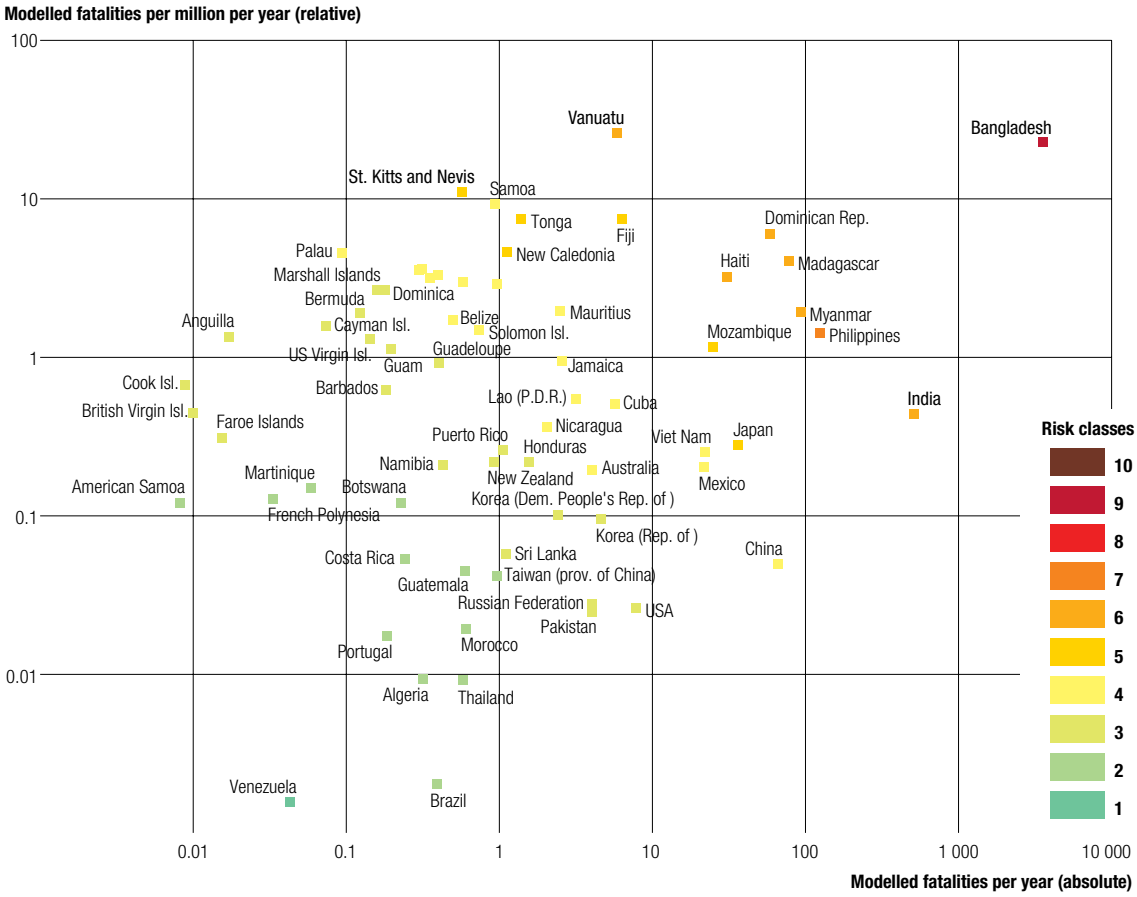


Table 2.1: Summary of predicted losses from tropical cyclone events[14]

*insufficient observations

Region	Average annual number of reported tropical cyclones 1975–2007	Average annual estimated economic loss (million constant 2000 US$)	Average annual GDP exposure (million constant 2000 US$)	Percent of global total economic loss	Estimated average annual economic loss as % of GDP in affected countries	Ratio of economic loss to GDP exposure (global mean = 100)
East Asia and Pacific	8.8	5,835	44,136	15.1	0.22	438
Europe and Central Asia*	–	–	–	–	–	–
Latin America and Caribbean	3.2	2,465	14,656	6.4	0.13	557
Middle East and North Africa*	–	–	–	–	–	–
South Asia	1.2	1,054	8,380	2.7	0.11	417
Sub-Saharan Africa	1.9	306	3,467	0.8	0.55	292
OECD	11.1	27,451	1,060,431	71.2	0.13	86
Other high income countries	3.5	1,434	176,010	3.7	0.19	27
Total	**29.7**	**38,545**	**1,307,080**	**100**		

Table 2.2 shows the number of people and GDP exposed to tropical cyclones and related storm surge hazards, for different tropical cyclone categories. An average of 78 million people worldwide are exposed each year to tropical cyclone wind hazard and a further 1.6 million to storm surge. Asian countries have the largest absolute population exposed, while SIDS have the highest proportion of their population exposed. In particular, SIDS have a far greater relative exposure to highly destructive Category 3 and 4 storms than larger countries. Some countries, such as the Philippines have a very high absolute and relative exposure.

In terms of economic exposure, an annual average of US$ 1,284 billion of GDP is exposed to tropical cyclones. The country with the highest absolute exposure is Japan. The countries with the highest relative exposure, however, are almost all SIDS.

The strength of a tropical cyclone and the number of people or exposed economic assets in the area affected explain a large part of the risk (see Figures 2.7, 2.8 and 2.9). However, even for comparable storms and exposure, large differences persist between countries (also see Box 2.4 for unexpected events).

Box 2.4: Unexpected risks: tropical cyclone Catarina, 2004

For the first time since monitoring of tropical cyclones began a tropical storm in the South Atlantic reached a force of Category 1 on 26th March, 2004 (Figure 2.6). By the 28th it had strengthened to Category 2, when it reached Santa Catarina Province of Brazil. Even though it weakened somewhat before landfall, it caused US$ 350–425 million damage[15], killing 4 people and injuring 518 others[16].

It was commonly thought that tropical cyclones could not be generated in the South Atlantic Ocean. Today there is still no scientific agreement on the cause of the Catarina cyclone, but it provides a clear demonstration that unexpected events can occur in places where they have not happened before. Longer-term changes in the Earth's oceans and atmosphere may bring more such surprises.

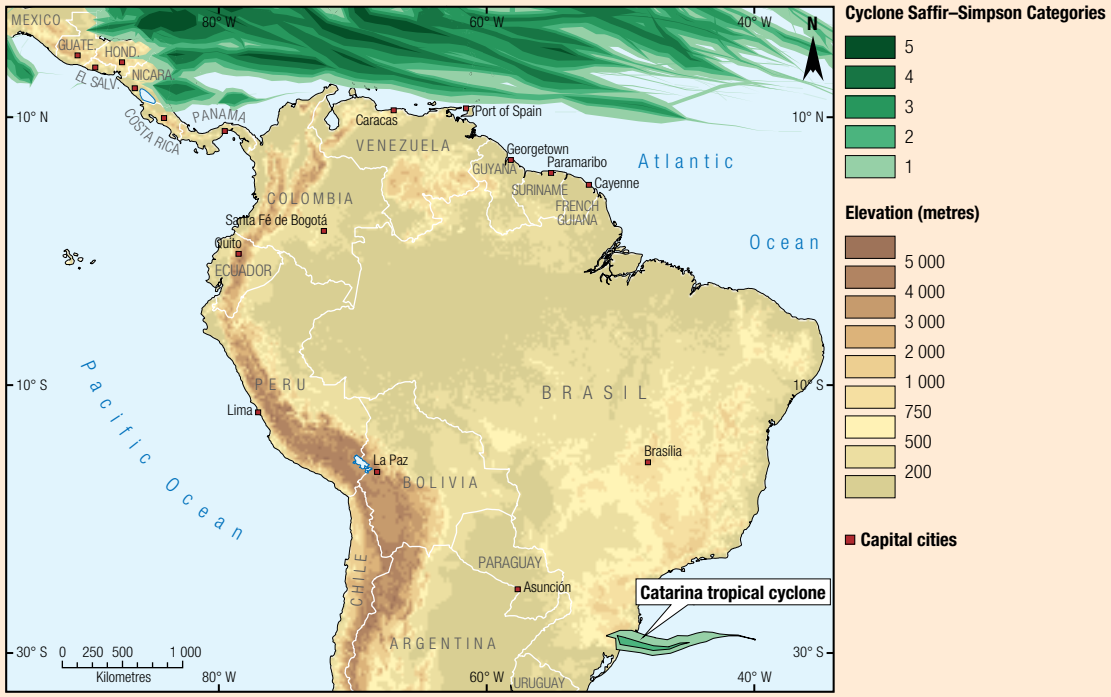


Figure 2.6: Tropical cyclones over a 30-year period

Table 2.2: Annual exposure to tropical cyclones by classes of intensity (Saffir–Simpson)*

Source: Adapted from the U.S. National Oceanic and Atmospheric Administration (NOAA), National Hurricane Center (NHC)[17]

* Modelled

Cyclone category	Annual population exposure (millions)	Annual GDP exposure (US$ millions)
Category 1: Winds (Km/hour) 118–153, Surge: less than 2 m	57.8	942,300
Category 2: Winds (Km/hour) 154–177, Surge: 2–3 m	13.5	229,025
Category 3: Winds (Km/hour) 178–210, Surge: 3–4 m	5.5	100,684
Category 4: Winds (Km/hour) 211–249, Surge: 4–5 m	0.8	11,623
Category 5: Winds (Km/hour) more than 249, Surge 5–10 m	0.2	824
Total	**77.7**	**1,284,456**

Figure 2.7: People exposed to tropical cyclones (wind speed categories)

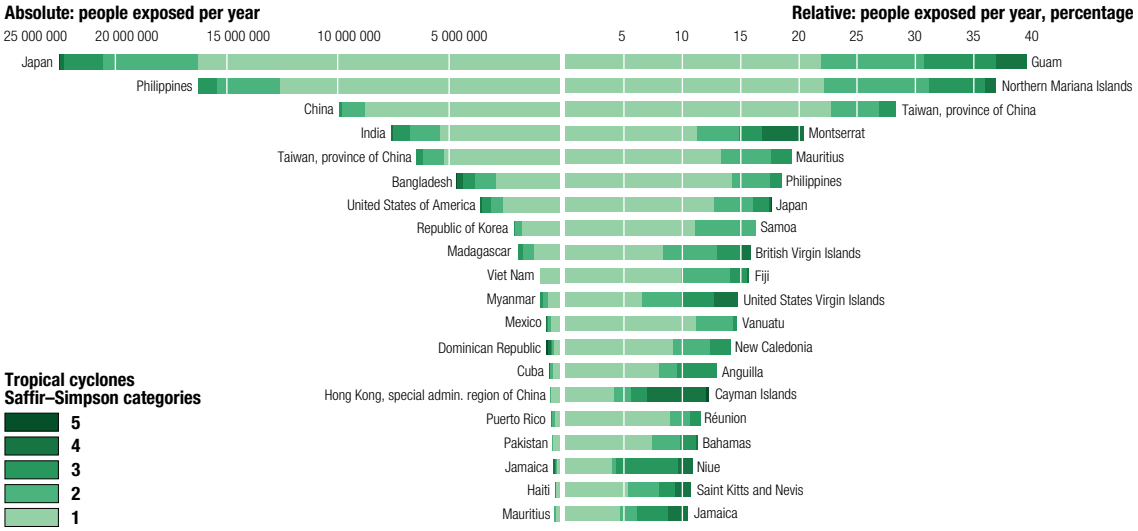


Figure 2.8: People exposed to storm surge for all categories of tropical cyclone

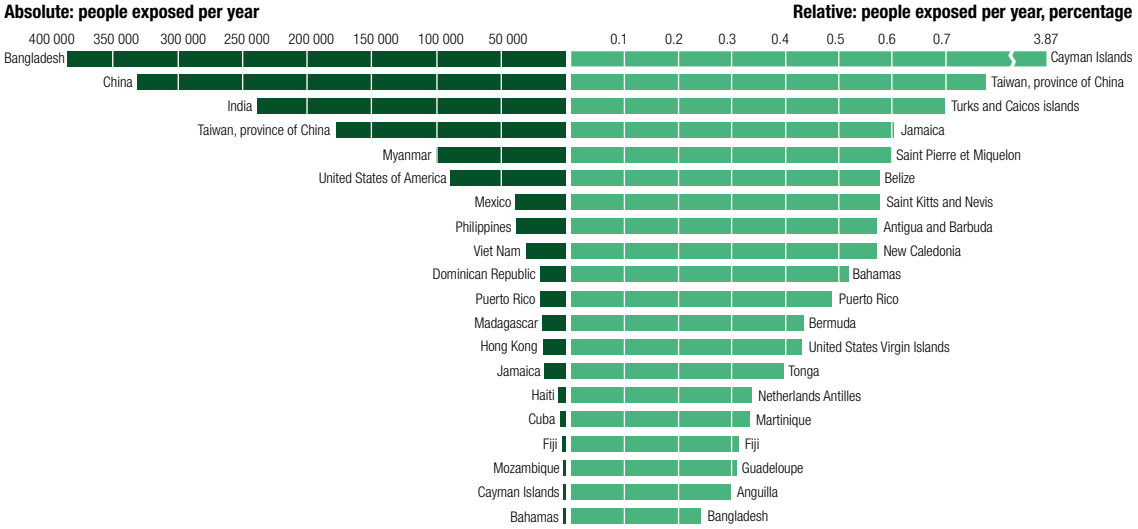


Figure 2.9: GDP exposed to tropical cyclones

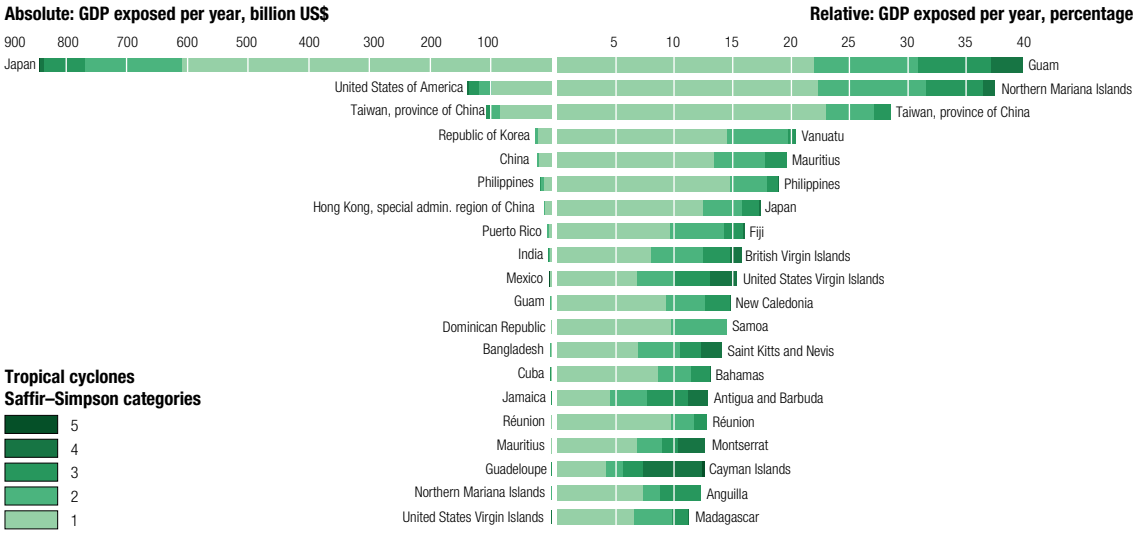


Figure 2.10 shows that in general, low-income countries are far more likely to suffer mortality for a given number of people exposed and, in particular, for powerful Category 3 and 4 tropical cyclones. Similarly, lower-middle income countries are much more likely to suffer economic loss across all categories of cyclone intensity.

The key vulnerability factors that contribute to mortality risk are low GDP per capita and remoteness. As exposure increases and income decreases there is a greater risk of tropical cyclone mortality. Areas that are remote with respect to the main administrative and economic centre of the country, tend to suffer more. The case of tropical cyclone Nargis in Myanmar in 2008 is an example. Densely populated, very poor remote rural areas were devastated by a Category 4 tropical cyclone and associated storm surge.

In the case of economic losses, well-governed countries seem to experience lower damages in comparable tropical cyclones with similar magnitude and exposure, than poorly governed countries. In contrast, income inequality is associated with higher levels of damage. To illustrate the effect of these variables, the economic risk model suggests that if Bangladesh had the significantly higher institutional quality and lower levels of inequality found in Japan, its annual economic loss from tropical cyclones could be about 60% lower, even if exposure and hazard severity remained unchanged.

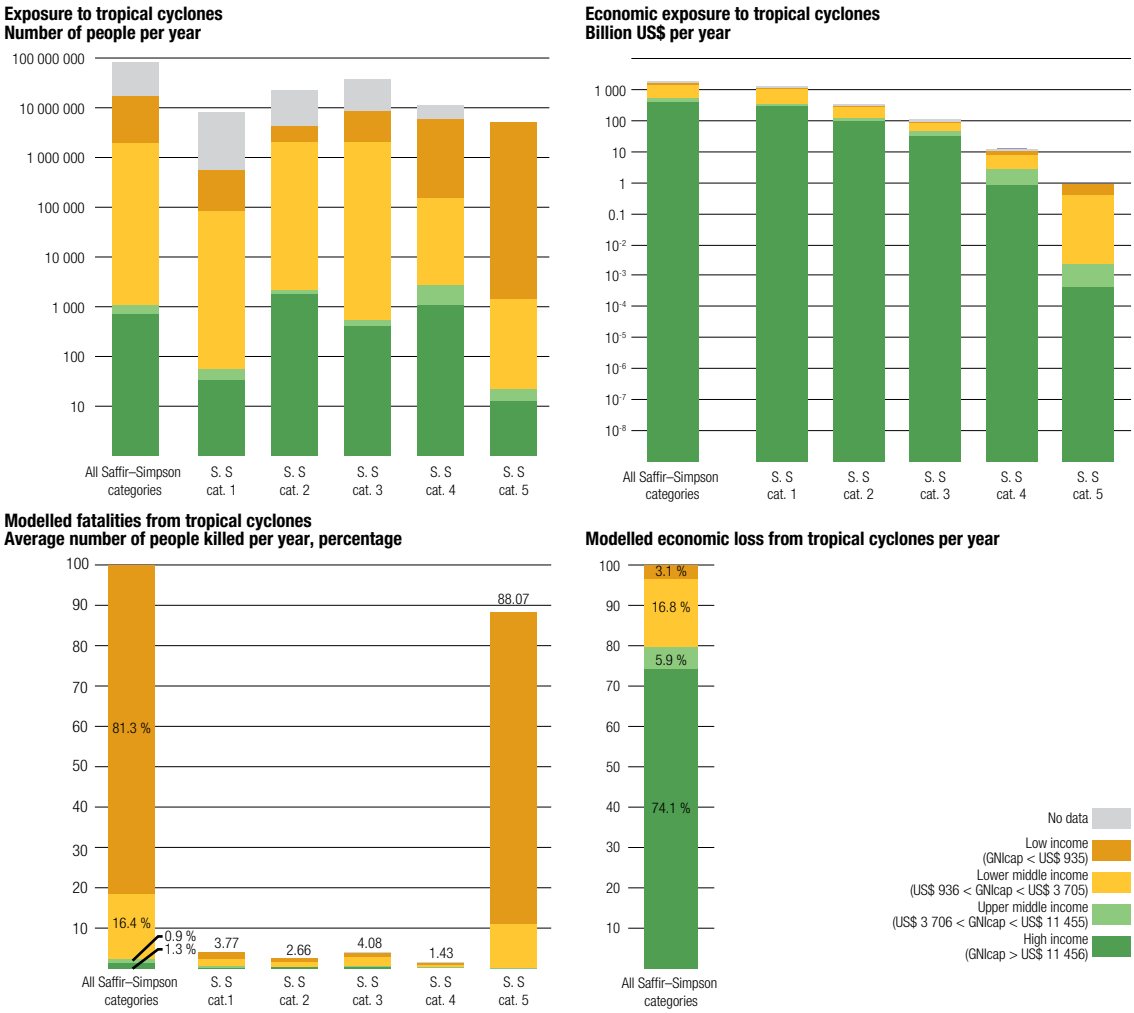
Finally, even after controlling for population size, SIDS generally experience greater economic losses.

2.2.2 Floods

Disaster risk for floods has been calculated for large rural flood events. The risk calculations do not include flash floods or urban flooding from inadequate drainage.

Figure 2.11 shows the geographic distribution of mortality risk for 10 km × 10 km squares of the Earth's surface. Figure 2.12 shows the distribution of both absolute and relative mortality risk for floods aggregated at the country level. As with cyclones, absolute risk is the average annual expected mortality, while relative risk is measured as the average annual expected number of deaths as a proportion of national population. The geographical distribution of flood mortality risk mirrors that for exposure. It is heavily concentrated in Asia, especially in India, Bangladesh and China. Between them these countries concentrate 75% of the modelled annual global mortality. Viet Nam also has high absolute and relative flood risks. The top ten countries on the Mortality Risk Index for floods and their respective values are India (7.5), Bangladesh (6.5), China (6), Viet Nam(6),

Figure 2.10: Mortality and economic loss from tropical cyclones compared to exposure for income classes



Cambodia (6), Myanmar (5.5) Sudan (5.5), Democratic People's Republic of Korea (5.5), Afghanistan (5), Pakistan (5).

The regional distribution of economic loss risk is shown in Table 2.3. Severe flooding affects more countries than tropical cyclones[18]. Flood losses are also somewhat less concentrated across countries than tropical cyclone losses. The top five countries account for 68%, and the top 10 for 78%, of total modelled economic losses. By region, OECD countries (especially the United States of America and Germany) account for the largest share of average annual modelled damages. But the East Asia and Pacific region and South Asia experience almost similar levels of losses. China, Indonesia and Thailand combined account for 25%, as do India, Pakistan and Bangladesh. By far the largest economic losses in relation to the size of economies occur in South Asia, followed by sub-Saharan Africa and East Asia.

The ratio of losses to GDP exposure in the OECD countries is far higher than in Latin America and the Caribbean, or South Asia. This probably indicates the differential impact of flooding on primary sector activities, such as agriculture and fishing in the latter two regions, compared to the impact on industry and services in the OECD.

Figure 2.13 illustrates why global hazard identification cannot be used for local risk mapping. In August 2008, a dyke breach led to a large flood in Bihar, India. The red areas are those that actually flooded, while the blue areas

Figure 2.11:
Distribution of mortality risk associated with floods (10 × 10 km)

GIS and cartography: C. Herold, P. Peduzzi, UNEP/GRID-Europe, 2009

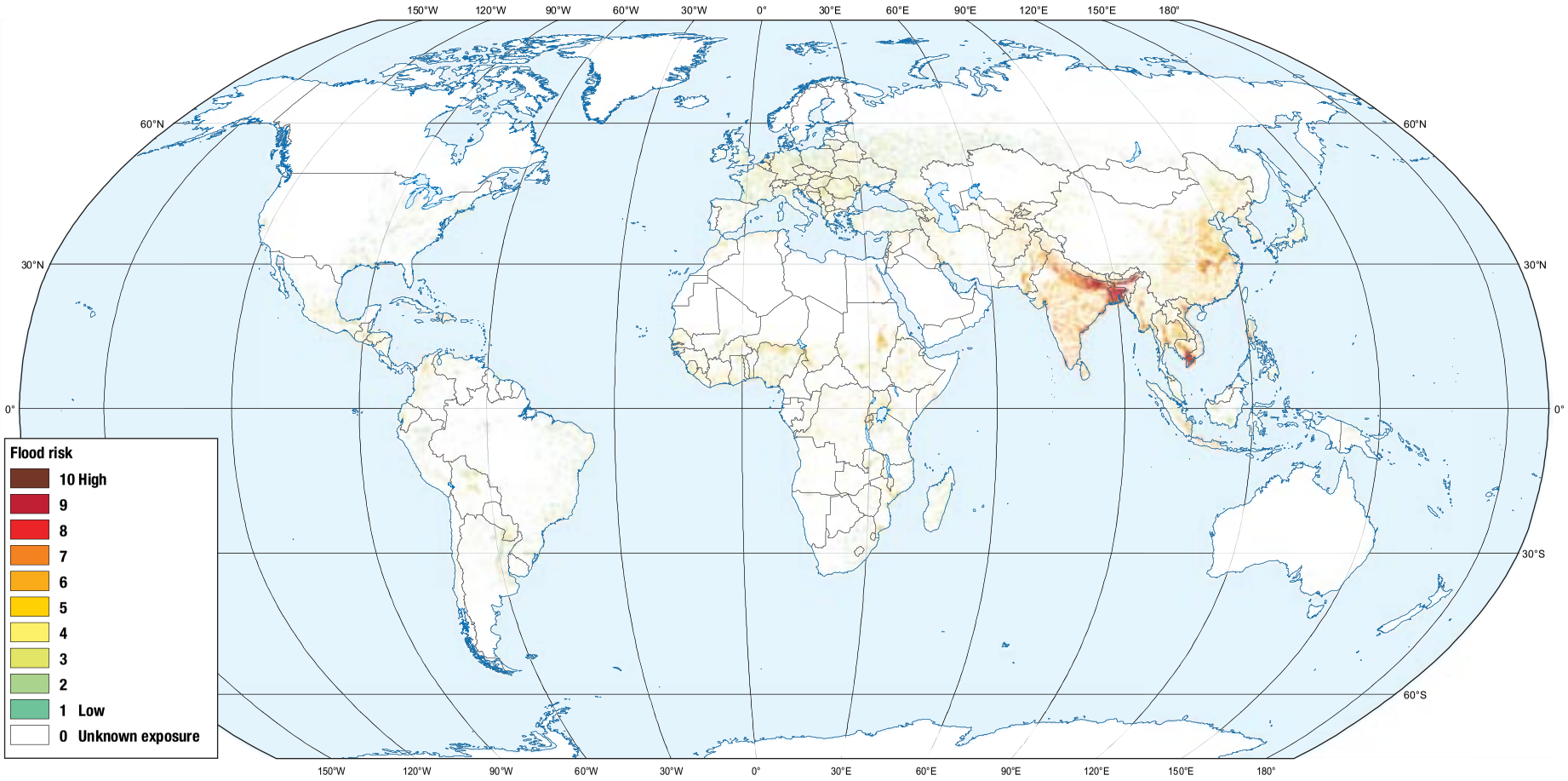


Figure 2.12: Absolute and relative mortality risk for floods

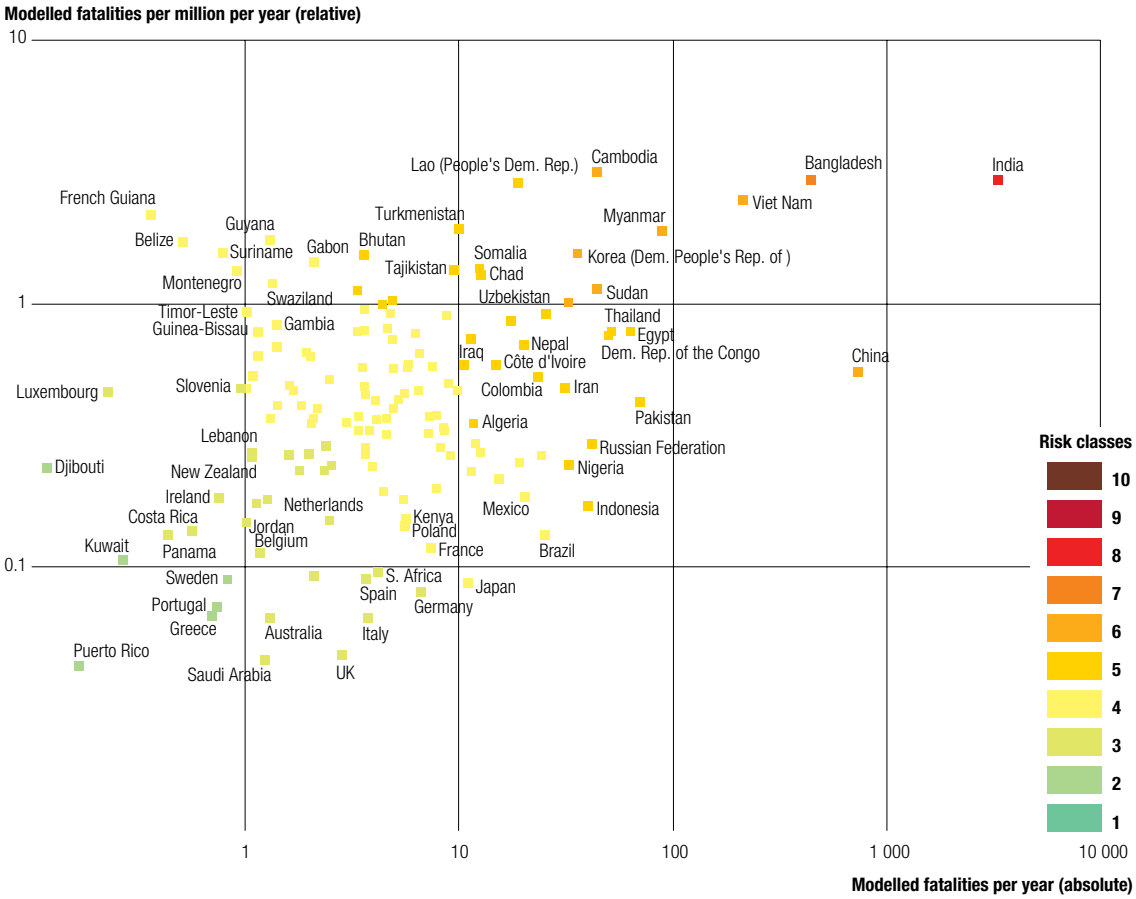


Table 2.3: Summary of predicted losses from flood events

*insufficient observations

Region	Average annual number of reported floods 1999–2007	Average annual modelled economic losses (million constant 2000 US$)	Average annual GDP exposure (million constant 2000 US$)	Percent of total global economic loss	Modelled average annual economic loss as % of GDP in affected countries	Ratio of economic loss to GDP exposure (global mean = 100)
East Asia and Pacific	4.0	4,935	8,707	27.4	0.16	128
Europe and Central Asia	4.9	1,382	3,156	7.7	0.11	99
Latin America and Caribbean	3.2	470	1,818	2.6	0.02	59
Middle East and North Africa*	–	–	–	–	–	–
South Asia	5.7	4,807	13,817	26.7	0.49	79
Sub-Saharan Africa	8.6	767	867	4.3	0.19	201
OECD	4.2	5,536	12,113	30.7	0.03	104
Other high income economies*	–	–	–	–	–	–
Total	**30.6**	**17,897**	**40,478**	**100**		

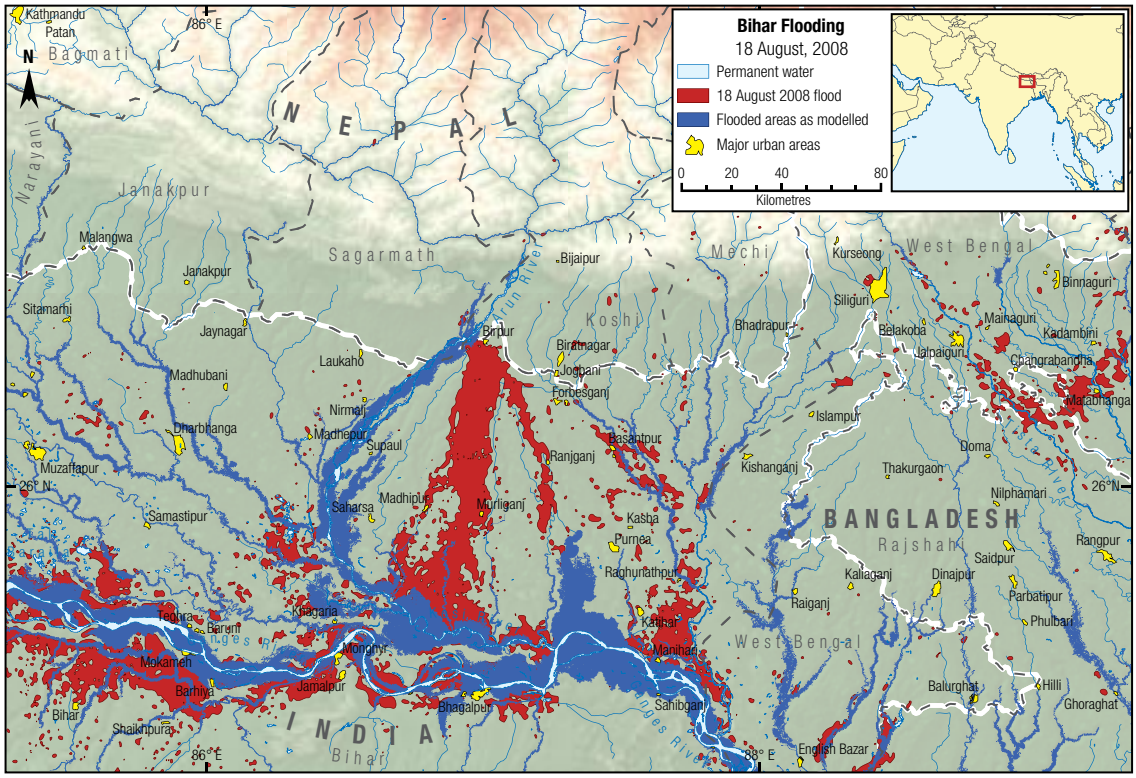


Figure 2.13: Example of one limitation of the model

Cartography and GIS analysis: UNEP/GRID-Europe
Data source for detected Bihar flood event: courtesy of Dartmouth Flood Observatory.

represent modelled flood hazard. The global model cannot take into account locally specific risk factors, such as the strength of dykes, even though these have a critical influence on the distribution and magnitude of losses.

Risk drivers and vulnerability factors

Flood hazard is shown for each region in the regional multi-hazard maps presented in Figures 2.1, 2.2 and 2.3.

As Figure 2.14 shows, human exposure to floods is heavily concentrated in Asia. The top ten most exposed countries – in absolute and relative terms – are in South and South-East Asia, where a number of heavily populated river deltas and watersheds are located. GDP exposure is also heavily concentrated in Asia (see Figure 2.15). However, developed countries such as the United States of America, Germany, Japan and France also have high absolute GDP exposure, while African countries, such as Benin, the Sudan and Chad have high relative GDP exposure.

Compared to their exposure, lower-middle income countries have higher mortality rates and higher levels of economic loss (Fig. 2.16).

Mortality from flood events [19] is closely associated to the size and growth rate of exposed rural populations. Lack of voice and accountability were also identified as significant factors. Flood mortality risk is thus highest in heavily populated rural areas in countries with weak governance.

In the case of economic risk, smaller, more concentrated floods appear to cause relatively greater economic damages than floods with a larger extent. The former may affect areas with higher population density more severely, while the latter might mostly impact relatively lower value agricultural lands. The effect of a country's wealth is much less pronounced for floods than for other disaster types. While mortality is concentrated in developing countries, significant economic damages from floods also occur regularly in North America and Central Europe, for instance.

Figure 2.14: People exposed to floods

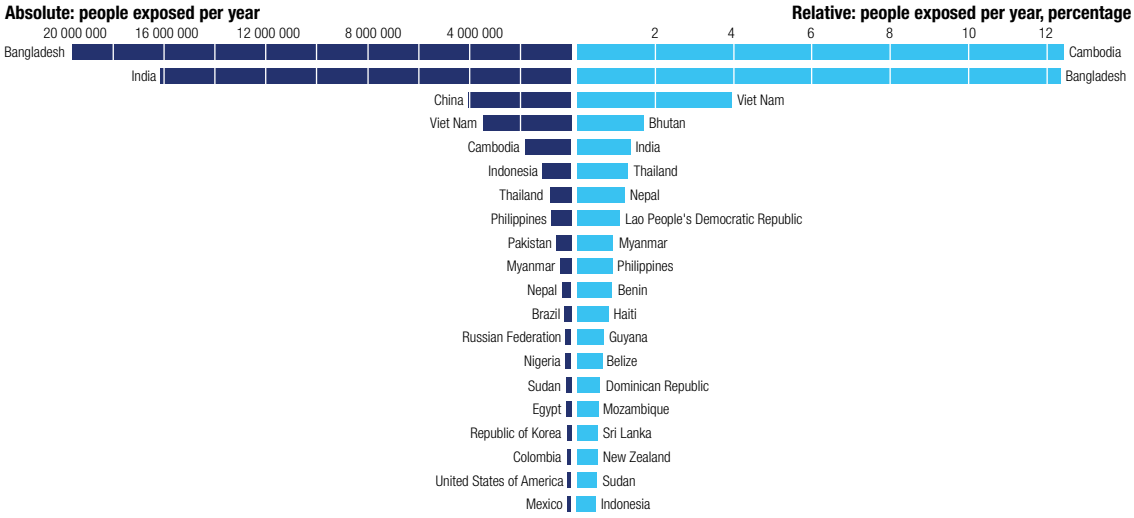


Figure 2.15: GDP exposed to floods

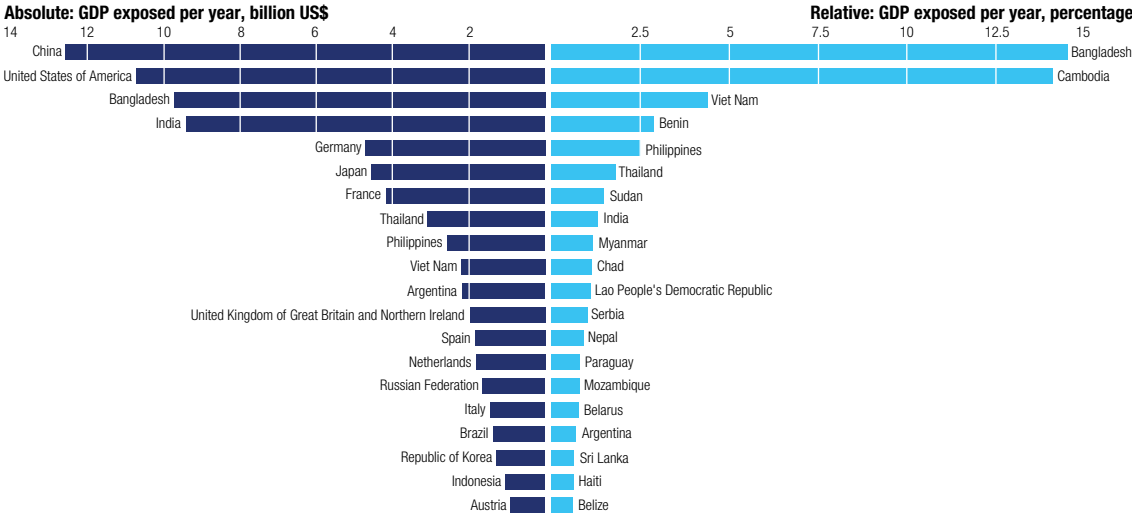
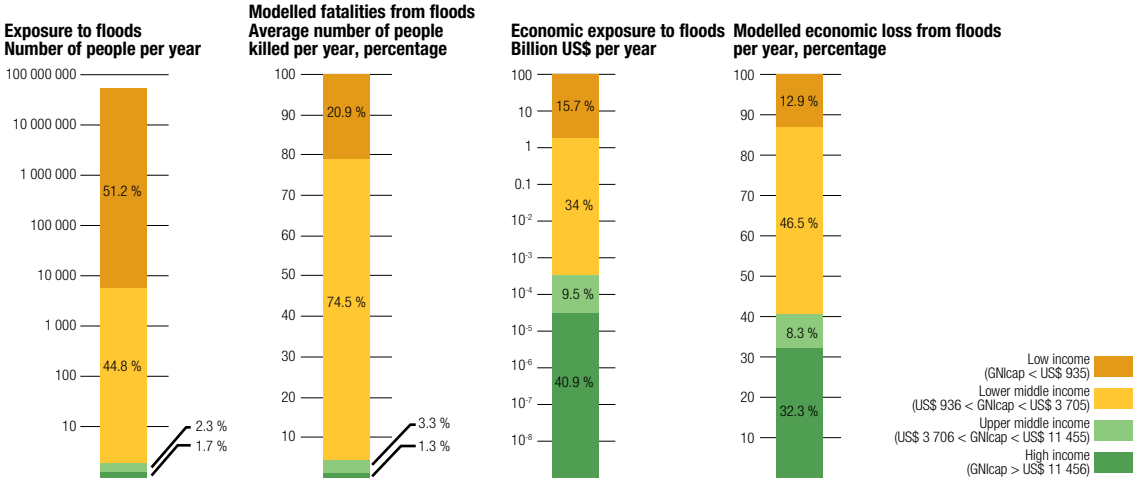


Figure 2.16: Exposure, mortality and economic loss to floods by income class



2.2.3 Landslides

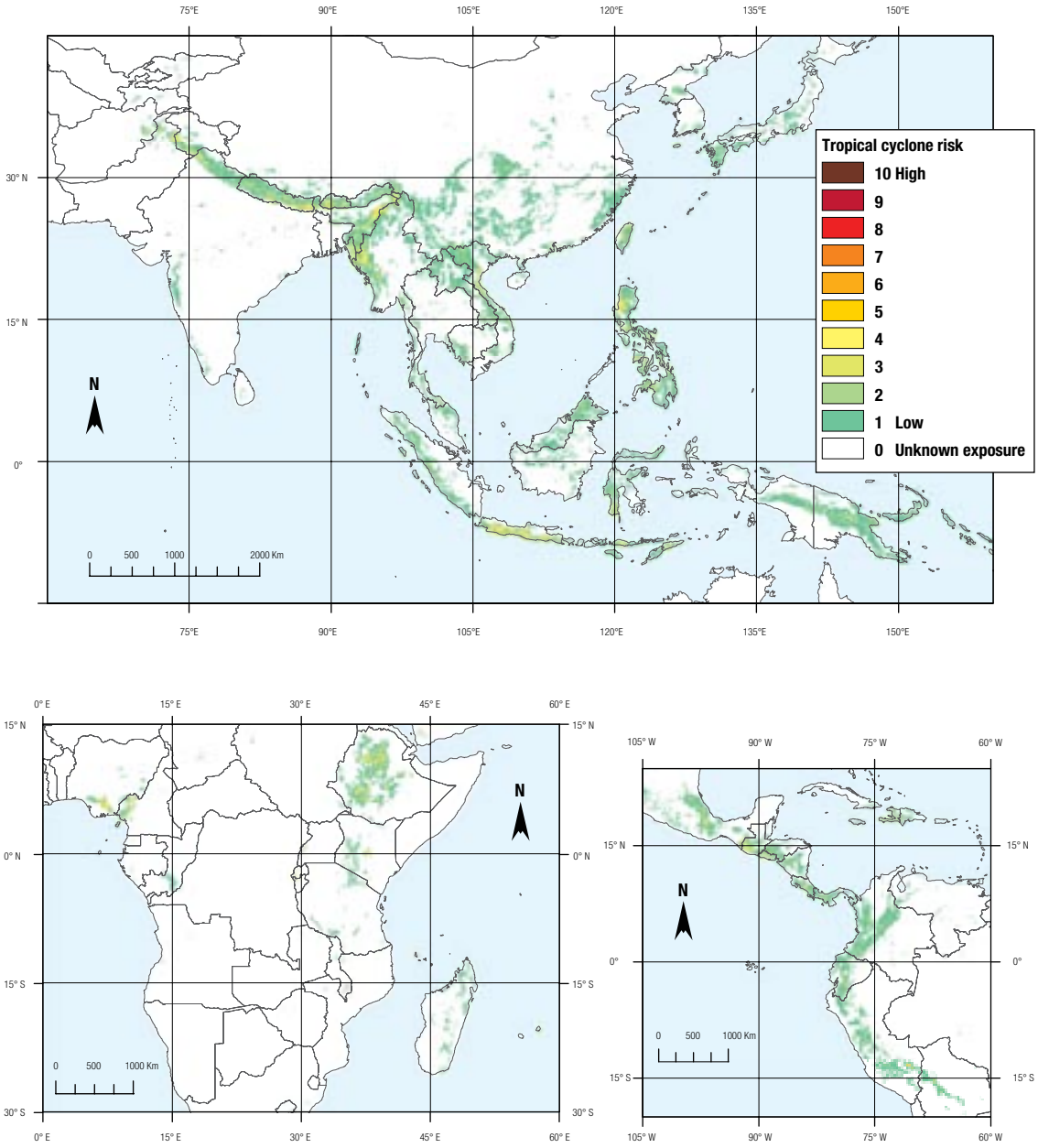
Observed mortality in landslides triggered by high precipitation is approximately six times higher than in landslides triggered by earthquakes. The risk model therefore focuses on precipitation triggered landslides (Fig. 2.17). Exposure, however, has been calculated for both kinds of landslide.

Figure 2.18 shows absolute and relative mortality risk for precipitation triggered landslides. Countries with very high absolute and relative risk include Guatemala, Nepal and Papua New Guinea. Compared to other hazards, global landslide mortality risk is relatively low, although many small landslide events causing deaths are not internationally reported. The predicted mortality risk, even in very large countries such as India or China, is less than 100 deaths per year. Absolute mortality risk is highest in countries such as Ethiopia, Indonesia and India. Relative mortality

Figure 2.17: Distribution of mortality risk associated with precipitation triggered landslides (10 × 10 km)

GIS and cartography: P. Peduzzi, ISDR, UNEP/GRID-Europe, 2009.

Mortality risk distribution for landslides triggered by precipitation



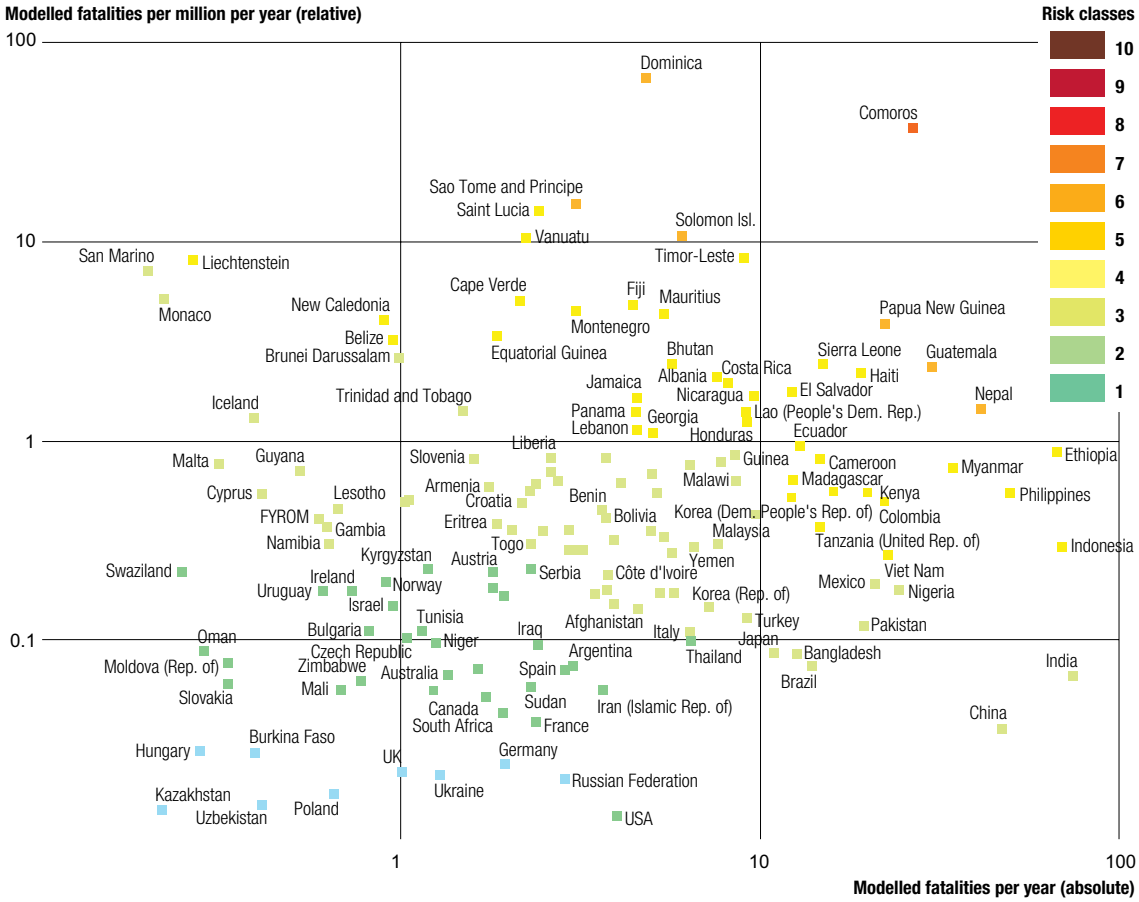


Figure 2.18: Absolute and relative mortality risk for precipitation triggered landslides

risk is highest in small islands, notably in Dominica and the Comoros. Approximately 55% of mortality risk is concentrated in 10 countries, which also account for 80% of the exposure. The top ten countries on the Mortality Risk Index for landslides and their respective values are Comoros (6.5), Dominica (6), Nepal (5.5), Guatemala (5.5), Papua New Guinea (5.5), Solomon Islands (5.5), Sao Tome and Principe (5.5), Indonesia (5), Ethiopia (5), and the Philippines (5).

Risk drivers and vulnerability factors

Landslide hazard is shown for each region in the regional multi-hazard maps presented in Figures 2.1, 2.2 and 2.3. Figures 2.19 and 2.20 illustrate the relative and absolute exposure of people and GDP to both earthquake and precipitation triggered landslides. Approximately 2.2 million people are exposed to landslides worldwide. In absolute terms, exposure is very high in a number of large Asian countries, especially India, Indonesia and China. Relative exposure is highest in small countries with steep terrain including a number of small island nations. The relative importance of the triggering mechanism varies widely among countries.

Taiwan, Province of China, has the highest absolute GDP, as well as the highest relative GDP exposure, both due to earthquake triggered landslides. As illustrated in Figure 2.21, lower-middle income countries in general experience greater mortality with respect to the population exposed.

This is confirmed by the identification of vulnerability factors. Precipitation triggered landslide mortality is best explained by the exposure of the population and by local GDP per capita. As in the case of tropical cyclones, poor countries have significantly more landslide mortality than wealthier countries.

Data limitations prevent the analysis of economic losses due to landslides.

Figure 2.19: People exposed to landslides triggered by precipitation or earthquake

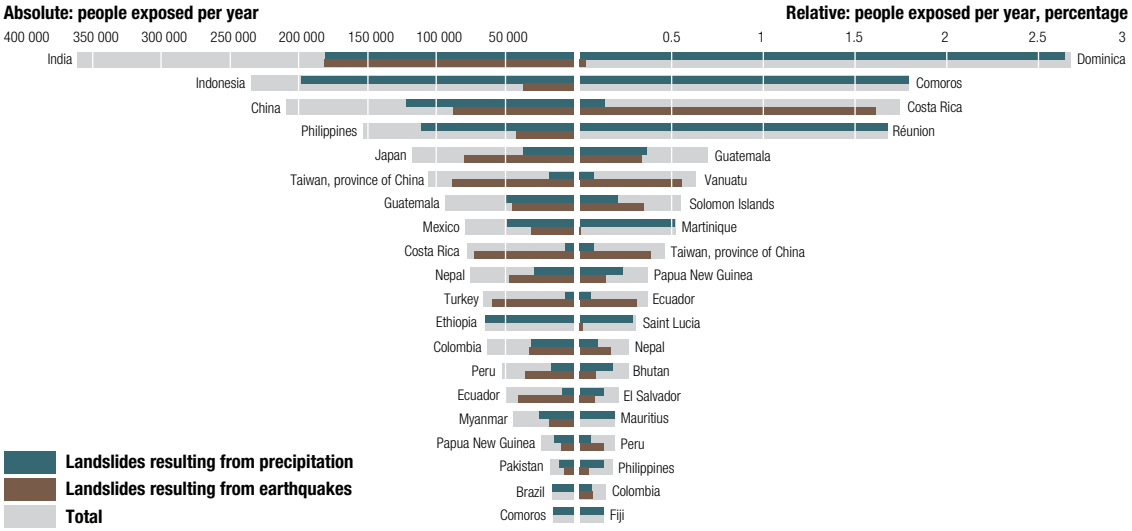


Figure 2.20: GDP exposed to landslides triggered by precipitation or earthquake

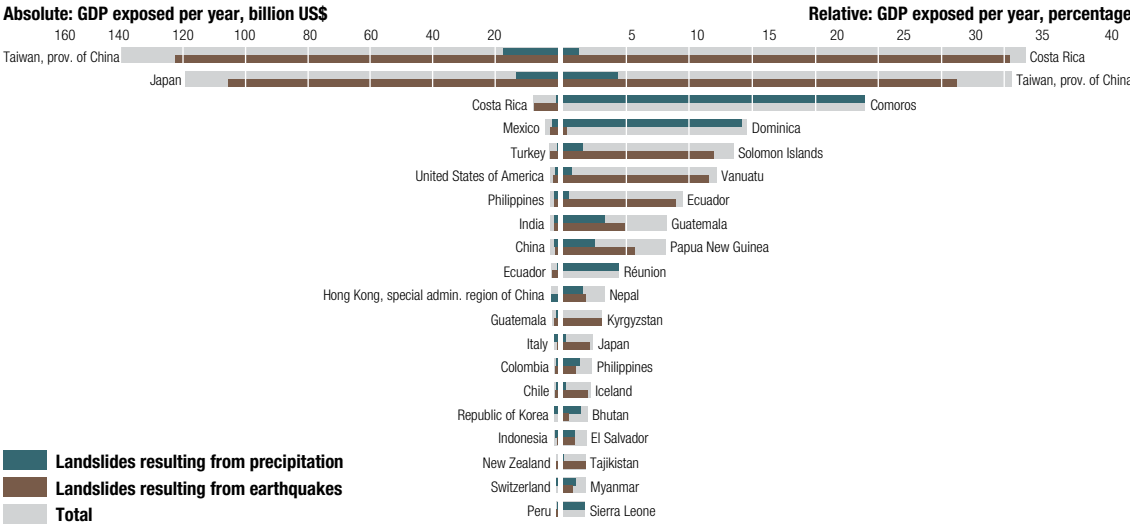


Figure 2.21: Mortality and exposure to landslides by income class

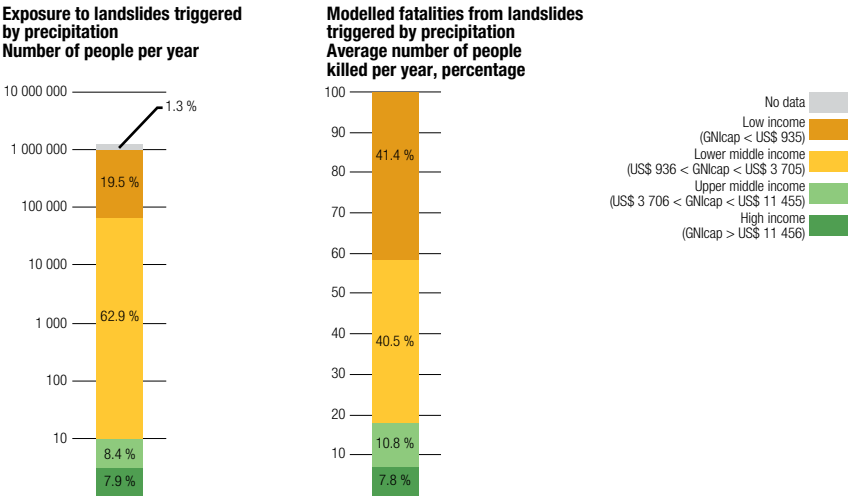
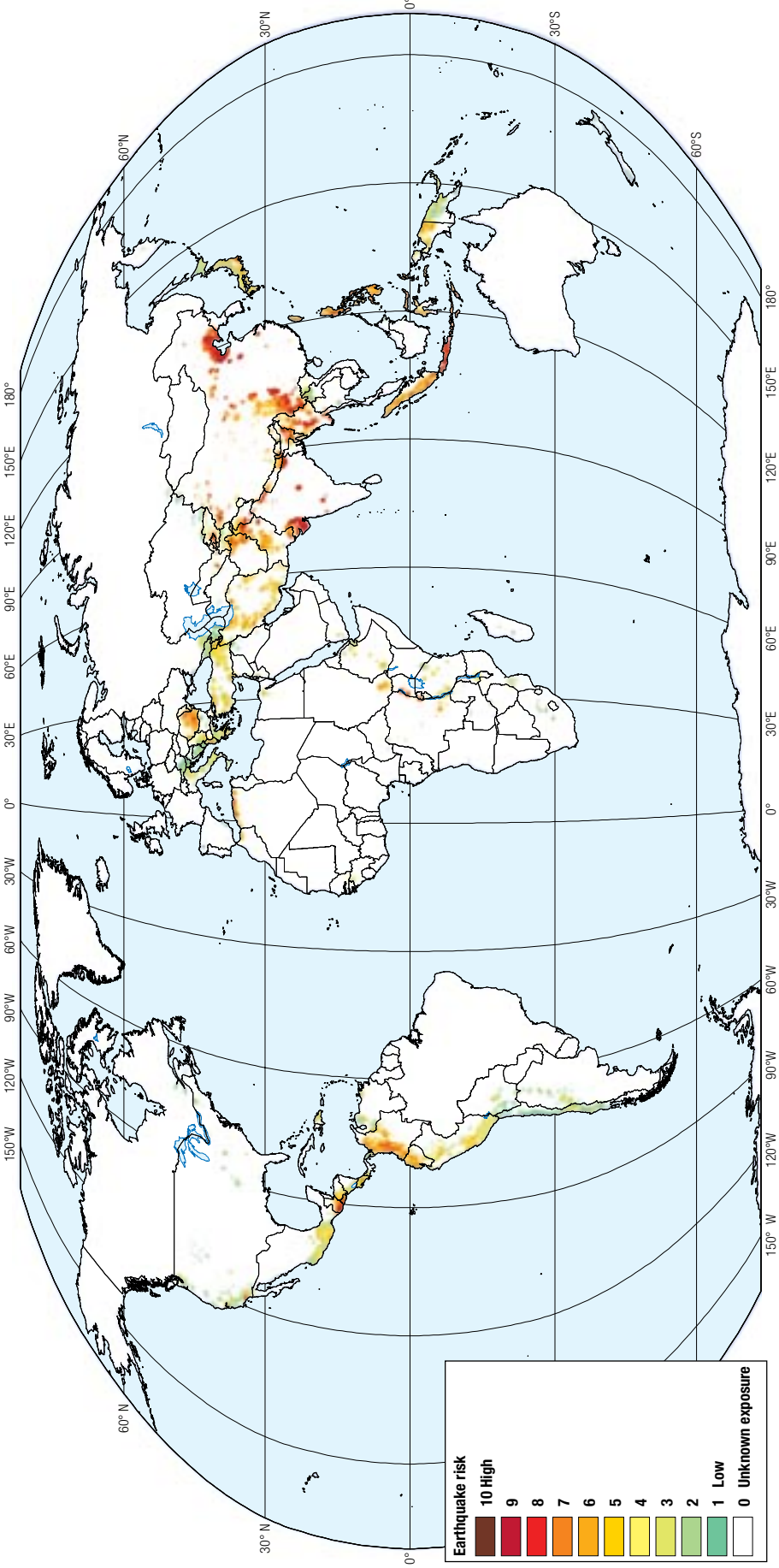


Figure 2.22:
Distribution of mortality risk associated with earthquakes (10 × 10 km)

GIS and cartography: P. Peduzzi, ISDR, UNEP/GRID-Europe, 2009.



2.3 Other hazards

2.3.1 Earthquakes

Earthquake risk has been calculated using four categories of seismic intensity, corresponding to values between V and XII on the Modified Mercalli Intensity scale (MMI) (see Table 2.4). Different exposure models were used to calculate mortality risk and economic loss risk and results are presented with a medium level of confidence. As with other hazards, economic loss risk is calculated only for groups of countries (regions and income classes).

Categories 1 and 2 include 93.0% and 5.8% respectively of the population exposure, but account for only 0.6% of the mortality risk. Most mortality risk is concentrated in earthquakes of higher intensities (Categories 3 and 4).

Figure 2.22 shows the geographic distribution of mortality risk as modelled for each 10 km × 10 km square of the Earth's surface. Figure 2.23 shows the distribution of both absolute and relative mortality risk from all categories of earthquakes aggregated at the country level.

China, India and Indonesia are the countries with the highest absolute mortality risk, while some smaller countries, such as El Salvador and Guatemala have very high relative risk. Some countries, such as the Democratic Republic of the Congo, that have not experienced recent major earthquake disasters have high levels of both absolute and relative mortality risk. Mortality risk is highly concentrated. The model

Table 2.4: Categories of seismic intensity

Categories	1	2	3	4
MMI	V to VI	VII	VIII	IX to XII

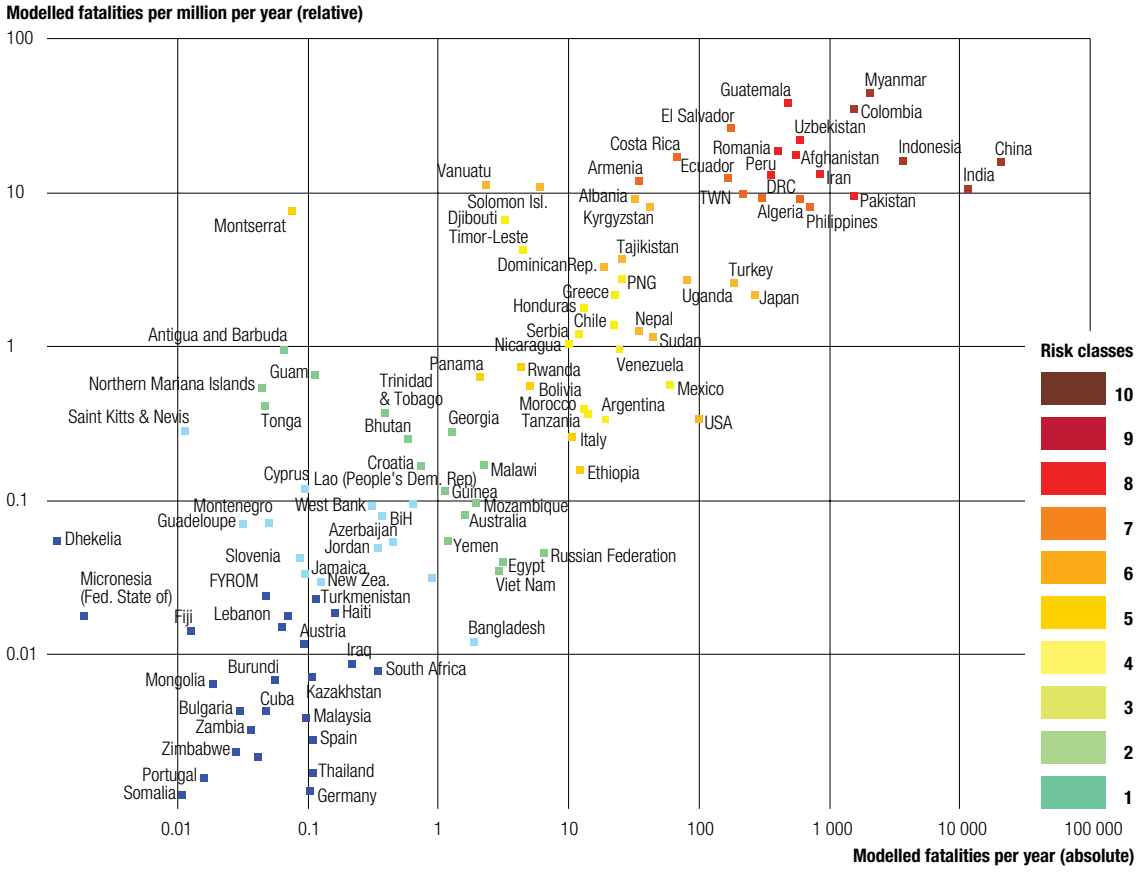


Figure 2.23: Absolute and relative mortality risk for earthquakes

Note: BIH, Bosnia and Herzegovina; DRC, Democratic Republic of the Congo; FYROM, Former Yugoslav Republic of Macedonia; PNG, Papua New Guinea; TWN, Taiwan, province of China.

suggests that 86% of mortality risk is manifested in disasters with more than 10,000 fatalities. This is consistent with the observed losses. Of the 246,200 people killed by earthquakes over the last ten years[20], 226,000 (91.8%) were killed in just five mega-disasters[21]. The top ten countries on the Mortality Risk Index for earthquakes and their respective values are China (8.5), India (8.5), Indonesia (8.5), Colombia (8.5), Myanmar (8.5), Guatemala (8), Pakistan (7.5), Afghanistan (7.5), Iran (7.5) and Peru (7.5).

Table 2.5 shows the modelled economic losses from earthquakes. OECD countries account for 58% of the modelled annual total losses. East Asia also has high absolute modelled economic losses, followed by Latin America and the Caribbean. Relative to GDP, modelled losses are most significant in the Middle East and North Africa region, followed by Eastern Europe and Central Asia. The vulnerability of economic infrastructure appears to be much higher in both Asia and the Pacific, and Eastern Europe and Central Asia, than elsewhere. The ratio of modelled damages to exposed GDP is between 8 and 10 times greater in these two regions than in OECD countries.

Risk drivers and vulnerability factors

Earthquake hazard is shown for each region in the regional multi-hazard maps presented in Figures 2.1, 2.2 and 2.3. Figure 2.24 shows the number of people exposed to each category of earthquake hazard. More than one hundred million people worldwide (103.2 million) are exposed to an average of 144 earthquake events per year, with intensities higher than V on the MMI scale. As with other hazard types, absolute exposure is concentrated in large countries, particularly in Asia, but also in the United States of America and parts of Latin America. Relative exposure is higher in smaller countries.

Figure 2.25 shows that exposure is higher in lower middle-income countries than in all other income classes. However, altogether, 85.3% of mortality risk is concentrated in lower middle-income countries. Upper middle and high-income countries concentrate only 1.7% and 0.9% of the risk respectively. This means that the countries with the highest human vulnerability are lower middle-income countries. Both low- and high-income countries have relatively lower levels of vulnerability. This suggests that earthquake vulnerability is highest in countries

Table 2.5: Summary of predicted economic losses from earthquake events by region

*insufficient observations

Region	Average annual number of reported earthquakes 1975–2007	Average annual modelled economic losses (million constant 2000 US$)	Average annual GDP exposure (million constant 2000 US$)	Percent of total economic losses	Modelled average annual economic losses as a % of GDP in affected countries	Ratio of economic losses to GDP exposure (global mean = 100)
East Asia and Pacific	3.8	3,266	1,888	14.4	0.12	702
Europe and Central Asia	1.9	1,301	974	5.7	0.15	542
Latin America and Caribbean	2.7	2,010	3,812	8.9	0.12	214
Middle East and North Africa*	1.8	1,277	1,774	5.6	0.31	292
South Asia	1.3	401	570	1.8	0.04	286
Sub Saharan Africa	–	–	–	–	–	–
OECD	2.2	14,446	90,448	63.6	0.07	65
Other high income economies*	–	–	–	–	–	–
Total	**13.7**	**22,701**	**99,466**	**100**		

Figure 2.24: People and GDP exposed to earthquakes

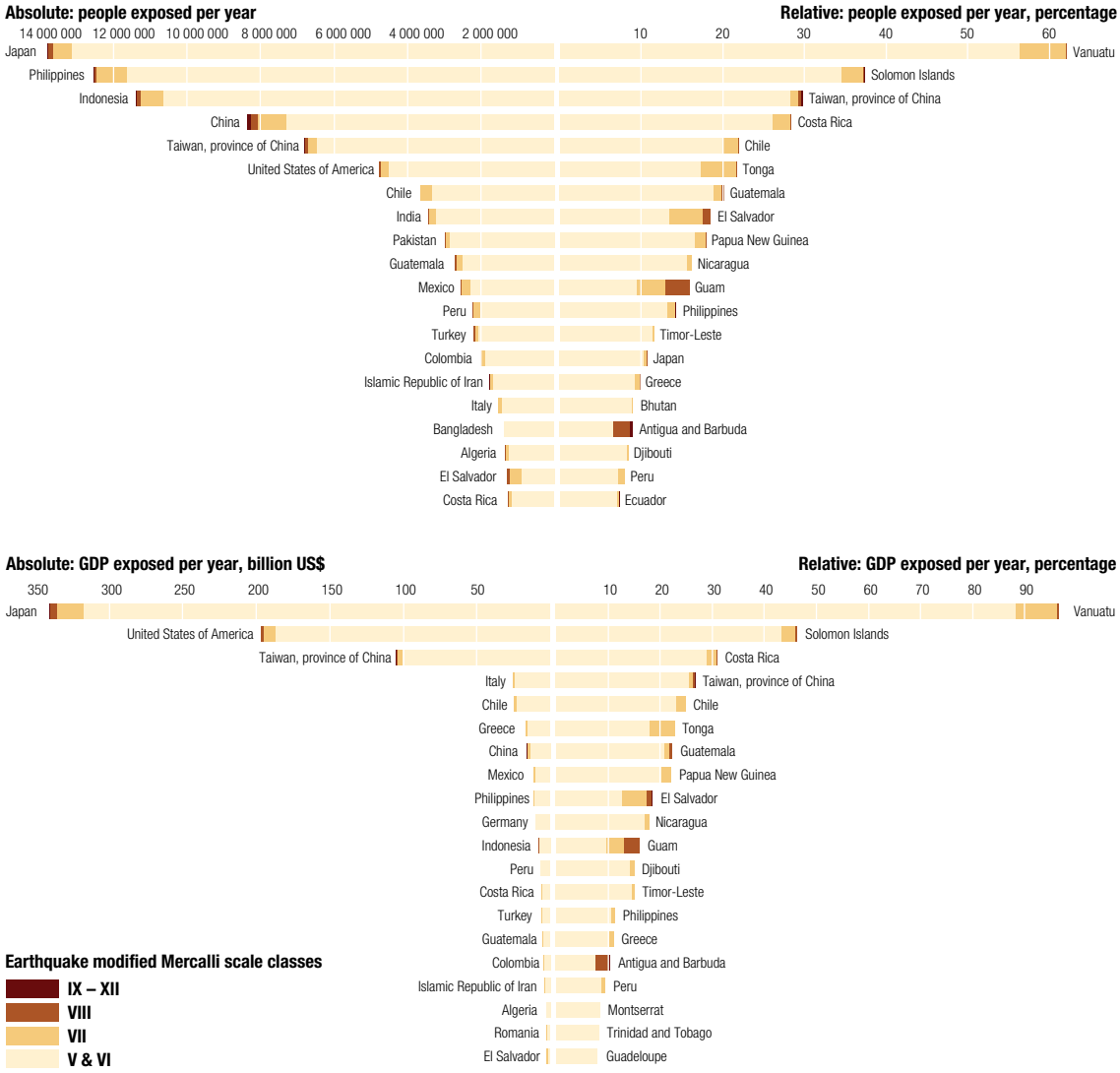
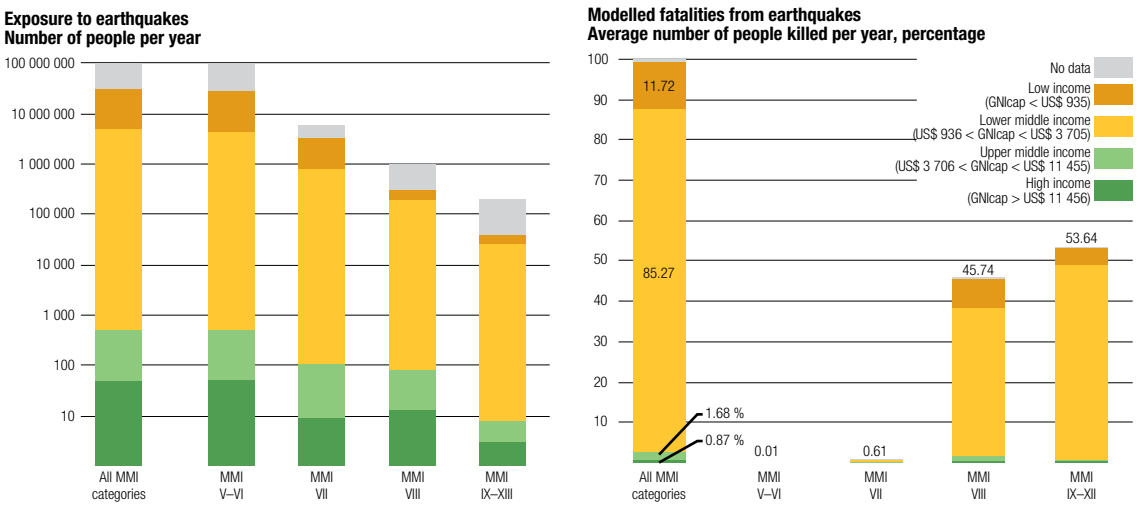


Figure 2.25: Exposure and mortality risk for earthquakes of different intensities by income class



with relatively higher levels of economic and urban growth, but that have not yet put in place planning and regulatory frameworks capable of factoring disaster risk reduction considerations into urban development. Structural collapse of buildings is more frequent in countries with fast rates of urbanization and weak enforcement of building codes, especially where informal construction is prevalent. Some low-income countries have yet to urbanize sufficiently to increase their earthquake risk. High-income countries on the other hand have been able to regulate development through tools such as building codes and land-use zoning and have invested in retro-fitting buildings to withstand strong shaking.

Examination of the risk drivers associated with earthquake damage reinforces these findings. Earthquake mortality for all categories is correlated positively with exposure and, in the case of Category 1 and 3 earthquakes, negatively with GDP per capita. In the case of Category 2 earthquakes, mortality was correlated with rapid urban growth [22], while Category 4 earthquakes mortality was negatively correlated with voice and accountability. Typically, therefore, poorer countries with high exposure, rapid urban growth and weaker governance have the highest mortality.

In the case of economic loss risk, richer countries have higher absolute, and poorer countries greater relative, damages from earthquakes. A country with a GDP of US$ 20,000 per capita would experience 2.3 times the absolute economic losses of a country with a GDP of US$ 2,500 per capita [23]. But relative to GDP, economic losses in the rich country would be only 43% of those in the poorer country. Institutional quality as measured by voice and accountability, and government effectiveness were also identified as relevant to economic loss risk. The model suggests that a country with average per capita income and the highest score in the voice and accountability indicator would experience only a quarter of the economic losses from a Category 4 earthquake than a country with the lowest institutional quality. This provides further evidence that earthquake loss risk is strongly associated with the quality of urban governance, and in particular with the lack of regulation of urban development and the ineffectiveness of building codes.

2.3.2 Drought

Drought differs from other hazard types in several ways. First, unlike earthquakes, floods or tsunamis that occur along generally well-defined fault lines, river valleys or coastlines, drought can occur anywhere (with the exception of desert regions where it does not have meaning). Secondly, drought develops slowly, resulting from a prolonged period (from months to years) of precipitation that is below the average, or expected, value at a particular location. Drought ultimately represents a condition of insufficient water supply relative to demand, both being highly location specific. For example, a few months of deficient rainfall may adversely affect rain-fed agriculture but not a reservoir system with substantial storage capacity, and defining what constitutes 'deficient' precipitation depends on the local climate. Scientists therefore distinguish between three general categories of drought: meteorological, agricultural and hydrologic. Meteorological drought refers to a prolonged period of deficient precipitation, while agricultural drought occurs when soil moisture is depleted to the point where crops, pastures or rangelands are impacted. Hydrologic drought refers to a prolonged period with below-average water levels in rivers and streams, lakes and reservoirs, or groundwater.

Drought also differs from other hazard types in the way losses are incurred. Few droughts lead directly to mortality. Those that do cause mortality have generally occurred during a political crisis or civil conflict where aid could not reach the affected population. In these cases the mortality should more properly be attributed to the conflict than to the drought. Impacts might also be highest even after the meteorological drought event has ended, for instance when people have exhausted their food supplies long before the next harvest.

Overall, the unique characteristics of drought make it difficult to analyse vulnerability and risk in the same framework as the other

hazard types. Available loss data sets do not provide information on the factors contributing indirectly to drought mortality, while mortality itself is not a good indicator of impact. Similarly, there is also no clear way to translate meteorological drought into agricultural drought since it depends on the farming system and even on individual crop choice. Specific risk and vulnerability to droughts and how they affect income, consumption, health, human development and productivity are therefore best analysed in detailed local and context specific studies (see Chapter 3)[24].

Given the varying impacts of drought, several drought indicators are in use around the globe. These include the Standardized Precipitation Index (SPI) and the coefficient of variation (CV)[25]. Drought intensity and frequency are captured by the SPI. The CV gives additional information since it is a summary measure of how large the variability of precipitation is from year-to-year, relative to the amount of mean annual rainfall. The CV tends to be high in semi-arid regions, where there tends to be both high variability of rainfall and a small mean annual rainfall. In Figures 2.1, 2.2 and 2.3 drought hazard was calculated by multiplying the SPI-defined drought event frequency by the CV therefore combining drought intensity, frequency and information on where interannual precipitation variability is high or low (Fig. 2.26).

Approximately 400 geo-referenced drought disasters recorded in EMDAT were also compared with various SPI drought indicators. The EMDAT disasters were best matched with severe droughts identified using a SPI indicator for six-month total precipitation. This is consistent with the observation that the majority of EMDAT drought disasters are in tropical areas that experience a distinct rainy season with a typical duration of six months or less. Again, the drought indicator showing the best correspondence with EMDAT disasters (or other impacts) may vary locally.

Drought Exposure

Figures 2.27 and 2.28 show the number of people and areas of crops exposed to drought hazard as measured by the six month SPI. In terms of relative exposure, sub-Saharan African countries are highly exposed in both categories. For the reasons explained above, exposure does not necessarily indicate a risk of mortality, crop or economic loss.

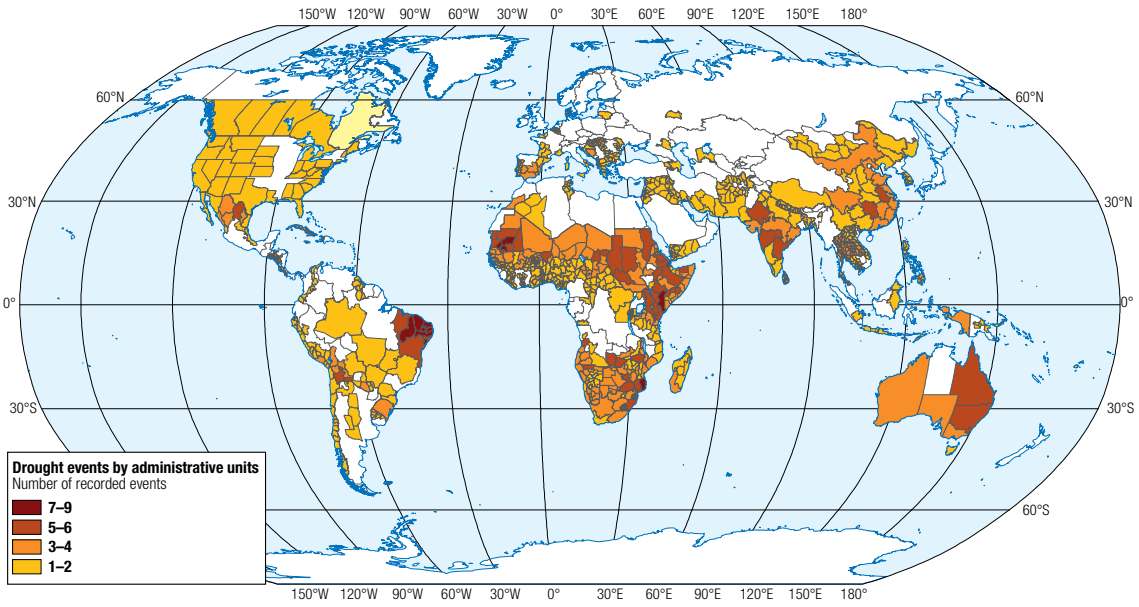


Figure 2.26: Number of drought disasters as recorded by EMDAT (1974–2004)

Data source: EMDAT: The OFDA/CRED International Disaster Database: www.emdat.net; *GIS analysis:* IRI, Columbia University; *Cartography:* UNEP/GRID-Europe, 2009.

Figure 2.27: People exposed to drought

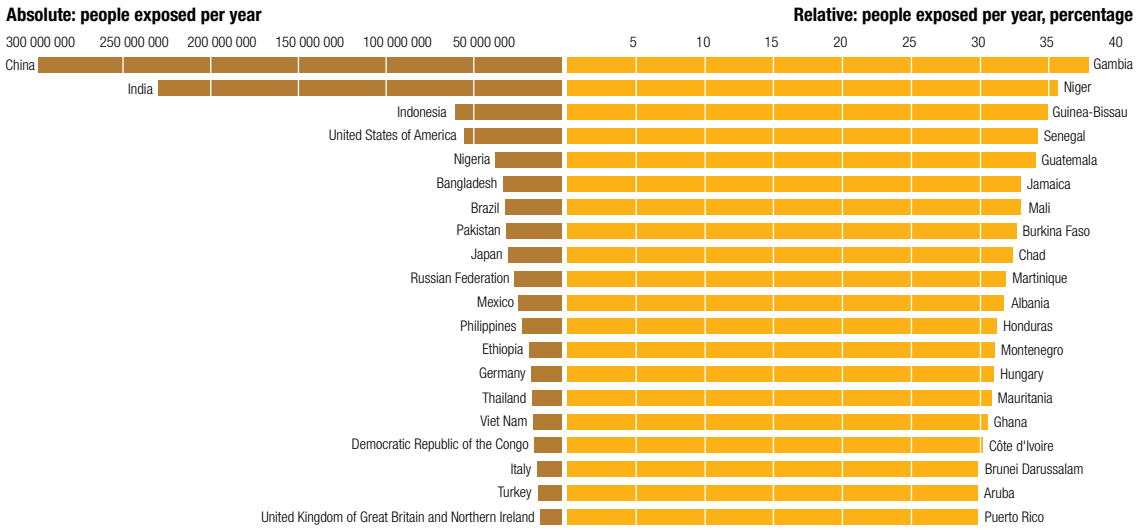
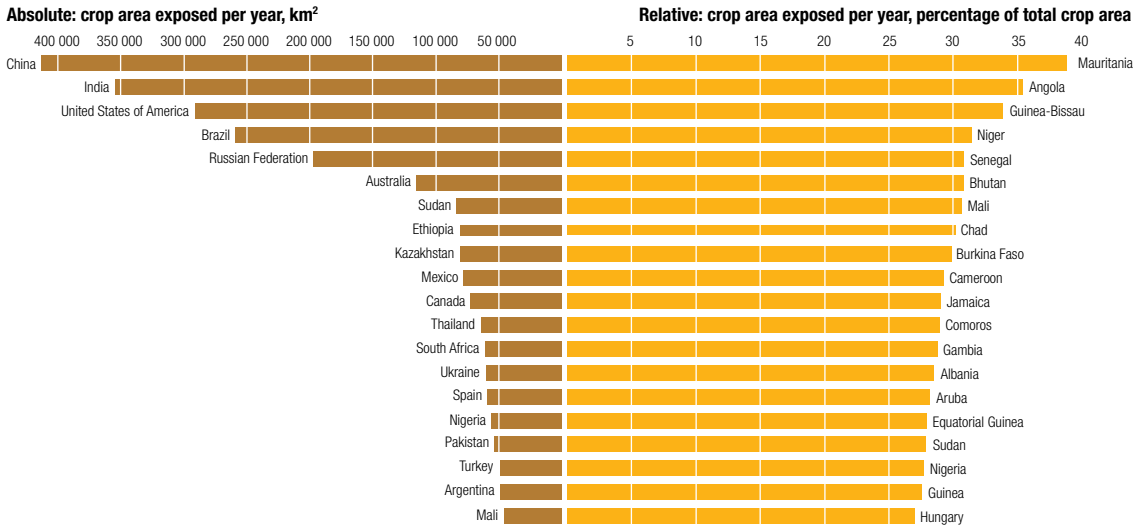


Figure 2.28: Crop area exposed to drought



2.3.3 Tsunamis

Tsunamis are relatively infrequent with only 5–10 events reported globally per year, but as demonstrated in the Indian Ocean in 2004 they can be devastating. Tsunamis are waves set in motion by large and sudden forced displacements of sea water caused by submarine earthquakes or landslides as well as other causes such as submarine volcanoes or asteroid impacts. When the tsunami is generated, its speed in the open sea can reach several hundred kilometres per hour, reaching distant coastlines in relatively short times. Tsunamis slow down as they approach the shoreline but their height increases. Because of their relatively large wavelength, tsunamis may travel far inland, and because of their relatively short wave period, they cause flooding faster than tidal waves and storm surges. Their enormous capacity to erode the landscape and destroy buildings makes them highly destructive both in terms of mortality and economic loss. The Indian Ocean tsunami is estimated to have caused

210,000 deaths and more than US$ 10 billion in damages. Figure 2.29 shows the distribution of tsunami hazard globally.

Large and infrequent, but highly destructive tsunami events generally pose greater mortality risk than the cumulative effect of smaller and more frequent events. The tsunami exposure analysis therefore focuses on extreme events generated by large earthquakes with return periods of approximately 500 years (formally, a probability of 10% of an event occurring in 50 years). Large Asian countries such as Indonesia and Japan account for a large proportion of people living in tsunami prone areas, while SIDS account for the highest proportion of their population (Figure 2.30). Countries on the Pacific coast of South America, notably Chile and Peru have a very high number of people living in tsunami prone areas in both absolute and relative terms. It is worth noting that given the low probability of tsunami occurrence, Figure 2.30 provides the number of people living in tsunami-

Figure 2.29: Sketch of global tsunami hazard

GIS analysis: Norwegian Geotechnical Institute; *Cartography:* UNEP/ GRID-Europe, 2009.

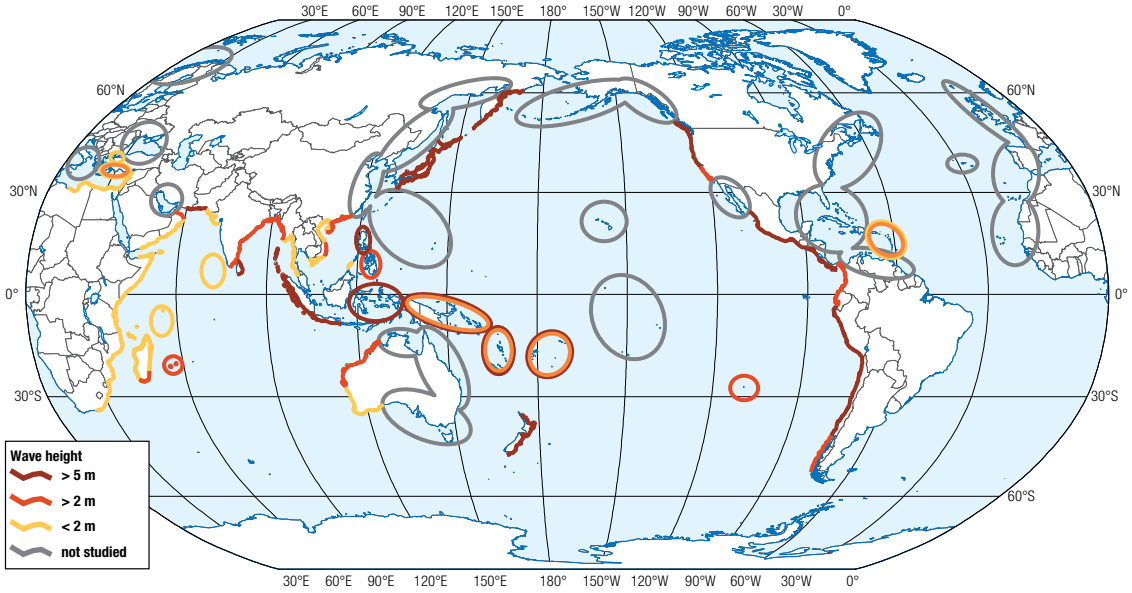
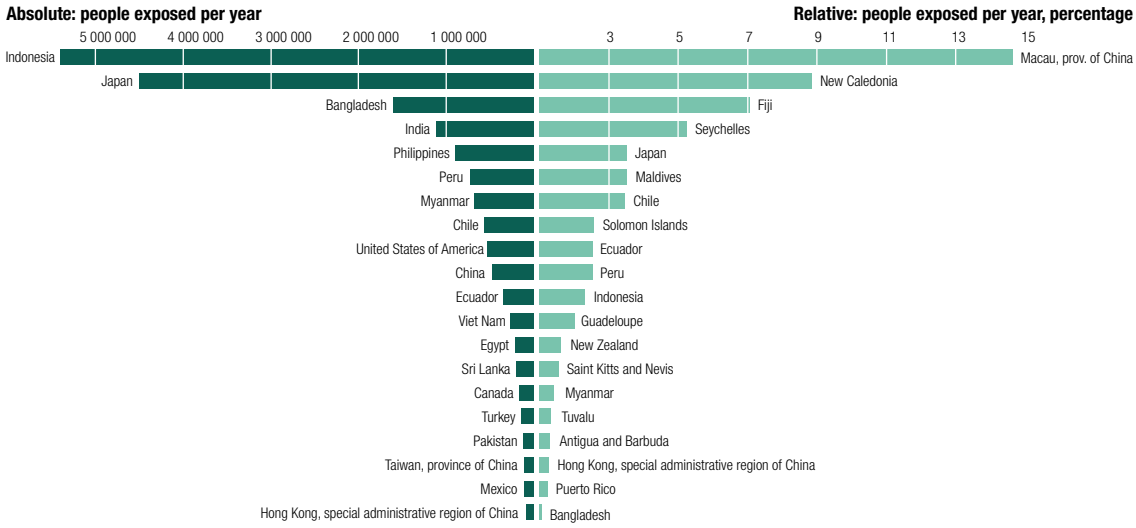


Figure 2.30: Number of people living in areas potentially affected by tsunamis



prone areas and not the average yearly exposure as provided for other hazards.

As shown in Figure 2.31, Japan has the highest absolute GDP exposed to tsunamis, but relative exposure is higher in SIDS and some South American countries, such as Ecuador and Peru.

The time between the triggering event and the tsunami's landfall is a key variable as it influences the effectiveness of tsunami

Figure 2.31: GDP exposed to tsunamis

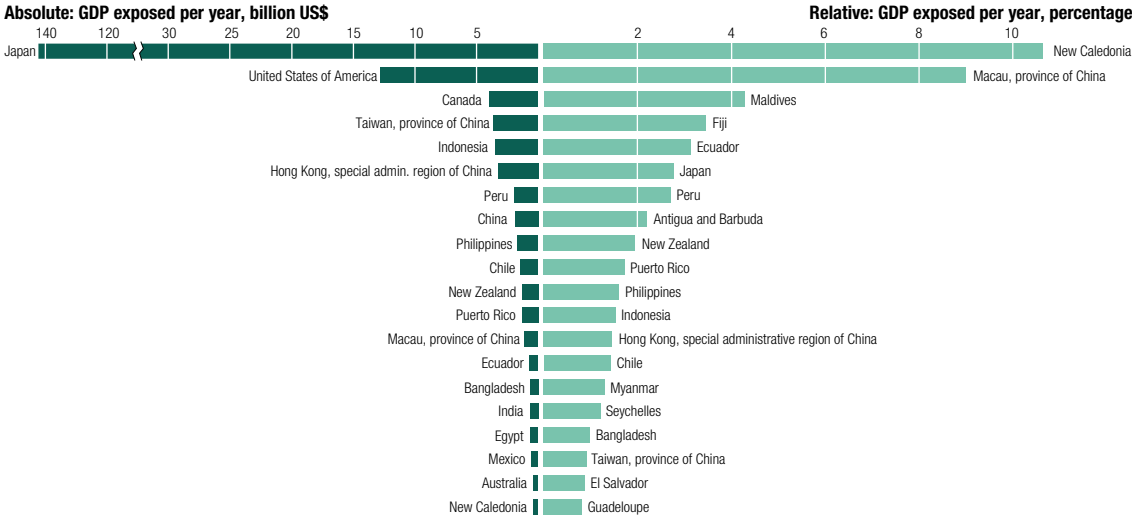


Figure 2.32: Tsunami modelling of Manila Bay (the Philippines)

early warning systems and the possibility of evacuation. Chile, India, Indonesia, Myanmar, Peru, the Solomon Islands, Portugal, Tonga, Pakistan, Papua New Guinea and the Philippines all have particularly high levels of hazard, given that tsunamis could hit the shoreline in less than 15 minutes with wave heights in excess of 6 metres.

It is important to emphasize once again that hazard is modelled with a 10% probability of occurrence every 50 years, or in other words, a 500-year return period. Similarly, the actual tsunami hazard in any particular area in these countries depends on local topography, bathymetry and other factors. For example, while the Philippines could be subject to wave heights of up to 16 metres hitting the shoreline in only 9 minutes, Figure 2.32 shows that the most severe impact zones are outside of the city of Manila.

2.3.4 Forest and other biomass fires

According to a recent inventory[26] wild land fires and other biomass fires annually burn a total land area of between 3.5 and 4.5 million km^2, equivalent to the surface area of India and Pakistan together, or more than half of Australia. This makes it makes it one of the most spatially prevalent hazards after drought.

Emissions from biomass burning inject pollutants into the atmosphere, as well as GHGs. The IPCC attributes 17.3% of total anthropogenic emissions to biomass burning[27], making it the second largest source of GHGs from human activities after the burning of fossil fuel. However, this figure may in reality be even higher, as it is based on pre-2000 data. Biomass fire is the only hazard that has both an impact on, and is exacerbated by, climate change. Most fires have human causes.

Figure 2.33 shows the average density of fires per 100 km^2, between 1997 and 2008. Not all high temperature events are biomass fires, as gas flares and other high temperature events are also detected. However, most fires are due to biomass burning.

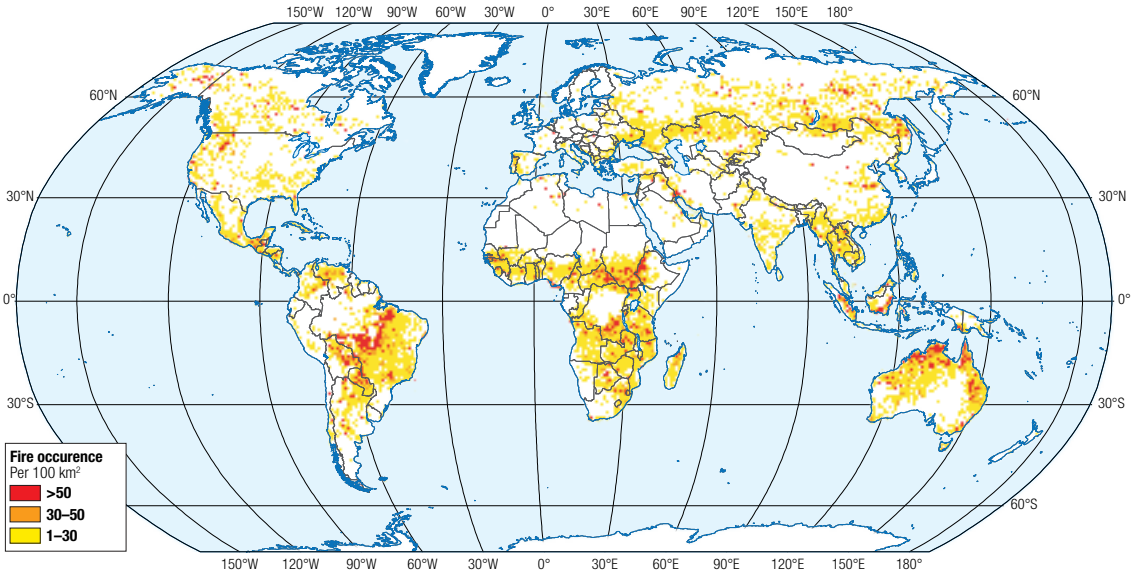


Figure 2.33: Distribution of average density of fires per 100 km^2 (1997–2008)

GIS analysis and cartography: P. Peduzzi, ISDR, UNEP/GRID-Europe, 2009.

2.4 Multi-hazard and risk identification

2.4.1 Multi-hazard risk

Figure 2.34 shows multi-hazard risk for tropical cyclones, floods, earthquakes and landslides. Given that drought is not represented, mortality risk is underestimated for countries in some regions, particularly in Africa.

Figure 2.35 shows the spatial distribution of mortality risk accumulated for tropical cyclones, floods, earthquakes and landslides.

Figure 2.34: Absolute and relative multi-hazard mortality risk for tropical cyclones, floods, earthquakes and landslides

Note: DRC, Democratic Republic of the Congo; TWN, Taiwan, province of China; UK, United Kingdom of Great Britain and Ireland; USA, United States of America.

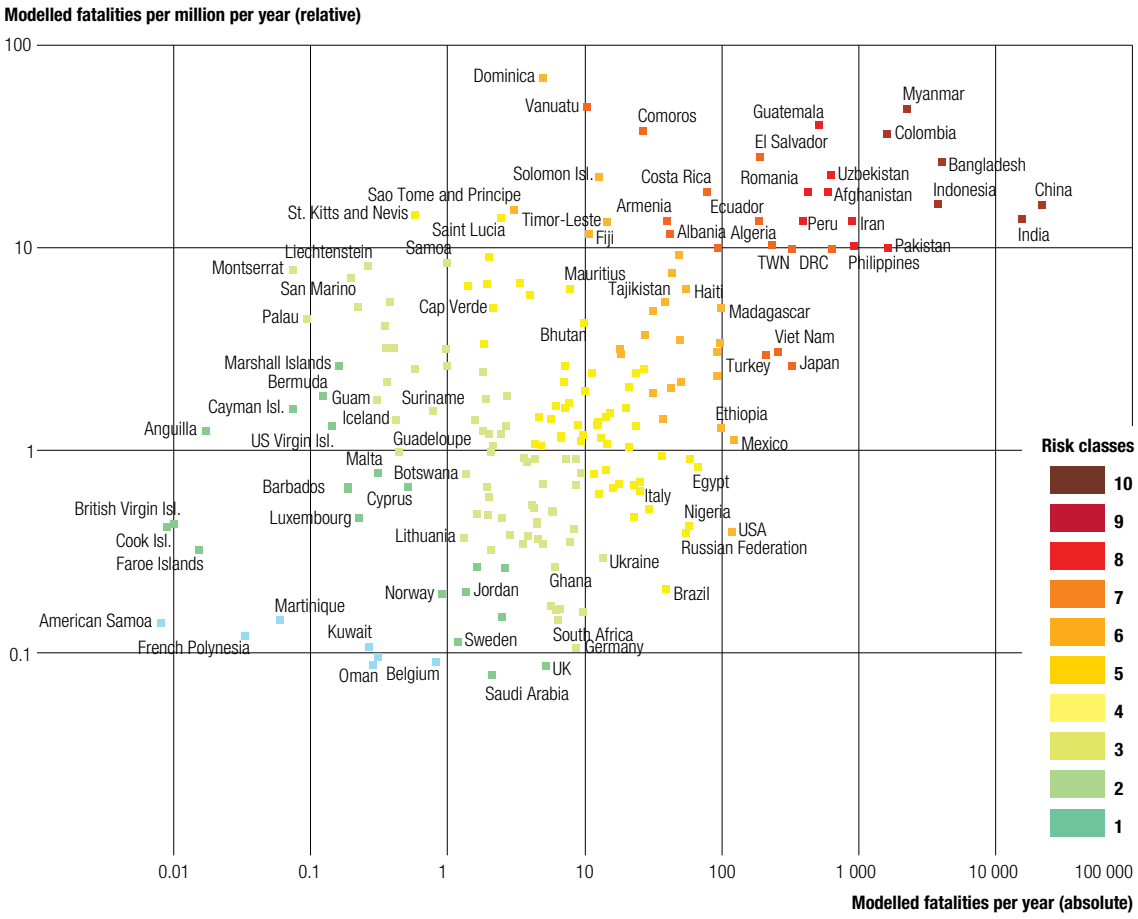
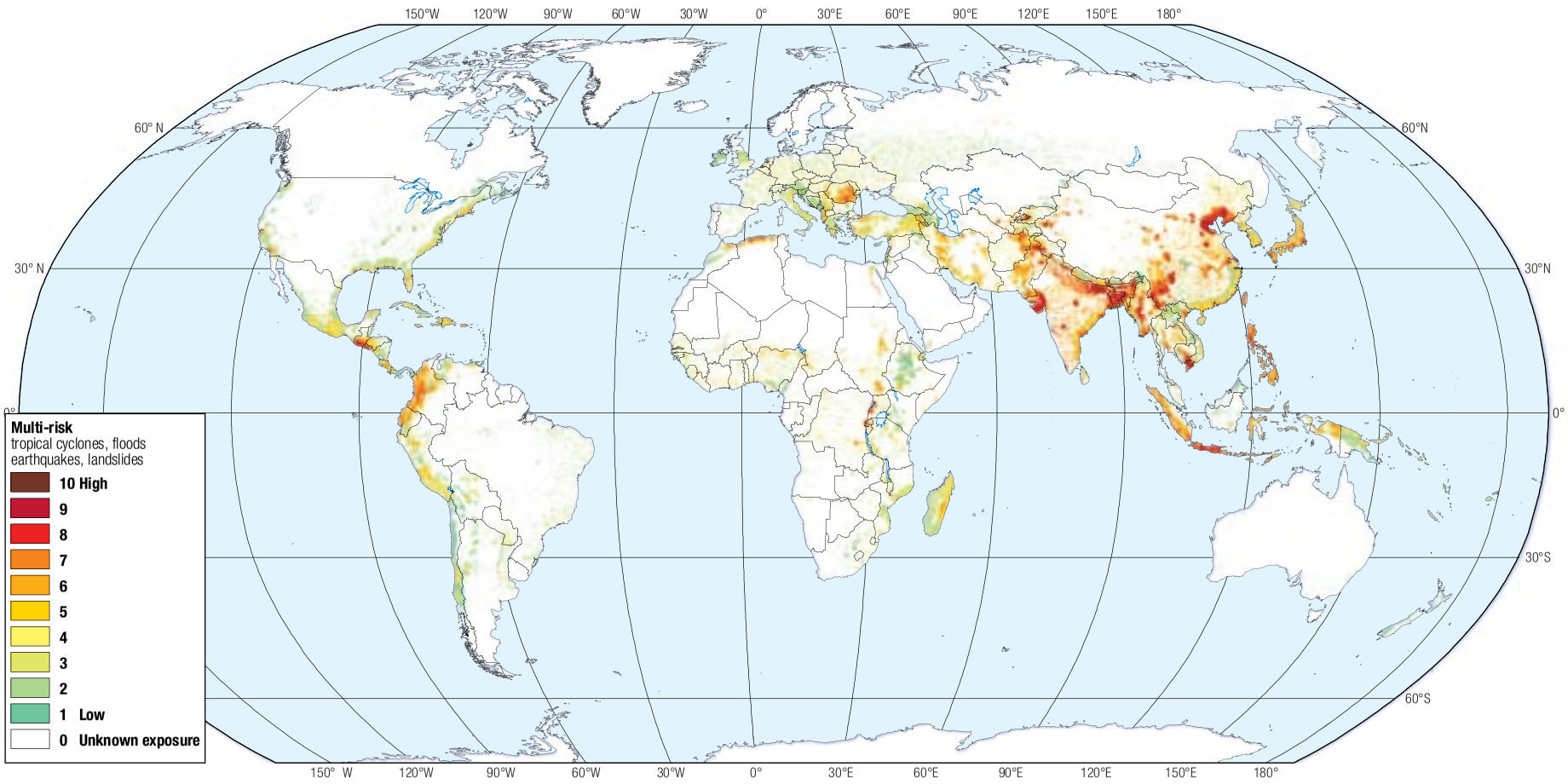


Figure 2.35:
Global distribution of multiple hazards mortality risk

GIS analysis and cartography: P. Peduzzi, ISDR, UNEP/GRID-Europe, 2009.



2.5 Trends in global disaster risk

Both mortality and economic loss risk are increasing in absolute terms for all the principal hazards, except for landslides, where the tendency appears to be stable. However, relative risk when measured as a proportion of population or GDP is stable and, in the case of mortality, may be declining.

Many readers will be familiar with graphs such as Figure 2.36, which show an exponential increase in economic loss from disasters since the 1970s. Figure 2.37 shows that when these losses are adjusted for inflation and expressed as a percentage of global GDP, the trend is far less pronounced and statistically insignificant.

2.5.1 Risk, exposure and vulnerability

In order to see how risk patterns are changing over time, modelled mortality and economic loss in 1990 and 2007 were compared, assuming constant levels of hazard.

Figure 2.36: Total reported economic losses from natural disasters[28]

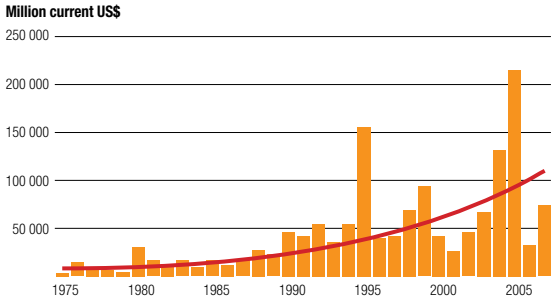
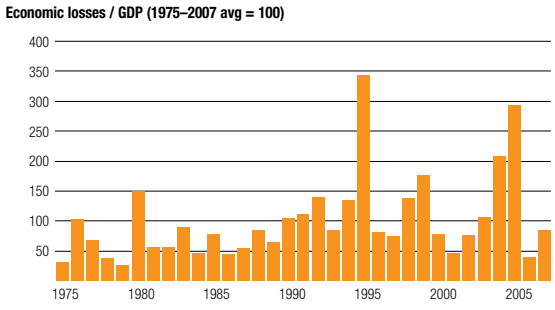


Figure 2.37: Inflation adjusted economic losses as a share of global GDP



In the case of floods, modelled mortality increased by 13% from 1990 to 2007. This increase was driven by a 28% increase in modelled exposure. Vulnerability actually declined by 11%.

Modelled economic loss over the same period increased by 33%, while GDP exposure increased by 98%. Vulnerability actually declined by 33%. This concurs with the fact that globally GDP increased by 64% over the same period, but countries with very high flood exposure, such as China and India, increased their GDP by more, in this case 420% and 185% respectively.

In the case of landslides, mortality risk was stable from 1990 to 2007 (the model indicates a decrease of 1%). Exposure increased by 23%, while vulnerability decreased by 20%, reflecting GDP growth in the countries exposed.

These simulations of risk indicate that increases in weather-related disaster risk are principally being driven by increases in exposure. Vulnerability actually appears to be going down although these simulations do not indicate which specific factors are increasing or decreasing over time.

The overall implication is that while economic development can reduce vulnerability, at the same time it drives increased exposure of people and economic assets in areas prone to weather-related hazards, particularly urban and coastal areas. Economic loss risk appears to be increasing faster than mortality risk, reflecting a faster increase in GDP exposure than population exposure.

Since 1975, for example, the global population has increased by 63%[29]. In terms of economic assets, between 1975 and 2007, global GDP grew by 166%, from US$ 14.8 trillion to US$ 39.4 trillion (in constant 2000 US$), far faster than world population which grew from 4.1 to 6.6 billion. GDP per capita therefore grew from US$ 3,600 to US$ 5,900[30]. But these gains have not been uniform. The economies of richer countries and some successful lower-income countries grew faster than those of

many poor countries, especially in Africa and South Asia.

Although solid data are hard to come by, there is evidence that economic activities, assets and productive infrastructure are also further concentrated within countries. Growth has been fastest in coastal regions and near large navigable rivers, many of which are prone to natural hazard events[31]. Urban growth has added significant economic assets to large cities in developing countries, some of which are located in geologically unstable areas. Earthquake prone Tehran and Istanbul, for instance, experienced faster urban and economic growth than the Islamic Republic of Iran and Turkey as a whole. As populations concentrate and economic activity in those centres grows even faster, exposure also increases significantly.

It is also likely that risk is increasing fastest in low and lower-middle income countries with rapidly growing economies. These countries have rapidly increasing exposure at the same time as only slowly improving vulnerability indicators. In contrast, most high-income countries experience more sedate increases in exposure, with very low vulnerability.

2.5.2 Is hazard increasing?

The above simulations of loss trends assume constant hazard levels. Yet hazard is changing, due to climate change, urbanization and environmental degradation.

In the case of tropical cyclones, Table 2.6 shows that there has been an increase in the frequency of Category 4 events during warm years. These results are in line with findings published recently[32] in which it was calculated that a 1ºC increase in sea surface temperatures would result in a 31% increase in the global frequency of Category 4 and 5 storms per year. This is also consistent with the IPCC's 4th Assessment report (p. 795)[33] which states that *"Tropical cyclones (including hurricanes and typhoons), are likely to become more intense with sea surface temperature increases."*

Table 2.6 shows that the average number of tropical cyclones between cold, average and hot years is fairly stable (between 56 and 58 tropical cyclones per year). However, Category 3 and 4 cyclones show a marked increase in average and hot years compared with cold years. Global sea surface temperature data are available only since 1985. The "No data" years (1976–1984) show more Category 1 and fewer Category 3, 4 and 5 cyclones.

Any increase in the severity of cyclones will magnify the unevenness of disaster risk distribution. For example, the economic risk model shows that 1.9% of the GDP of Madagascar is at risk annually from Category 3 cyclones, but only 0.09% of the GDP of Japan. If these cyclones were to increase to Category 4 storms, 3.2% of the GDP of Madagascar would be at risk, but only 0.16% of the GDP of Japan.

Table 2.6: Tropical cyclone intensity and occurrence (1977–2006) grouped by sea surface temperature for 1985–2006

Group by average sea surface temperature (SST)	Number of cyclones for the period*	Number of years	Average number of events/ year	Number events Cat. 1	Number events Cat. 2	Number events Cat. 3	Number events Cat. 4	Number events Cat. 5
No data on SST	494	9	54.9	22.7	12.7	12.9	6.2	0.6
Cold SST	407	7	58.1	25.4	13.9	10.4	7.1	1.3
Average SST	448	8	56.0	18.0	13.9	14.0	9.3	1.9
Hot SST	460	8	57.5	20.4	11.6	16.1	8.1	1.3

*Analysis covers the period 1977–2006; sea surface temperature (SST) data were available from 1985–2006; cyclones for the period 1977–1984 were grouped as one category (no data on SST).

2.6 Economic resilience, vulnerability and development constraints in developing countries

Previous research has confirmed that the level of economic losses experienced by a country is not a good indicator per se of the country's capacity to absorb the impact of a major hazard event and recover, even when expressed in relation to the size of a country's GDP or exposed GDP. In the development of the Disaster Deficit Index[34], for example, it was proposed that countries with access to insurance and reinsurance payments (for example through participation in a catastrophe pool), with disaster reserve funds, with access to external credit and with internal reserves would in general be more resilient to catastrophic disaster loss than countries without.

The stock of physical (economic) capital has always been considered as a determinant factor in economic growth, a perspective that has been enriched by incorporating other forms of capital (human, social-relational and natural capital) as well as institutions and knowledge, as *endogenous capacities* contributing to explaining growth[35].

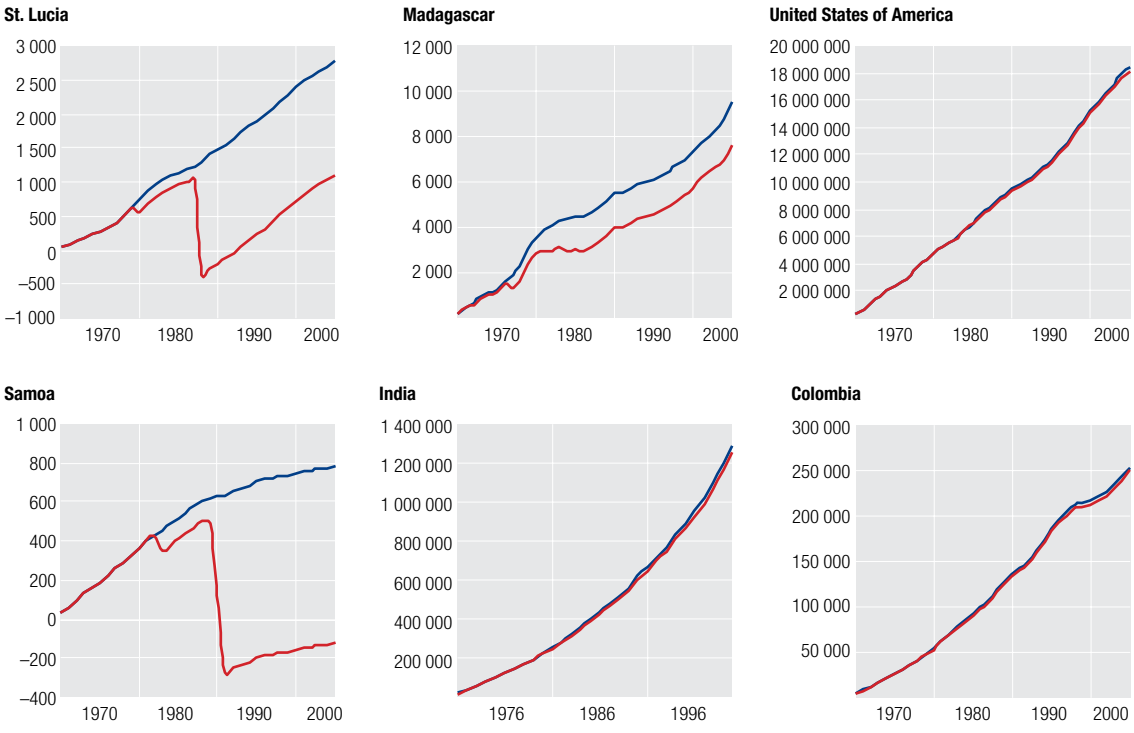
Estimates prepared for this report show that disasters have a major impact on the accumulation of capital stock in a small number of vulnerable countries. The top three countries in this situation, in which the ratio of economic losses to capital stock was highest are all SIDS, namely Samoa, Saint Lucia and Grenada. The next two most affected countries, Afghanistan and Tajikistan, are land-locked countries[36].

Figure 2.38 clearly shows the differential impact of economic loss in countries with different characteristics.

In Samoa, for example, economic losses in a series of disasters including a tropical storm and forest fire in 1983, and a series of back-to-back tropical cyclones between 1989 and 1990 appear to have set back the country's economy by about 30 years. It was not until 2000 that the island's capital stock recovered to its 1970's level. A similar pattern is presented in Saint Lucia due to the impacts of Hurricane Allen in 1980 and

Figure 2.38: Impact of economic loss

Cumulative net capital formation (NCF) from 1970 to 2006, in millions of constant 2000 US$, with (red lines) and without (blue lines) the effect of economic losses in disasters.



Hurricane Gilbert in 1986. Madagascar shows a different pattern but a clear impact of disaster loss on cumulative net capital formation. In contrast, the impact of major disasters on high-income countries such as the United States of America is imperceptible, even though that country has experienced disasters with enormous absolute economic loss. Similarly, the effect in large low-income countries such as India or middle-income countries such as Colombia is not so significant.

The implications are that disasters do not have a significant impact on economic growth in countries with large economies, but a devastating impact on those with small economies. Such economies are highly vulnerable to disaster loss. While in large countries disasters may have a devastating impact on the localities and regions where they occur, as Hurricane Katrina demonstrated, this is not necessarily translated into a national impact unless the affected area concentrates a significant proportion of a country's capital.

Approaches to measuring the resilience of a country to economic shocks have included the Disaster Deficit Index, mentioned above, and others[37]. Another approach is to use net savings as a proxy of a country's ability to absorb the impact and recover from disaster losses. Net savings is probably a better proxy of resilience than GDP per capita because it more accurately estimates the available internal resources, which could be invested in the recovery of losses including capital stock.

However, the factors that influence a country's resilience (i.e. its capacity to recover from deviations in its development path caused by disaster impacts) are complex and cannot be reduced easily to any one variable. Nevertheless, five groups of countries can be identified that share common characteristics in terms of their vulnerability and resilience to disaster loss and their development limitations, particularly their capacity to benefit from international trade[38].

Table 2.7 shows the countries in this classification. Groups 4 and 5 are those with high and very high economic vulnerability to natural hazards. The table also shows the number of developing countries (including LLDCs) in those groups that experience extreme limitations in their ability to benefit from international trade. Countries suffering extreme trade limitations are characterized by a very low participation in world export markets (less than 0.1%) and simultaneously show low export diversification, which render them highly exposed to trade shocks.

The higher the vulnerability of a group to natural hazard risks, the higher the number of developing countries in it that suffer extreme trade limitations[39]. In the groups with high and very high vulnerability (i.e. Groups 4 and 5), 81% of all countries suffer extreme trade limitations (reaching 100% in Group 5), while in groups with very low, low and medium vulnerability (Groups 1, 2 and 3), only 4% suffer such limitations.

It is also clear that SIDS and LLDCs represent the majority of countries with high and very high vulnerability and those suffering extreme trade limitations. In fact, SIDS and LLDCs together constitute 60% and 67% of all countries in Groups 4 and 5 respectively, and about two thirds of all countries in the groups affected by extreme trade limitations.

Given that the risk circumstances of many SIDS and LLDCs are likely to worsen because of climate change trends, in the absence of particular attention from the international community, their prospects for a positive insertion in the global economy will further deteriorate, and even their economic and social viability as nations could be seriously compromised.

Given the limitations on economic loss data mentioned in Section 2.2, it is likely that with more complete information, the specific countries identified in each of those groups would change. The exercises mentioned above should, therefore, be considered illustrative only. Nevertheless, a key conclusion is that SIDS, landlocked countries, LLDCs and others with small and vulnerable economies and low levels of resilience to economic loss will require a specific policy focus that takes into account the complexity of the factors involved. This conclusion will be revisited in the recommendations of the report in Chapter 7.

Table 2.7:
Five groups of countries characterized in terms of their economic vulnerability to natural hazards, and developing countries in each group experiencing extreme limitations in international trade

	Groups of countries according to their economic vulnerability to natural hazards		Vulnerability factors relative to all countries	
Short vulnerability characterization	**Countries in the group**	**Developing countries in the group experiencing extreme trade limitations** (Very Low Revealed Competitiveness; High Exposure to Trade Shocks)(3)(4)	**Relative economic loss (1)**	**Economic resilience (2)**
1 Very Low	(16) Bahrain; Finland; Gabon; Iraq; Ireland; Kuwait; Lybian Arab Jamahiriya; Luxembourg; Macau; Malta; Norway; Qatar; Saudi Arabia; Singapore; Suriname; United Arab Emirates	0	In the best (lowest) 25% of the world	In the best (highest) 25% of the world
2 Low	(33) Albania; Austria; Belgium; Botswana; Bulgaria; Canada; Congo, Rep. of; Cyprus; Czech Republic; Denmark; Egypt; Equatorial Guinea; France; Germany; Hong Kong; Iceland; Kiribati; Lithuania; Malaysia; Netherlands; New Zealand; Oman; Panama; Russian Federation; Slovenia; South Africa; Sweden; Switzerland; Trinidad & Tobago; Tunisia; United Kingdom; Uruguay; Venezuela.	(2) Equatorial Guinea; Kiribati	In the second quartile (Between 25% and 50% of the world)	In the third quartile (Between 50% and 75% of the world)
3 Medium	(23) Algeria; Antigua & Barbuda; Azerbaijan; Bahamas; Chile; China; Costa Rica; Dominican Republic; Fiji; India; Iran, Islamic Republic of; Jamaica; Liberia; Mauritius; Moldova; North Korea; Peru; Portugal; Phillipines; Romania; Somalia; Sudan; Turkey	0	In the third quartile (Between 50% and 75% of the world)	In the second quartile (Between 25% and 50% of the world)
4 High	(33) Bangladesh; Barbados; Bermuda; Bolivia; Bosnia-Herzegovina; Cape Verde; Chad; Cuba; Ecuador; Georgia; Grenada; Guyana; Honduras; Jordan; Madagascar; Malawi; Mauritania; Mongolia; Nauru; Nepal; Pakistan; Papua New Guinea; St Kitts & Nevis; St Lucia; Seychelles; Solomon Islands; Sri Lanka; Swaziland; Tajikistan; Tuvalu; Vanuatu; Vietnam; Zimbabwe	(25) Bangladesh; Barbados; Bermuda; Bolivia; Cape Verde; Cuba; Ecuador; Grenada; Guyana; Honduras; Jordan; Madagascar; Malawi; Mauritania; Mongolia; Nepal; Nicaragua; Papua New Guinea; St Kitts & Nevis; St Lucia; Sri Lanka; Swaziland; Tajikistan; Tuvalu; Vanuatu	...Either in the worst (highest) 25% of economic losses and between 25% and 50% of resilience simultaneously, ...	
			...Or in the worst (lowest) 25% of resilience and between 50% and 75% of economic losses simultaneously	
5 Very High	(18) Afghanistan; Armenia; Belize; Cambodia; Comoros; Dominica; El Salvador; Guatemala; Haiti; Kyrgyzstan; Lao People's Democratic Republic; Former Yugoslav Republic of Macedonia; Mozambique; Myanmar; St Vincent & The Grenadines; Samoa; Senegal; Tonga	(18) Afghanistan; Armenia; Belize, Cambodia; Comoros; Dominica; El Salvador; Guatemala; Haiti; Kyrgyzstan; Lao People's Democratic Republic; Former Yugoslav Republic of Macedonia; Mozambique; Myanmar; St Vincent & The Grenadines; Samoa; Senegal; Tonga	In the worst (highest) 25% of the world	In the worst (lowest) 25% of the world

(1) Economic losses relative to GDP and/or to capital stock are used to proxy fragility; (2) Net savings per capita is used as a proxy for economic resilience; (3) A share of 0.10% or less of world export market in is used for very low revealed competitiveness; (4) Being in the worst 50% of the world in terms of trade diversification is used as an indicator of high exposure to trade shocks

Endnotes

1 The LandScan™ Dataset comprises a worldwide population database compiled on a 30" × 30" latitude/longitude grid. Census counts (at sub-national level) were apportioned to each grid cell based on likelihood coefficients, which are based on proximity to roads, slope, land cover, nighttime lights and other information. LandScan has been developed as part of the Oak Ridge National Laboratory Global Population Project for estimating ambient populations at risk: http://www.ornl.gov/sci/landscan/index.html
2 The ShakeMap Atlas: http://earthquake usgs.gov/eqcenter/pager/prodandref/index php; Allen, et al, 2008
3 Wald, et al, 2008
4 Normally economic loss in disasters is divided into direct economic loss referring to the value of destroyed and damaged assets, and indirect economic loss, referring to knock-on effects in broader economic flows. The term economic loss risk in this chapter refers specifically to the former, although in practice it is often impossible to know whether reported loss estimates include indirect losses.
5 MunichRe NatCatService, GeoRisikoForschung, Great Natural Disasters 1950–2007: http://www.munichre.com/en/ts/geo_risks/natcatservice/default.aspx; EMDAT, 2008; analysis by ISDR (data as of September 2008).
6 IPCC, 2007b
7 Detailed information on data sources and methodology is provided in Appendix 1 and in the technical background papers produced for this chapter. Maps, figures and tables illustrating key highlights of the findings are presented in this chapter. User-generated maps and graphs may be created on http://preview.grid.unep.ch
8 UNDP/BCPR, 2004; Dilley et al., 2005
9 World Bank, 2000
10 Altez, 2007; Altez and Revet, 2005
11 BBC, 29 December, 1999. Venezuala disaster 'worst this century': http://news.bbc.co.uk/2/hi/americas/581579.stm
12 Cormac, 2007
13 The level of confidence of the model for Category 1 events was (R^2 = 0.417), Category 2 (R^2 = 0.413), Category 3 (R^2 = 0.450), Category 4 (R^2 = 0.681) and Category 5 (R^2 = 0.998).
14 Estimates are based on EMDAT reported damages and predicted losses for cyclone events during 1975–2007 for which no damage estimates were available.
15 McTaggart-Cowan, et al., 2006
16 Marcelino, et al., 2004
17 NOAA/NHC (United States National Oceanic and Atmospheric Administration/National Hurricane Center): http://www.nhc.noaa.gov/aboutsshs.shtml
18 The difference would be smaller if extra-tropical storms were included in the analysis.
19 As observed by the Dartmouth Flood Observatory between 1980 and 2001.
20 As reported by CRED/EMDAT for earthquakes between 1999 and 2008; EMDAT, 2008; analysis by ISDR (data as of September 2008).
21 Izmit (Turkey, 1999; 17,000 killed); Bhuj (Gujarat, India, 2001; 20,000 killed); Bam (Iran, 2003; 26,800 killed); Jammu/Kashmir (Pakistan/India, 2005; 74,000 killed) and Sichuan (China, 2008; 87,900 killed).
22 GDP per capita, voice and accountability, and urban growth were highly correlated and therefore could not be used in the same regression. For Categories 1 and 3 earthquakes, GDP per capita was the best fit; for Category 2 urban growth, and for Category 4 voice and accountability.
23 Assuming average earthquake magnitude, exposure and institutional quality.
24 Fuente and Dercon, 2008
25 See Appendix 1 for details.
26 Lehsten, et al., 2009
27 IPCC, 2007c
28 EMDAT, accessed 12 December 2008
29 Data sources: UN Population Division, on UNEP geodata portal: http://geodata.grid.unep.ch
30 GDP data: DDP, 2008. Population data: UN Population Division, 2006.
31 McGranahan, et al., 2007
32 Elsner, et al., 2008)
33 IPCC 2007a
34 Cardona, 2005
35 Corrales and Miquilena, 2008.
36 Baritto, 2009.
37 For example, Brugiglio's Economic Vulnerability Index, and Economic Resilience Index
38 Risk factors used were the per capita net savings, a proxy for resilience, and the ratio of economic losses to capital stock, as a proxy of vulnerability. The capacity to benefit from insertion in the global economy was expressed in terms of the 'revealed competitiveness' of countries (the market share of world exports), and the concentration of exports in a few export lines, an indicator of the country's exposure to trade shocks. The indicators of development outcomes were the human development index, and countries' per capita GDP.
39 Corrales and Miquilena, 2008

Chapter 3

Deconstructing disaster: risk patterns and poverty trends at the local level

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The chapter was developed in collaboration with GRIP, UNDP Regional Centre Bangkok, UNDP Regional Bureau for Latin America and the Caribbean, and OSSO. The analysis of extensive risk and the case studies on disaster risk and poverty in Asia were coordinated by Sanny Jegillos, Rajesh Sharma, Nescha Teckle (UNDP Regional Centre Bangkok); Aromar Revi; and Julio Serje. The analysis of extensive risk in Latin America was coordinated by Andres Velasquez, Cristina Rosales, Fernando Ramirez, Nayibe Jimenez and Natalia Diaz (Corporacion OSSO) and the case studies on disaster risk and poverty by Luis Felipe Lopez-Calva and Jesus Eduardo Ortiz (UNDP Regional Bureau for Latin America and the Caribbean). The analysis of disaster risk and poverty in Africa was coordinated by Alejandro de la Fuente and Stefan Dercan.

The methodology for identifying extensive risk was proposed by Fernando Ramirez Gomez (advisor) and further developed by Julio Serje and Aromar Revi. The methodology for analyzing disaster risk poverty interactions was developed by Alejandro de la Fuente, with contributions from Luis Felipe Lopez-Calva and Aromar Revi.

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Introduction

Viewed at the local level disaster risk reveals a complexity that is essentially invisible when observed from a global perspective, but which is critical to understanding both risk dynamics and disaster risk–poverty interactions.

National disaster databases contain disaster loss reports aggregated at the local government level[1]. Databases from a sample of 12 Asian and Latin American countries document a total of 126,620 such reports between 1970 and 2007[2] and show that, as at the global level, mortality and direct economic loss are highly concentrated. Just 0.7% of the reports cover 84% of the total mortality and 75% of the destroyed housing across the 12 countries. In contrast other risk attributes are more evenly spread. For example, 51% of housing damage is distributed across the other 125,632 loss reports.

These patterns illustrate concentrations of intensive risk and geographically dispersed patterns of extensive risk. The first part of this chapter opens a window on both kinds of risk, viewed at the local level. The second part then examines the empirical evidence on how poverty is translated into disaster risk and how disaster impacts are translated into poverty outcomes at the same scale.

Summary of findings

1. Low-intensity damage and asset loss is extensively spread

Mortality and housing destruction are highly concentrated in infrequently occurring events affecting a small number of geographic areas. However, housing damage is both widely spread and frequently occurring and is indicative of similar impacts in local infrastructure in other sectors. These low-intensity but widespread losses represent a significant and largely unrecognized component of disaster impacts and costs.

2. Weather-related extensive risk is increasing rapidly

Extensive manifestations of risk associated with weather-related hazards are expanding geographically, occurring with more frequency and leading to increased damage levels. These loss patterns reflect ongoing patterns of risk configuration, illustrating a tendency of increasing exposure of people and assets at the local level. Given that almost all the losses are weather-related, they are highly susceptible to magnification by climate change.

3. Urbanization, territorial occupation and environmental degradation have been identified as underlying risk drivers

At least part of the increase in losses associated with extensive risk can be explained by improved disaster reporting. It may also already reflect climate change, which is increasing the frequency and intensity of precipitation events in some areas. However, urbanization, territorial occupation and environmental degradation have also been identified as key risk drivers. There is evidence to show that in some areas risk is becoming more intensive over time.

4. Disaster impacts are associated with both short- and long-term poverty outcomes

There is empirical evidence to show that poor communities are far more vulnerable to, and disproportionately affected by, natural hazards, mirroring the uneven distribution of disaster risk observed at the global level. At the same time, evidence from a range of microstudies indicates that poor households are also less resilient and face greater difficulties in absorbing and recovering from disaster impacts. Both intensive and extensive impacts have both short- and long-term poverty outcomes, including reductions in income and consumption, increases in poverty and inequality, and decreases in human development and welfare. Inadequately targeted and untimely relief and assistance, and a lack of access to insurance and social protection are all underlying drivers of the translation of disaster impacts into poverty outcomes.

3.1 Data and method

The analysis builds on important recent advances in the compilation of national disaster databases in both Asia and Latin America[3] that for the first time enable the exploration of loss patterns at the local level. The data used in this analysis has been extracted from these databases and restricted to those reports with identified losses, associated with weather-related[4] and geological[5] hazards and with verifiable source data. Approximately one third of the reports from the national databases were not used in this analysis because they did not comply with one or more of the above conditions.

The country sample analysed is characterized by a wide range of hazard types, development contexts and geographic conditions. Nevertheless, high-resolution disaster data is still not widely available for Africa, Europe and other regions. As such, while the findings point to many broad patterns and trends across different contexts they may not be globally valid. Case study evidence from Africa has been used to complement the analysis in Asia and Latin America.

Relatively robust and comparable disaster loss data exists for attributes such as mortality, housing destruction and damage. Data on crop and livestock loss is far less robust. As a result, risks associated with droughts and rural agricultural livelihoods have not been covered. In contrast microstudies on the impact of disasters on poverty have tended to focus on rural areas.

While disaster losses are indicative of realized risk, they do not indicate risk levels in a probabilistic sense. Current data does not allow an assessment of local risk levels analogous to the global analysis presented in Chapter 2. Information on local-level hazards, such as urban flooding, does not systematically exist. Global data sets on hazard and population exposure become inaccurate when examined at a high resolution. This chapter, therefore, presents an analysis of patterns and trends in losses and impacts, rather than of probabilistic risk levels.

The spatial units of analysis are local government areas or second or third tier administrative units according to the political–administrative division of each country. These areas are highly heterogeneous both within and between countries, ranging from densely populated urban municipalities, where populations of several hundred thousand may be concentrated in a small area, to sparsely populated rural districts, where a much smaller population is spread over several thousand square kilometres. This heterogeneity again means that absolute losses cannot be used to impute a given level of risk. However, these spatial units are not arbitrarily defined. They reflect the way territory is organized and managed politically and administratively in each country. Demographic, social and economic data, including on poverty attributes, is usually aggregated in the same units. While influenced by global processes such as climate change and economic flows, risk is shaped locally at this level. The losses reported in each local area reflect complex local interactions between hazard, exposure and vulnerability. In many ways they represent the social territory of risk at the local level in the same way as countries do at the global level.

A statistical analysis of the sample of 126,620 disaster loss reports was carried out to identify a threshold where the maximum proportion of the losses was concentrated in the minimum number of reports (see Appendix 2, Note 2.2). For this sample, the threshold was established at 50 deaths or 500 houses. Those loss reports with 50 deaths or 500 destroyed houses or more are characterized in this chapter as manifestations of intensive risk and those with less than 50 deaths and 500 destroyed houses are characterized as manifestations of extensive risk. Taking into account the characteristics of the available data and the spatial units in which this data is aggregated, the application of this threshold to the data does not impute higher or lower levels of risk in specific local areas. However, it does enable a characterization of the extensive spread and intensive concentration of losses. Table 3.1 summarizes the loss reports across the sample by hazard type, by loss attribute and by the type of risk manifestation.

Table 3.1: Extensive and intensive loss reports associated with weather-related and geological hazards

Risk type	Hazard type	Loss reports	%	Deaths	%	Houses destroyed	%	Houses damaged	%
Extensive	Weather-related	121,373	95.9	48,392	15.5	739,002	24.1	3,654,596	48.3
Extensive	Geological	4,259	3.4	2,406	0.8	40,684	1.3	226,545	3.0
Intensive	Weather-related	801	0.6	58,559	18.7	1,618,682	52.7	3,235,176	42.7
Intensive	Geological	187	0.1	203,524	65.0	671,980	21.9	453,094	6.0
Total		**126,620**	**100.0**	**312,881**	**100.0**	**3,070,348**	**100.0**	**7,569,411**	**100.0**

Figure 3.1 shows the distribution of mortality across the sample between 1980 and 2006. The application of the threshold to this mortality distribution clearly illustrates a number of intensive peaks of mortality underpinned by a continuous extensive mortality stream.

The fact that loss attributes such as mortality and destroyed housing are so intensively concentrated in such a small number of reports presents challenges for the identification of patterns and trends. For example, more than two-thirds of the reported mortality in Colombia since 1970 was associated with a single event: the eruption of the Armero Volcano in 1985. The intensive–extensive threshold described above was used as a simple and transparent procedure to filter out these intensive manifestations of risk. Given the large number of remaining extensive manifestations, the trends and patterns identified are then statistically robust.

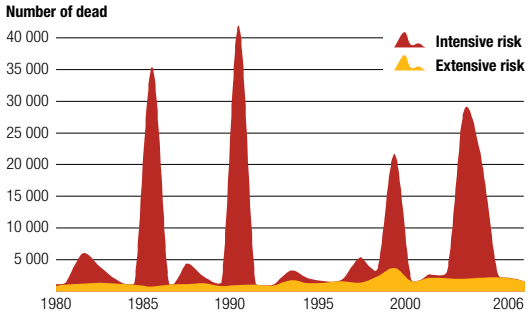


Figure 3.1: Distribution of mortality associated with intensive and extensive risk across the data set (1980–2006)

Poverty data at a local or household resolution also exists in many of the same countries and has been compared with disaster data in a series of case studies in nine countries[6]. Together with a systematization of the findings of previous studies on disaster and poverty in Africa, this has enabled the identification of the different mechanisms through which disaster risk and poverty interact. The comparison of disaster loss reports and poverty data presents an additional set of data and methodological complications that are examined in Section 3.7.1.

3.2 Reported losses, hazard events and disasters

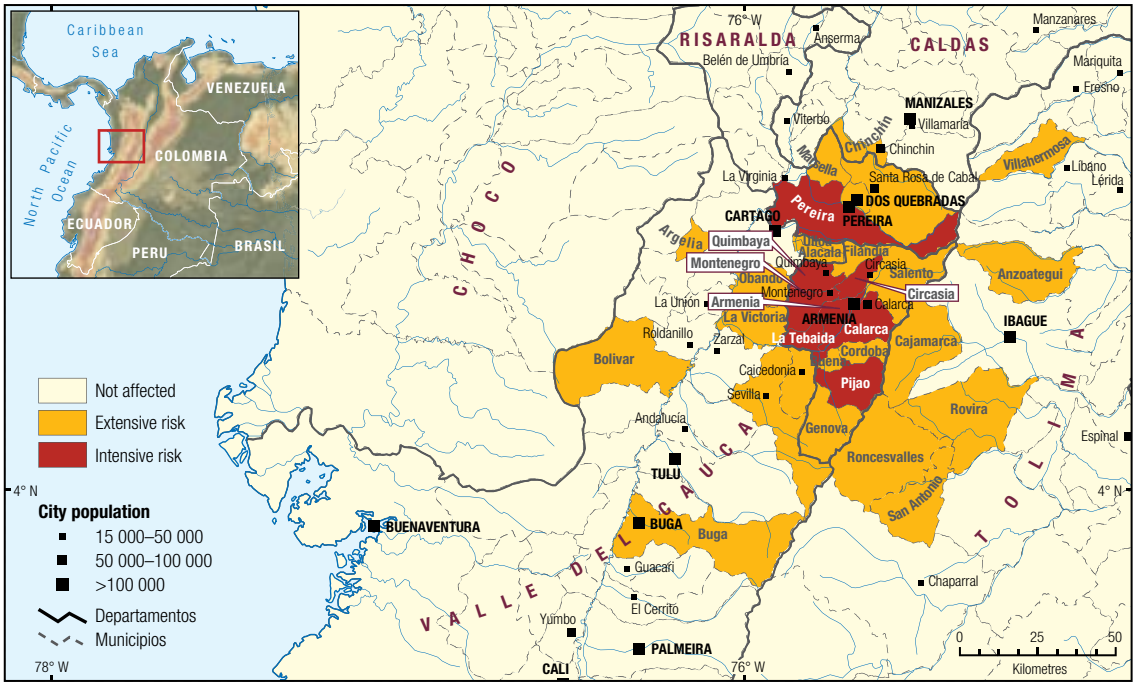
Loss reports in local government areas are not necessarily synonymous with individual hazard events. Most of the loss reports characterized as extensive in this analysis are associated with highly localized hazard events, such as flooding, landslides, fires and storms. However, a major flood or cyclonic event may also lead to extensive losses in multiple local areas, as well as intensive losses in others. Similarly, some small-scale hazards may have intensive impacts, for example the landslide that killed more than 500 people in a single neighbourhood in Villa Tina, Medellin in Colombia in 1987.

Disasters are socially constructed. Whether a series of loss reports is characterized as a single large disaster or multiple small disasters,

therefore, depends on the perspective of the observer. Extensive loss reports associated with specific localized hazard events are normally classified as small-scale disasters. These disasters are generally not internationally reported and are thus largely invisible at the global level. However, when large numbers of small-scale disasters are associated with a common event, for example the 1997/1998 El Niño episode, their aggregated impact may be viewed from the global perspective as a single disaster, even when the local loss reports occur over a long period in different areas. Events with intensive impacts, whether associated with small- or larger scale hazards are normally characterized as disasters at all scales.

For example, in the case of the earthquake in Armenia, Colombia on 25th January, 1999 (see Figure 3.2), eight municipalities intensively concentrated 98% of the deaths and 95% of the destroyed houses. The remaining 2% of deaths and 5% of destroyed housing were spread extensively over 23 municipalities in very different geographic areas. These losses were associated with a single hazard event. From the global perspective the Armenia earthquake was viewed as a single large-scale disaster. From a local perspective, however, the manifestations of risk were completely different in each municipality.

Figure 3.2: Armenia, Colombia earthquake (1999) – extensive and intensive impacts



3.3 Extensive and intensive risk patterns

All the countries in the sample experience continuously occurring low-intensity disaster impacts affecting most of their territory.

Across the sample, only 988 loss reports represent manifestations of intensive risk: an annual average of only 27 disasters – approximately one disaster every two weeks. In contrast, there is an annual average of 3,395 loss reports that manifest extensive risk, equivalent to 9 reports per day across the sample. Spatially, Figure 3.3 shows that in Sri Lanka only some districts had manifestations of

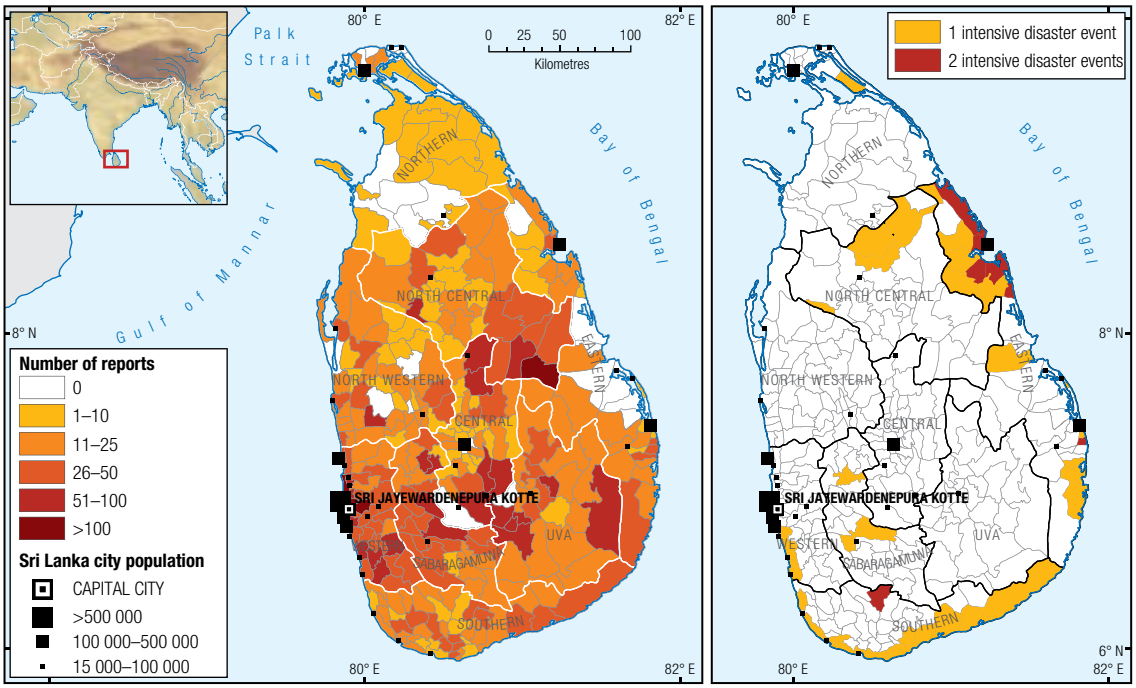


Figure 3.3: Sri Lanka extensive (left) and intensive (right) loss reports (1970–2007)

intensive risk whereas nearly all districts reported manifestations of extensive risk over the reporting period.

The spatial distribution of the extensive risk loss reports is further highlighted in Table 3.2, which shows that across the 12 countries, 82% of local administrative areas reported losses at least once during the reporting period and 48% were affected six or more times.

More than 96% of these disaster reports were associated with weather-related hazards, including periodic tropical cyclones and major floods but also large numbers of small-scale floods, landslides, storms, mudslides and other localized weather-related events. Of these weather-related events, as Figure 3.4 shows, 40.9% of the reports were associated with floods, flash floods and heavy rains, 24.7% with fires and forest fires, 14% with landslides, mudslides and avalanches, 12.3% with storm events, 4.6% with drought and heat waves and 3.5% with cold waves, frost and snowstorms.

Table 3.2: Spatial distribution of extensive risk loss reports (1970–2007)

Number of loss reports	Number of local administrative areas affected	%	Inverse cumulative %
0	982	17.90	100.00
1	639	11.65	82.10
2 to 5	1218	22.21	70.45
6 to 10	717	13.07	48.24
11 to 20	729	13.29	35.17
21 to 50	647	11.80	21.88
51 to 100	291	5.31	10.08
more than 100	262	4.78	4.78
Total	**5485**	**100.00**	

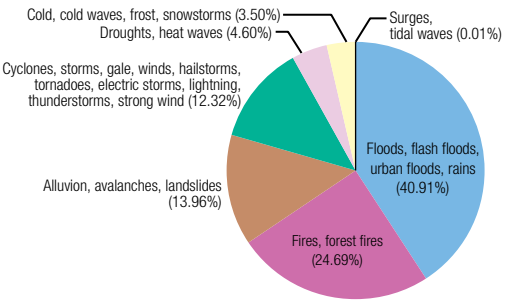


Figure 3.4: Weather-related extensive loss reports by hazard type across sample

Each country however, has a unique hazard profile. In Orissa, India, for example, fires account for almost 59% of the extensive loss reports due to rural villages of tightly packed thatch houses that are extremely vulnerable to fire. As Figure 3.5 indicates, in Iran 42.9% of extensive loss reports are associated with earthquakes.

While mortality and housing destruction is intensively concentrated, extensive risk disasters account for 51.3% of damaged housing across the sample. In most Latin American countries over 75% of housing damage is extensive. In Asia the percentage is less – given that no less than 58.5% of the housing damage reported in Asia occurred in Orissa where 84.8% of the housing damage was intensive.

This loss pattern is compatible with the fact that most extensive risk loss reports are associated with floods, rains and storms, which are more likely to damage housing than cause mortality or destruction. Research from other countries suggests that mortality and injury only increase significantly in very severe floods, with a large number of affected buildings[7]. And, effectively, flood mortality in the sample is mainly concentrated in the intensive loss reports. Floods were associated with 34.7% of weather-related extensive risk loss reports but with over 60% of corresponding housing damage. Heavy rains were associated with only 6% of the loss reports but 26.7% of the housing damage.

To further illustrate this point, Figure 3.6 shows how housing damage is extensively spread while housing destruction is intensively concentrated in Tamil Nadu, India.

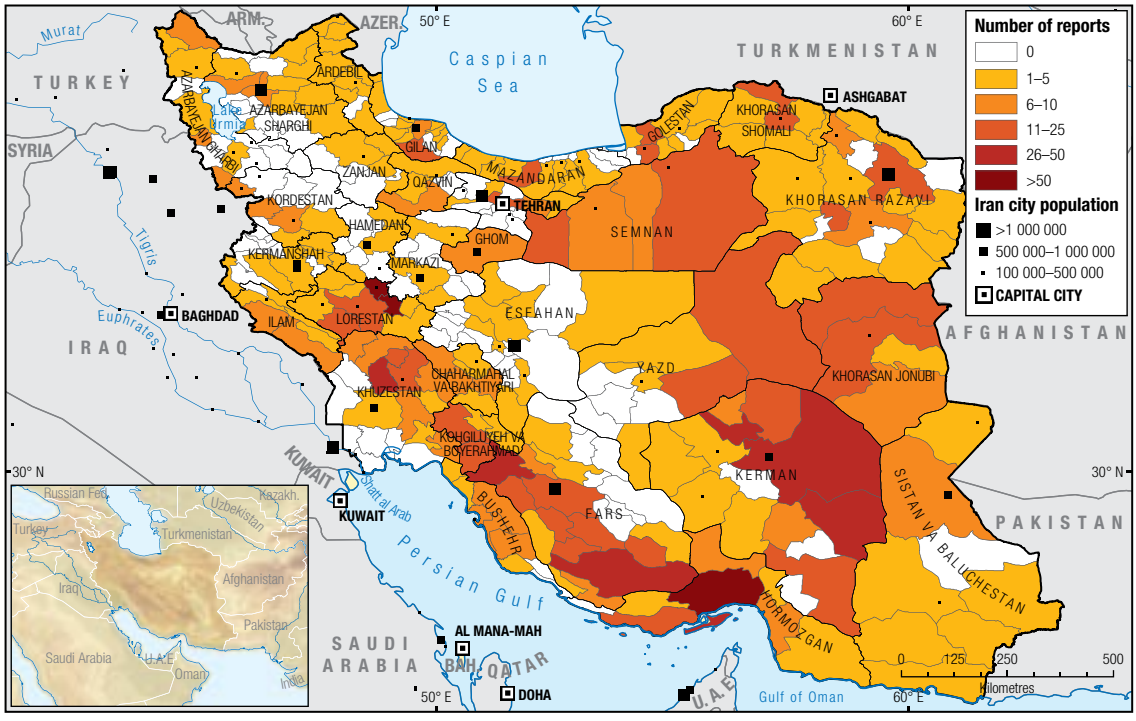


Figure 3.5: Extensive loss reports in Iran associated with earthquakes

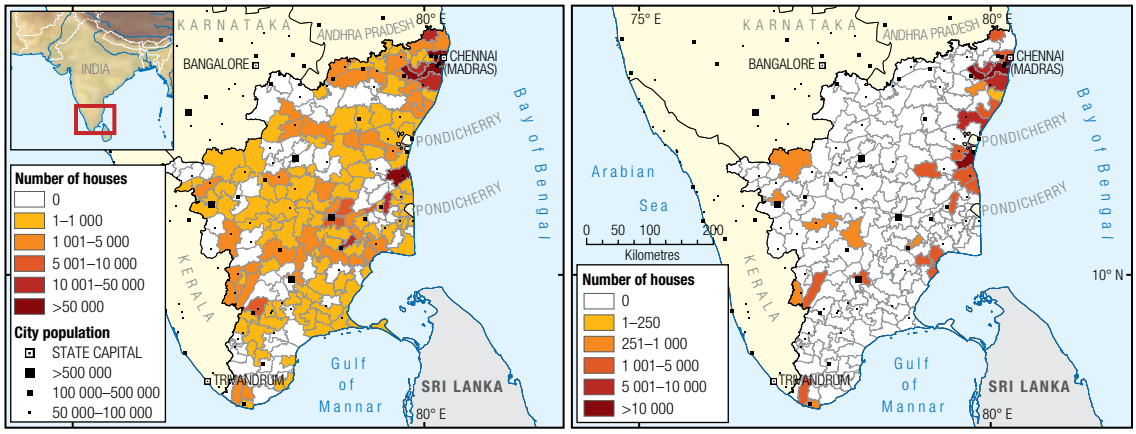


Figure 3.6: A comparison of extensive housing damage (left) and intensive housing destruction (right) in Tamil Nadu, India (1976–2007)

3.4 The costs of extensive risk

The costs associated with extensive risk manifestations are significant. The most robust attribute in the disaster databases is that of destruction and damage in the housing sector. In Mexico, for example, the disaster loss reports documented 316,928 destroyed and 471,708 damaged houses associated with manifestations of intensive risk between 1980 and 2006, and 29,510 houses destroyed and 1,468,509 damaged houses associated with manifestations of extensive risk. The cost of a destroyed house in Mexico has been estimated as US$ 16,800[8] and the cost of a damaged house as 20% of that value.

Based on these values, the cost of destroyed and damaged housing associated with intensive risk between 1980 and 2007 was US$ 6,909 million compared with US$ 5,429 million associated with extensive risk. In other words the losses associated with extensive risk represented approximately 44% of total economic losses in the housing sector. Applying the same methodology across the whole sample, the damage and destruction associated with extensive risk would represent approximately 34% of the value of economic losses in the housing sector.

Table 3.3 illustrates that, across the sample, a significant proportion of losses in other sectors such as education, health and transport, as well as of the people affected, are also associated with extensive risk: 57% of schools, 65% of hospitals,

Table 3.3: Loss attributes by risk category across the sample (1970–2007)

		Risk category			
Loss attribute	**Total**	**Extensive risk**	**%**	**Intensive risk**	**%**
Schools	32,157	18,488	57	13,669	43
Hospitals	1,037	677	65	360	35
Kilometres of roads	64,917	57,695	89	7,221	11
People affected	182,989,857	144,627,235	79	38,362,622	21

89% of damaged and destroyed roads, and 79% of the people affected. Disaster loss data in these sectors is less robust than in housing, meaning that the absolute figures are not meaningful. The proportional distribution between extensive and intensive risk manifestations, however, is valid given the size of the sample.

While the costs associated with extensive risk are clearly additional to those associated with intensive risk, it is not possible to directly compare these estimates with internationally reported economic losses. Around two thirds of internationally reported disasters do not have economic loss data and most of those that do include impacts associated with both intensive and extensive risk.

What can be demonstrated is that international attention to disasters – as measured by the release of UN situation reports; international appeals for assistance launched by the UN or by the IFRC; and post-disaster damage and loss assessments by the World Bank, regional development banks or the UN[9] – is usually triggered by intensive losses. For example, of 2,281 disasters registered by the IFRC between 2004 and 2009 only 142 led to emergency appeals and only 398 lead to the involvement of IFRC delegations. The remainder were managed nationally by the Red Cross and Red Crescent Societies[10]. The implication is that part of the costs associated with extensive risk are not accounted for by the international community.

3.5 Underlying risk trends

3.5.1 Extensive weather-related risk

Only 3% of the extensive risk loss reports in the sample correspond to geological hazard, mainly the extensive impacts of large-scale earthquakes and tsunami. As such, excepting Iran, which has a higher proportion of extensive risk associated with geological hazards, extensive risk is largely associated with weather-related hazard.

The average annual occurrence of extensive weather-related disasters has doubled over the last 27 years across the sample. As Figure 3.7 shows, the average number of deaths per loss report is actually going down while the number of houses damaged per loss report is increasing. This finding is coherent with the trends identified in Chapter 2 at the global level, which indicate that economic loss is growing faster than mortality. As countries develop, improvements in risk-reducing capacities lead to reductions in mortality but do not compensate for the increasing exposure of assets.

A comparison of these trends in mortality and housing damage with the average annual population growth in each country confirms this hypothesis (Table 3.4). In most of Latin America, with the exception of Ecuador and Mexico, mortality is falling relative to population size, whereas in Asia, except in Iran, it is increasing, probably reflecting differences in income and

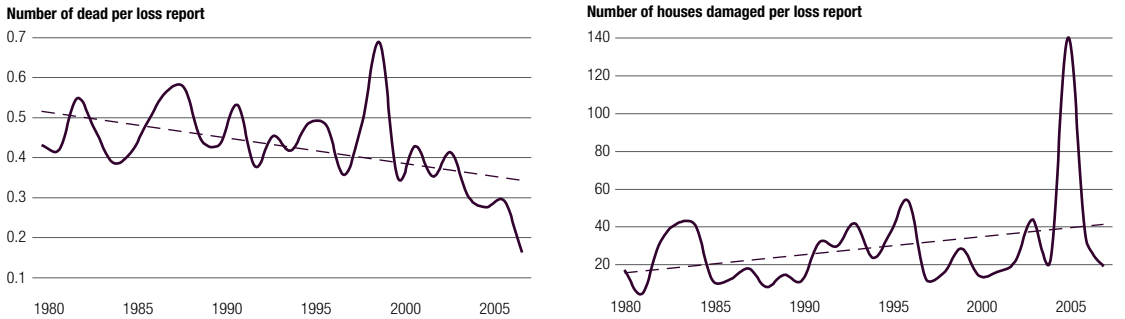


Figure 3.7: Extensive weather-related mortality (left) and housing damage (right) – all countries (1980–2006)

Table 3.4: Annual increase in mortality and housing damage compared with annual population growth (1980–2006)

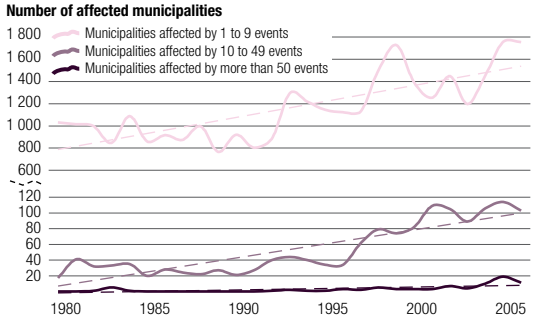
Country name	Average annual % change in mortality (1970–2007 unless otherwise indicated) from extensive weather-related events	Average annual % change in houses damaged 1970–2007 from extensive weather-related events	Average annual % increase in population 1970–2007[11]
Argentina	0.90	2.92	1.33
Bolivia	1.48	0.03	2.17
Colombia	–0.95	9.48	1.89
Costa Rica	0.93	8.18	2.35
Ecuador	3.93	26.12	2.09
Iran (1980–2007)	–1.23	–9.05	2.37
Mexico (1980–2007)	6.48	17.94	1.88
Nepal (1971–2007)	4.47	8.28	2.25
Orissa	5.75	7.80	1.66[12]
Peru (1970–2006)	1.31	3.03	1.96
Sri Lanka (1974–2007)	1.70	5.68	1.15
Tamil Nadu (1976–2007)	11.67	12.23	1.25[13]
Venezuela	0.51	5.96	2.49

human development between countries in both regions. In contrast, with the exception of Bolivia and Iran, housing damage is increasing far faster than population growth.

The identified trend of increasing exposure is associated with a centrifugal geographical expansion of extensive weather-related risk. Figure 3.8 illustrates the consistent increase in the annual number of affected local administrative areas. The number of local areas with 1–9 loss reports between 1980 and 2007 has doubled and those with 10–49 loss reports has almost quintupled. This confirms that many new local areas are now characterized by weather-related extensive risk, while the frequency of losses has also increased.

For example, Figure 3.9 highlights that the number of states with manifestations of extensive risk in Mexico has consistently grown over recent decades.

Figure 3.8: Number of municipalities across the sample affected by extensive weather-related risk (1980–2006)



Extensive risk configuring intensive risk

Extensive risk can become intensive over time in areas that are subject to severe levels of similar kinds of hazard. For example, areas with very frequent manifestations of extensive flood risks are likely to experience intensive impacts during major cyclonic events. Figure 3.10 indicates that in Orissa manifestations of intensive risk tend to occur in areas with the most frequent manifestations of extensive risk. Similar patterns can be seen in other countries[14]. In other words, intensive risk is often superimposed on patterns of extensive risk.

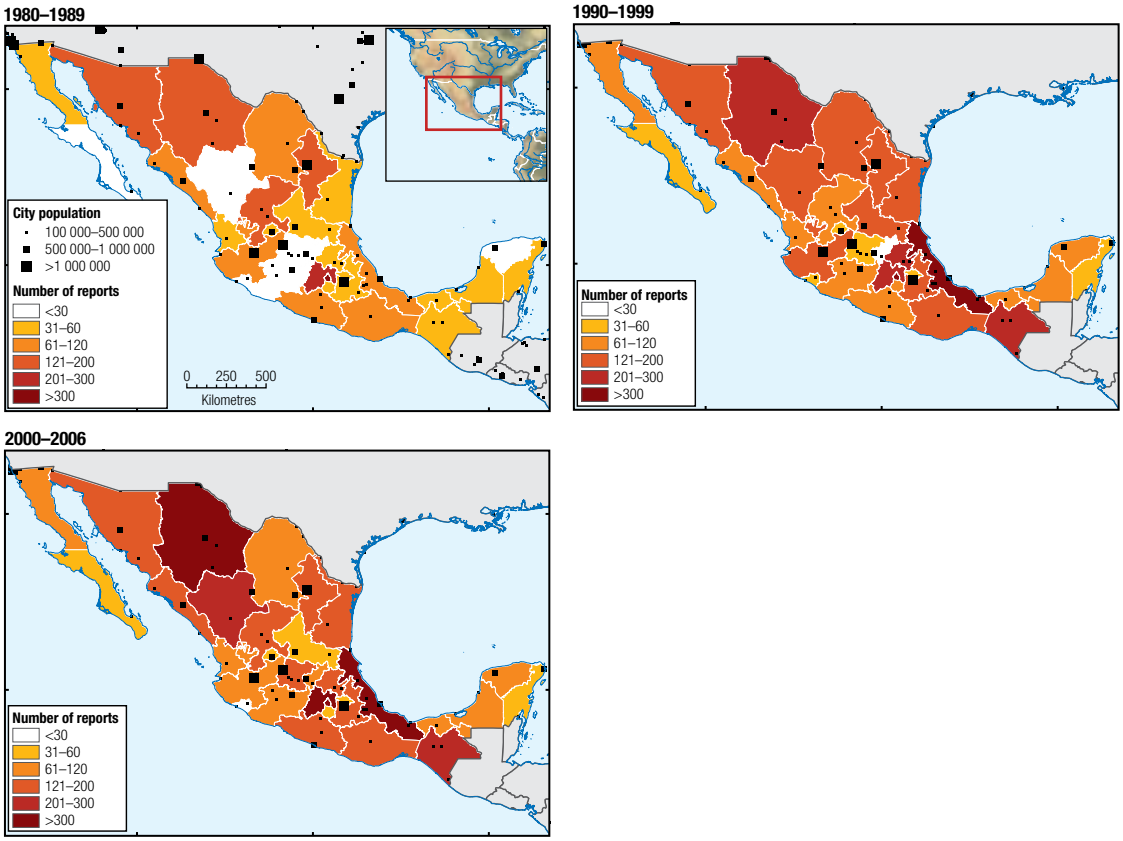


Figure 3.9: Number of extensive risk reports, Mexico (1980–1989, 1990–1999, 2000–2006)

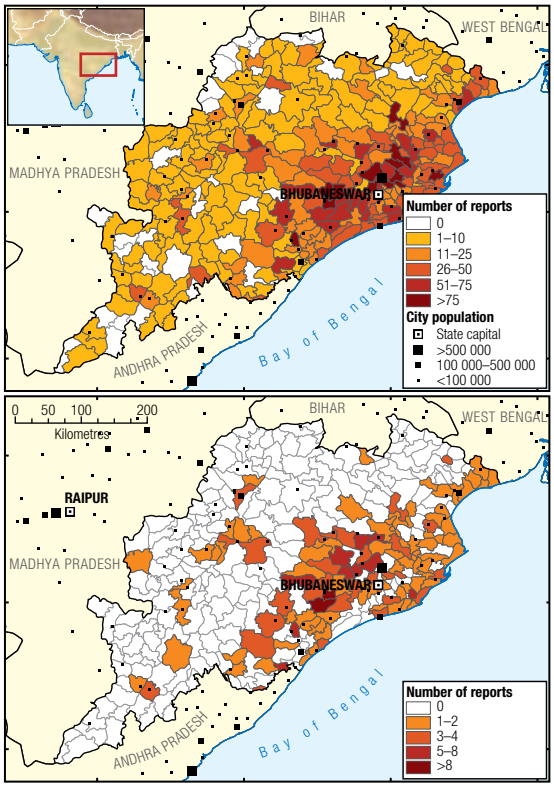


Figure 3.10: Comparison of extensive (above) and intensive (below) risk loss reports, Orissa, India (1970–2007)

Floods and heavy rains

As Figure 3.11 illustrates, the number of loss reports associated with floods and heavy rains is increasing at a far faster rate than all other categories of weather-related hazards, particularly since 1990.

In Mexico, for example, the annual average number of extensive loss reports associated with floods, rains and flash floods has increased eight-fold since 1980. These hazards accounted for 31% of all extensive weather-related loss reports in the 1980s but over 40% in the last decade. Similarly, in Colombia (Figure 3.12), floods, flash floods and heavy rains accounted for 43% of extensive weather-related disasters in the 1970s but 53% in the last decade.

Figure 3.11: Number of flood and rain extensive risk loss reports (1980–2006)

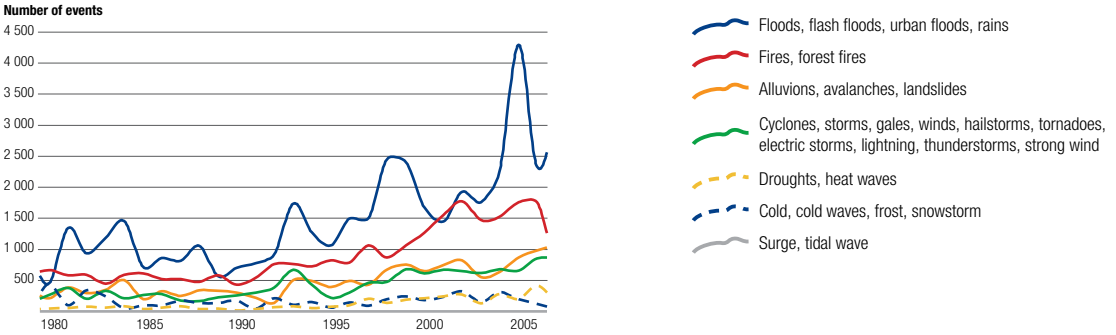
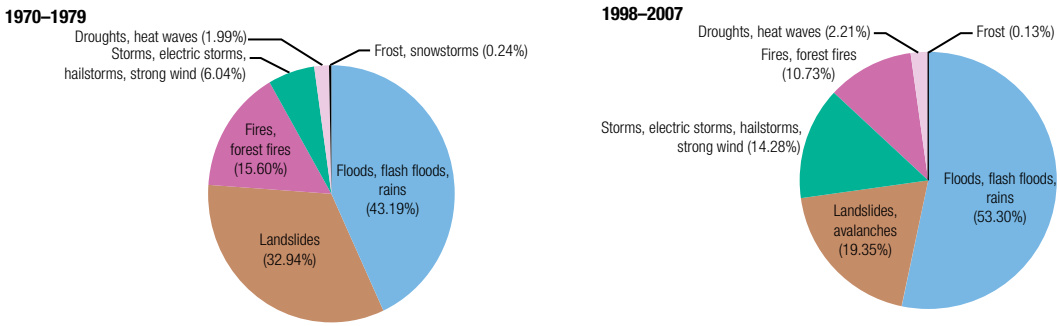


Figure 3.12: Floods and rains in Colombia as a proportion of all extensive weather-related loss reports, 1970–1979 and 1998–2007



3.6 Interpreting the trend

3.6.1 Improved disaster reporting and a bias in the data?

As in the case of the global trends identified in Chapter 2, it is very likely that improved reporting of disaster events due to enhanced communications, the introduction of the Internet and more systematic government reporting [15] is responsible for an increase in the number of loss reports. However, improved reporting alone is not sufficient to explain the trends identified. Improved reporting should lead to an even increase in loss reports across all hazard categories and not just floods and rains. Similarly the number of loss reports is increasing not only in remote rural areas, where disasters may previously have gone unreported, but also in major metropolitan areas, such as Buenos Aires or Mexico City.

Evidence from Colombia and Peru indicate that many more loss reports originate in major cities and from provincial capitals than from isolated rural areas [16]. This may reflect a bias in the reporting, given that losses occurring in centres of political administration are more likely to be reported than in remote rural areas. All the losses reported from urban areas are documented and therefore did occur. While it is likely that many small-scale losses in remote rural areas go unrecorded, it is unlikely that this includes nationally significant losses. In parts of Asia, in contrast, it is likely that losses in rural areas may be more consistently reported than in some cities.

3.6.2 Climate variability and change

The IPCC has confirmed that the geographic distribution, frequency and intensity of

precipitation events is already being altered significantly by climate change[17], although these effects will have different manifestations in different regions. It is likely therefore, at least in some regions, that climate change, as well as cyclical patterns of climate variability, is influencing the doubling of the number of loss reports associated with weather-related extensive risk over the last 27 years and the even more rapid increase in those reports associated with floods and rains.

Without a detailed analysis at the watershed level, however, it is impossible to determine the influence of climate variability and change. In some countries, such as Colombia, Costa Rica, Ecuador and Venezuela, the increase in flood- and rain-related reports since the mid-1990s has coincided with a period of increased annual average precipitation, as Figures 3.13 and 3.14 highlight in the case of Costa Rica[18]. However, in Mexico and Nepal, the number of loss reports is increasing while average precipitation is decreasing. In Peru, average precipitation is increasing while the number of loss reports is decreasing. In other words, there is no consistent relationship between both variables across the sample.

Figure 3.13: Extensive flood and rain loss reports in Costa Rica (1990–2007)

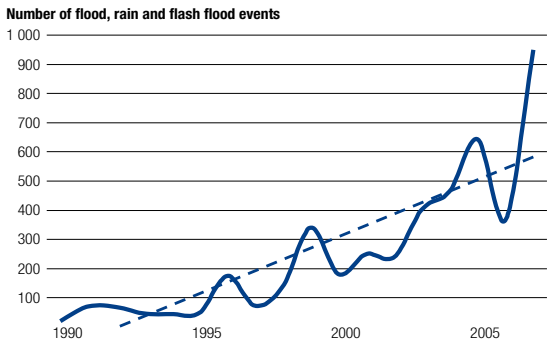
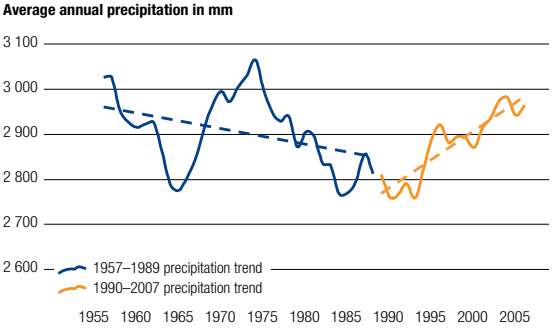


Figure 3.14: Precipitation in Costa Rica: 10-year averages (1957–2007)



3.6.3 Urbanization, environmental change and territorial occupation

Aggregate national statistics on variables such as deforestation and urban growth similarly provide little insight into the trend of increasing weather-related risk. Continuing with the example of Costa Rica, forest cover has increased, due to environmental protection policies and the application of a system of payment for ecosystem services, over the same period that a dramatic increase in flood and rain loss reports has occurred.

In contrast, case study evidence from Latin America, Asia and Africa demonstrates how drivers such as urbanization, environmental change and territorial occupation are fundamentally shaping the geography and evolution of extensive risk. A detailed description of evidence from national case studies is presented in Appendix 2, Note 2.4.

Urban expansion

Case studies from Argentina, Colombia, Costa Rica and Mexico indicate how extensive risk is generated through processes of urban expansion. Extensive flood risk is closely linked to the increased run-off caused by new urban development, a chronic underinvestment in city-wide pluvial drainage, the location of informal settlements and social housing projects in low-lying flood prone areas and inadequate water management in the surrounding watersheds. In other words, the urbanization process not only leads to increasing exposure of vulnerable people and assets in hazard prone areas but is also responsible for magnifying the hazards themselves, particularly floods.

In the metropolitan area of San Salvador, for example, the municipalities with recurrent extensive loss reports were those with the most rapid urban growth[19], in some cases up to 16% per year. And, according to the Municipality of San Jose, Costa Rica, more than 80% of the floods occurring in the country's capital are caused by either inadequate drainage to cope with the

increased run-off caused by urban growth or by the accumulation of garbage and waste in drainage channels. Most housing damage is concentrated in *precarios* occupying marginal land adjacent to the streams and torrents that drain the city.

Many cities in Asia are also increasingly experiencing losses due to urban flooding. For example, there were 240 reports of flood loss in Colombo since 1974. Almost half these reports and about 80% of the associated housing damage have occurred since 2005. Chennai similarly experienced major flooding in 1990, 1994 and 1996 and Kathmandu in 2000 and 2002. Flooding in these, as in other cities across South Asia, would tend to suggest that rapid urban growth, the expansion of informal settlements, inadequate water management and an underinvestment in drainage are driving risk in a way that is analogous to Latin America, although with very different characteristics.

Some cases also indicate how extensive risk in cities can be reduced over time through investment in public infrastructure as urban areas are consolidated. In some cities, this means that extensive risk patterns expand concentrically from the centre towards the periphery of the city following the logic of informal settlement, while at the same time progressively reducing in the centre. In other cases extensive risk is concentrated in pockets of land ignored by formal urbanization, for example in ravines or riverbanks.

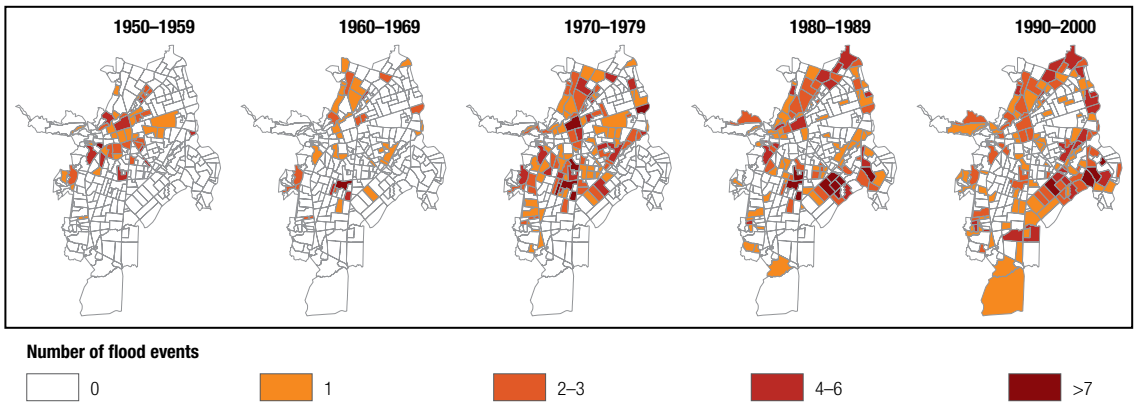
Figure 3.15 shows local loss reports from floods in Cali, Colombia since the 1950s. The number of flood loss reports mirrors the expansion of the city, mainly through the occupation of land for informal settlement without a corresponding investment in drainage infrastructure.

Flooding reported in early November 2006 in the Colombo District, Sri Lanka, destroyed 221 houses, damaged 1,674 houses and affected 80,128 people. Figure 3.16 shows the distribution of flooded areas overlaid with population density. The flooding illustrated the typical problems of settlements in low-lying areas and inadequate drainage.

Four types of flood have been identified in African cities[21]: (1) localized flooding due to inadequate drainage; (2) flooding from streams whose catchment is entirely within the urban areas; (3) flooding from major rivers on whose banks cities and towns are located; and (4) coastal flooding from the sea or by a combination of high tides and river flows. According to Action Aid, the first two kinds of flood are most prevalent.

The underlying cause has been the gap between the very rapid growth in the population of many urban centres and the capacity of urban governments to cope (see Box 3.1). Although growth rates in many urban centres have declined, far too little attention has been given to needed measures to improve urban governance. Very poor conditions in many rural areas, including the combined impacts of conflict, floods and drought, have underpinned much rural to urban migration. Due to poor urban governance, most cities absorb growth through the expansion of informal settlements,

Figure 3.15: Extensive flood reports in Cali, Colombia (1950–2000)



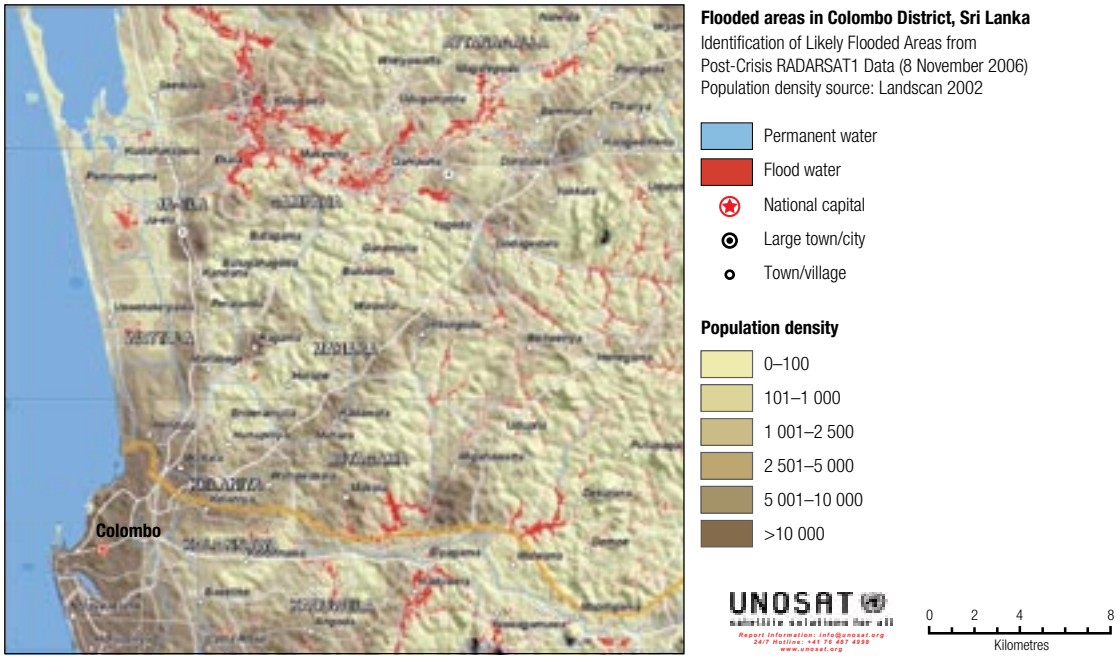


Figure 3.16: Flooded areas overlaid with population density in the Colombo District, Sri Lanka[20]

which often occupy low-lying flood prone areas. 72% of Africa's urban population lives in informal settlements. Investment in drainage infrastructure is often non-existent and there is little or no maintenance of existing infrastructure.

Territorial occupation

Case studies from Ecuador, Mexico and Peru show how in parallel to mirroring the growth of large cities, extensive risk also expands concentrically in a country's territory, following the construction or improvement of roads, the opening of the agricultural frontier and the growth of small and medium urban centres. Increasing extensive risk associated with floods, for example, is often related to a combination of factors including a decline in the regulatory services provided by ecosystems, inadequate water management, land-use changes, rural–urban migration, unplanned urban growth, the expansion of informal settlements in low-lying areas and an under-investment in drainage infrastructure.

Figure 3.17 shows how over the last four decades the distribution of extensive weather-related loss reports in Ecuador has followed the process of territorial occupation, from the country's Andean backbone westwards into the Pacific lowlands and eastwards into the Amazon.

Figure 3.18 shows a similar process in Peru, where the distribution of loss reports associated with landslides has moved eastwards, following the opening of new roads into the Amazon.

Figure 3.19 shows the devastating flooding in Tabasco, Mexico in 2007 due to a combination of inadequate water management in an 80,000 km^2 watershed and the urbanization of low-lying areas without adequate investment in drainage.

Densely populated rural areas

In contrast to Latin America, all the Asian countries, except for Iran, are still markedly rural. In Iran, 66.9% of the population was classified as living in urban areas in 2005 compared with 28.7% in India, 15.8% in Nepal and 15.1% in Sri Lanka. In these predominantly rural countries extensive risk flood losses are associated not only with urban growth and territorial occupation but also with major concentrations of the rural population living on floodplains, near major river deltas and along coastal plains.

Environmental degradation – in particular declines in the regulatory services provided

Box 3.1: Flooding in African cities[22]

Kampala, Uganda
Construction of unregulated settlements has reduced infiltration of rainfall and changed land cover leading to runoff six times higher than occurs in natural terrain. After the 1960 floods a channel from Nsooba to Lubigi was dug and workers were employed to clean it regularly. There were no further flood problems until the 1980s but since then residents have had to re-build their houses after flooding up to six times. Some of this is because the main drainage channel, originally two metres deep, is now only 30 cm deep because of an accumulation of sediment and rubbish.

Nairobi, Kenya
Flooding is a major problem in all of Nairobi's informal settlements. Houses are built of weak, inadequate building materials. Migration has led to more houses being built close to streams, with consequent greater disruption when floods occur. Many local residents link increased flooding to both local activities and climate change. Slum inhabitants agree that floods now occur in places where they did not two decades ago.

Accra, Ghana
Women in Alajo, Accra, observed that patterns of rain and flooding have become unpredictable since the 1980s. They noted that it used to rain heavily in June and July but since 2000 the heavy rains sometimes start earlier and in other years start only after July. Consequently, it is difficult for them to prepare for flooding in Alajo. Since slum dwellers' livelihoods depend on activities such as small-scale commerce, petty trading and artisanal trades conducted in wooden kiosks that do not withstand the force of the floods, people lose working time, economic opportunities and income. The immediate impact is loss of income for food and bills, including children's education and medical costs.

Bamenda, Cameroon
Bamenda's population expanded more than 10-fold between 1965 and 1993, to reach around 270,000 in 1993. Human settlements have expanded up hill-slopes and onto wetlands because land is much cheaper (land can be 300–400 times more expensive within the urban district compared to the very steep slopes and wetlands) but it is difficult (and expensive) to build stable, safe homes there. Around 20% of Bamenda's population lives on floodplains and around 7% lives in informal settlements on steep slopes. There is a serious lack of provision of water, sanitation, schools, health posts, roads and drainage. Land clearance for settlement and for quarrying and sand-mining, along with other land-use changes caused by urban expansion, have created serious problems of soil erosion – with the soil that is washed down the hills blocking drainage channels and changing peak water flows. These have exacerbated the long-standing problems with floods in the area. It is difficult to address these problems, especially given the economic crisis and the absence of capacity and skills within the local authority[23].

Saint Louis, Senegal[24]
The population of Saint Louis almost doubled between 1998 and 2002, from 115,000 to 200,000. Floods affect low-lying areas with no drainage that have been settled by very poor rural migrants fleeing the effects of rural drought. In order to protect against the floodwaters, residents make barriers using household waste, but this increases the incidence of health hazards. Flood risk in Saint Louis is basically a problem of poor urban governance. Basic information on flood risk is not available and urban development and risk reduction policies or projects are both uncoordinated and non-inclusive.

by forest ecosystems – may be contributing to increased flooding in some watersheds. In Nepal, increased flooding in the Terai region may be related to increased glacier melt in the Himalayas as well as to environmental changes in upland watersheds. In India, as well as in Nepal and Sri Lanka, housing damage in rural areas would seem to be closely associated with the high density of rural settlement in flood prone areas and the vulnerability of rural housing.

For example, in Tamil Nadu, India there is a concentration of extensive risk housing damage around urban centres in the north-east of the state (Figure 3.20). While poorly studied, flooding would seem to be associated with the high level of urbanization and associated problems of settlement of low-lying areas, increased run-off and inadequate drainage. In Chennai, for example, 18.9% of the urban population was living in slums in 2001[26]. However, the other

Figure 3.17: Spatial evolution of extensive weather-related loss reports in Ecuador from 1970–2007

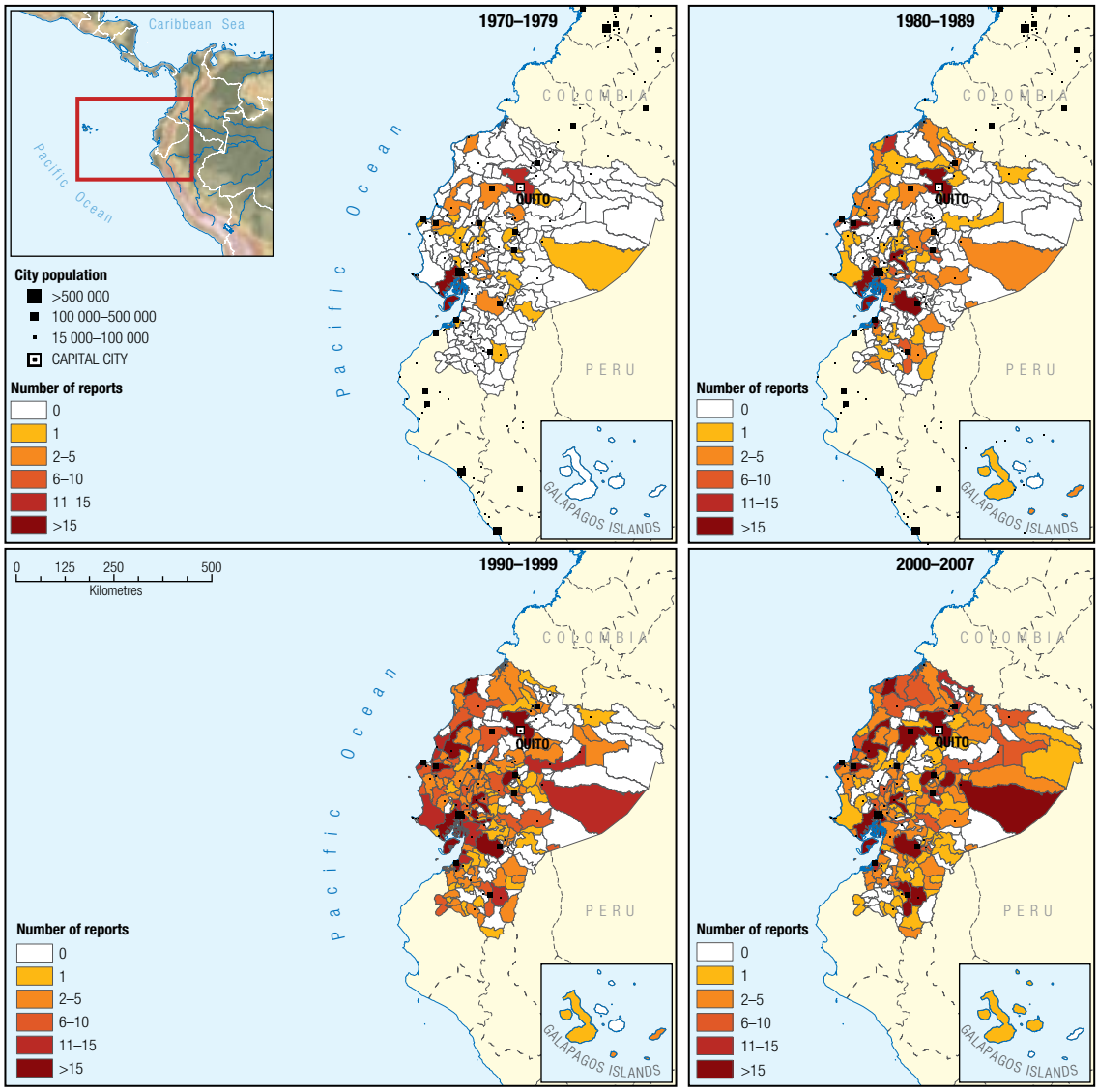


Figure 3.18: Redistribution of extensive landslide risk in central Peru between 1970–1985 and 1986–2006

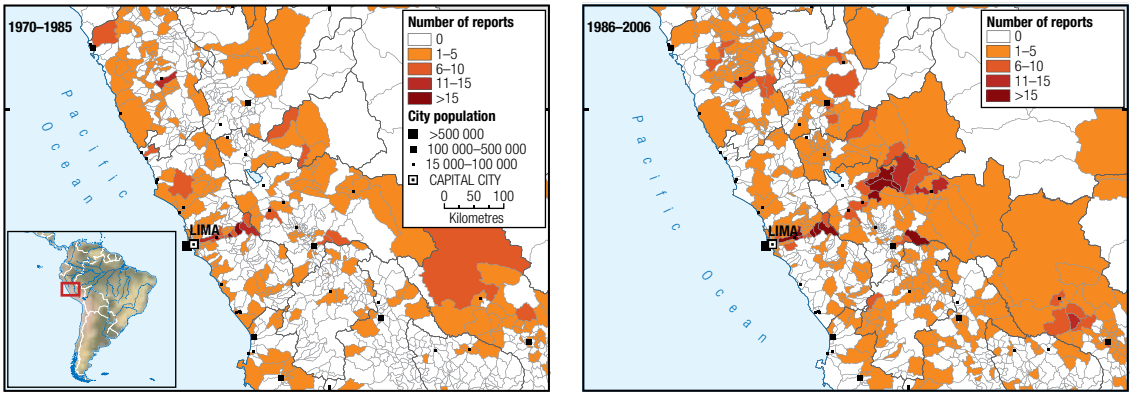


Figure 3.19: Population density and flooded areas in Tabasco, Mexico, 2007[25]

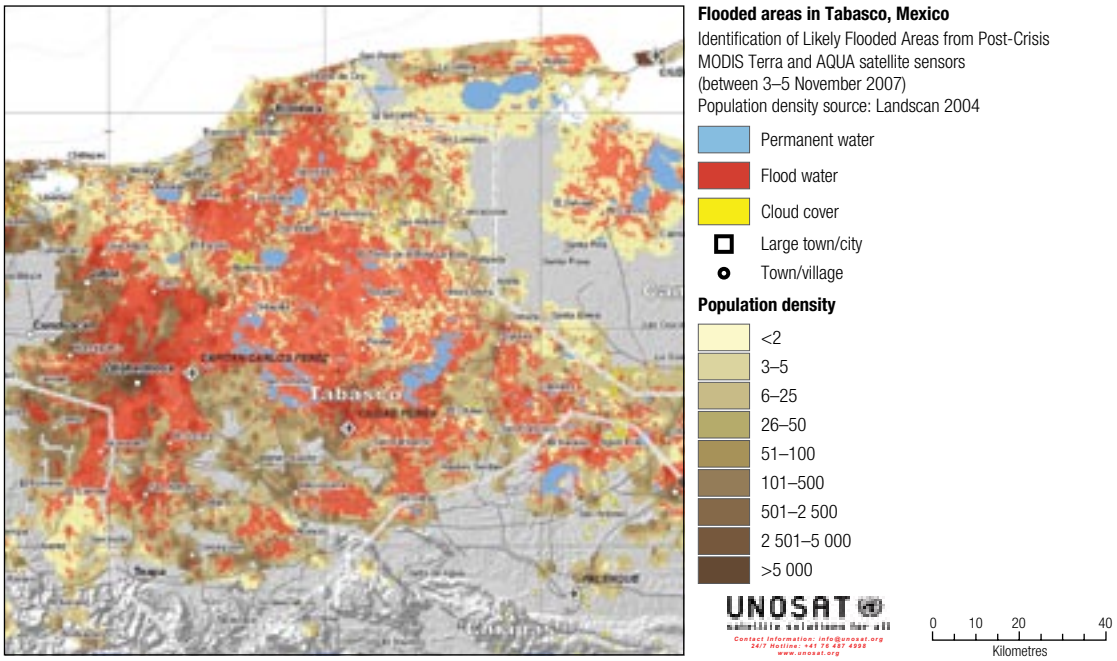


Figure 3.20: Distribution of housing damage in extensive flood and heavy rain loss reports in Tamil Nadu, India (1970–2007)

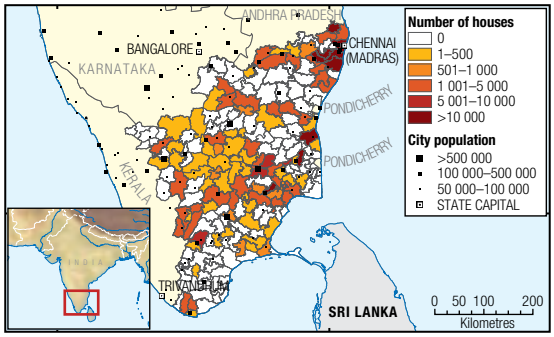
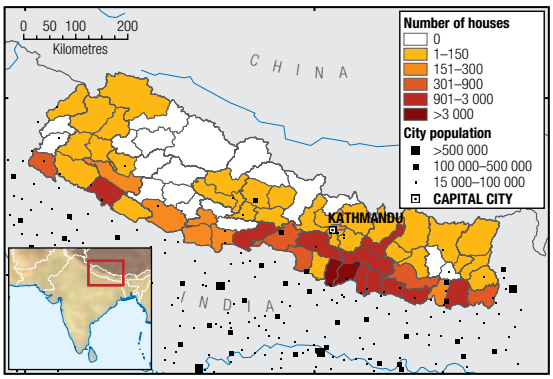


Figure 3.21: Housing damage by extensive flood events, Nepal



concentration of housing damage is along the floodplain of the Kaveri River, in the watershed of the Ponnaiyar River and in the Kambam Valley. Tamil Nadu has a long history of chain-tank irrigation – a system that has fallen into disuse. Much flood damage in rural areas is associated with chain-tank failure and the silting of irrigation channels. In upland areas, increasing extensive flood risk may be associated with issues of environmental degradation.

In Nepal, extensive flood risk and associated housing damage is concentrated in the densely populated alluvial plains of south-eastern Nepal in the Terai region (Figure 3.21). Floods in this case are not a consequence of urbanization or population density, but a cause. The richness of the soils is due to the frequent replenishment of nutrients through flooding and the reason why the region can support such a large dense population.

3.7 Disaster and poverty interactions at the local level

3.7.1 Data and methodological challenges

The analysis presented in Chapter 2 indicated that global disaster risk is disproportionately concentrated in low-income countries with weak governance. Similarly, countries with small and vulnerable economies, such as many SIDS, were shown to be far less resilient to disaster loss than those with larger and more diversified economies.

While the analysis of disaster risk at the local level presented in the preceding sections implies that losses would appear to be concentrated in poorer areas, such as urban informal settlements, it is far from easy to establish empirically a causal relationship between disaster risk and poverty, for a number of reasons:

- Empirical studies tend to be opportunistic rather than systematic, given the limited availability of both disaster and poverty data at a suitable scale.
- Spatially aggregated data may smooth important local differences in both disaster risk and poverty, making it difficult or impossible to identify statistically valid relationships.
- Disaster losses are often measured only in terms of mortality or direct economic impact. There is little systematic data collection on longer-term human development impacts in dimensions such as health, education and nutrition. Documenting impacts in these dimensions is not simple given the sparse survey data covering the same units of analysis over long periods of time. Few national statistical systems collect time series household panel data that incorporates information on hazard impacts.
- Hazard levels explain a large part of the variance in disaster incidence and loss between different local areas. However, information on the distribution and intensity of localized hazards is often not available, making it difficult to control for what may be a key variable.
- In Latin America, national disaster data may have an urban bias and over-estimate impacts in cities and under-estimate disaster risk in poor and dispersed rural areas. In Asia disaster data may be less reliable in urban areas due to the spatial resolution with which it is captured.
- When disaster impacts are compared nationally with data on the poverty headcount, poverty gap or unsatisfied basic needs, counter-intuitive results may be produced in countries with predominantly urban populations given relative differences between urban and rural poverty.

A number of case studies from Latin America and Asia were commissioned specially for this Report in countries where both poverty and disaster data were available. Despite the challenges mentioned above they do provide empirical insight into how poverty shapes disaster risk and vice versa. These case studies were complemented by a systematization of the results of other studies in Africa. Many of these empirical studies address drought and rural livelihoods, complementing the analysis on floods and the housing sector that characterized the previous section. Appendix 2 summarizes the empirical results of the country case studies commissioned for this report, other studies within both regions, as well as results from analysis of Africa poverty studies.

3.7.2 Assets, poverty and disaster risk

Households and communities exposed to natural hazards take decisions to manage the risks they face. Ex ante decisions in areas such as housing and livelihood have important short- and long-term implications for both welfare and human development as people seek to manage not only the risks associated with natural hazards, but also other everyday risks. Poor households may accept high levels of disaster risk and thus a higher risk of incurring losses in order to maximize income opportunities. Others may organize their livelihoods in such a way that overall risks are lowered, even if that means a reduction in income and increased poverty.

When disaster losses are incurred, ex post responses or the inability to respond also have implications for short- and long-term welfare and human development outcomes[27].Both ex

ante and ex post responses to disaster impacts are influenced by the range of tangible (natural, physical and financial capitals) and intangible assets (human capital, social ties and networks, intrahousehold relations) at people's disposal, which in turn are shaped by broader economic, social and political considerations in each context.

Asset holdings have a positive impact on welfare in at least two distinct ways. First, higher net asset holdings can increase the income-generating potential of poor households leading to higher welfare and less poverty during normal times. For example it may enable a household to choose a less hazardous location or to live in less vulnerable housing. Second, asset holdings offer a crucial means to buffer disaster losses[28]. The ability of a household to access and mobilize assets therefore has a dramatic influence on both the ex ante and ex post capacity of households and communities to manage disaster risk.

Households with limited ability to mobilize assets are less resilient when assets are lost in a disaster – for example, when houses are damaged or livestock killed. In the absence (or delayed activation) of formal and informal credit and insurance markets and state-funded mechanisms, such as safety nets and social security, these impacts can reduce consumption in the short term and also lead to an observable deterioration in health, nutritional and educational status and other long-term human development problems.

When assets are available, asset sales can buffer income and consumption fluctuations. However, particularly in the case of large disasters, such strategies are often ineffective when many households simultaneously decide to dispose of the same kind of asset in the context of limited demand. Moreover, in contexts of deprivation, where assets are already scarce, asset disposal makes recovery harder by affecting the ability to generate income in the future. Reduced future income further entrenches poverty and associated poor nutritional, educational or health status.

The role that assets play in managing disaster risk is also influenced by whether the risk is extensive or intensive in character. The impacts associated with both intensively concentrated and extensively spread risk have very different but equally important implications for the translation of disaster impacts into poverty outcomes.

As discussed earlier in the chapter, manifestations of intensive risk are characterized by major mortality and asset destruction, which can seriously compromise the capacity of a household to buffer losses and recover: for example when household income earners are killed or injured or where an asset such as a house, which may represent a reserve of inter-generational savings, is lost. In contrast, it is more likely that the low-intensity damages associated with extensive risk can be more easily buffered.

Similarly, manifestations of intensive risk are more likely to be associated with large-scale hazards that simultaneously affect large numbers of households, stretching and often overwhelming not only local but even national coping mechanisms. In contrast, in the case of extensive risk impacts affecting smaller numbers of households and communities, local and national coping mechanisms are more likely to be effective. This effectiveness will also be challenged, however, when a large number of extensive impacts occur, for example during an ENSO episode.

At the same time, intensive losses occur infrequently and only affect very specific areas and are more likely to be buffered by national and international assistance. In contrast, recurrent extensive losses affect wide areas on a regular basis and can lead to asset depletion and erosion, which significantly affects capacity to absorb future losses and recover.

3.7.3 Poverty, exposure and vulnerability: the uneven distribution of disaster occurrence and loss

Evidence that demonstrates that the poor are more exposed and vulnerable to natural hazards sometimes appears counter-intuitive. In some countries, the areas that experience most disasters are actually those with the most dynamic economic and urban growth or with prosperous rural economies. However, there is evidence to show that communities in poor areas lose a far higher proportion of their assets, confirming that they have far higher levels of vulnerability (Table 3.5).

Table 3.5: Summary of case study findings on the social distribution of disaster loss

Country	Findings
Burkino Faso	The 1984–1985 drought affected the poorest third of a sample of rural household's 10% more than the wealthier third: the former experienced crop-income losses of 69% versus 58% drop for the latter.
Madagascar	Tropical cyclone impacts led to a reduction of 11% in the volume of agricultural production of the poorest 20% households compared to a reduction of only 6% in the case of the richest 20%[29].
Mexico	Municipalities with the highest number of loss reports also had large percentages of their population with high or very high levels of marginality, according to an Index of Municipal Marginality developed by the National Population Council. For example, Acapulco (54.4%), Coatzocoalcos (54.1%), Juarez (45%), Tapachula (54.1%), Tijuana (31.3%) or Veracruz (31%)[30]. Municipalities with high or very high levels of marginality had high proportions of damaged and destroyed housing. In a third of these municipalities, between 10 and 25% of the housing stock was damaged or destroyed, while in another third this proportion was more than 25%. Over 20% had more than 50% of their housing stock affected. In contrast, only 8% of the housing stock was affected in municipalities with low or very low levels of marginality.
Nepal	Areas affected by floods tended to have lower poverty rates and higher per capita expenditures. Flooding incidence and impacts are concentrated in the highly productive lowland agricultural plains of the Terai belt in south-eastern Nepal. As flooding contributes to the fertility of the soil of the region, it contributes to the wealth of the area. Areas affected by landslides tend to have higher poverty and mortality rates. Landslide impacts are heavily concentrated in districts in mountainous western Nepal with marginal rain-fed agriculture and which concentrate the country's rural poverty.
Orissa, India	A statistically significant relationship was found between families living in houses with earth walls and thatch roofs (typically the housing of the poor) and those most affected by tropical cyclone, flood, fire and lightening. The incidence of extensive risk loss reports was higher in the central eastern coastal region where there are higher levels of urbanization and relatively affluent agricultural areas on floodplains and deltas. Mortality in extensive risk disasters was concentrated in the districts of Bolangir, Kalahandi and Koraput in southern Orissa, which are characterized by repeated droughts, floods, food insecurity and chronic income poverty and localized near-famine conditions.
Peru	Rural households that reported a disaster impact in 2002 on average had less access to public services, were less well integrated into the market and had a higher proportion of agricultural income.
Sri Lanka	A very strong correlation was found between the proportion of population living below the poverty line and the number of houses damaged due to floods, and a less strong but significant correlation between this population group and houses damaged due to landslides. This highlights that exposed human settlements and unsafe, vulnerable housing are poverty factors that increase the likelihood of suffering greater loss due to natural hazard.
Tamil Nadu, India	Mortality in areas with manifestations of extensive flood risk was higher in areas with vulnerable housing. Similarly, tropical cyclone housing damage was inversely related to the literacy rate. If literacy is taken to be a proxy for poverty again this indicates that the poor were more likely to suffer housing damage typically because their houses are more vulnerable or situated in more exposed locations. Mortality amongst the socially and economically excluded scheduled castes was also higher in blocks with a high proportion of vulnerable housing.

3.7.4 Disaster impacts and poverty outcomes

Disaster impacts include death, injury, acute and chronic illness, disruption of socio-economic activities and damage or destruction to property and natural resources and other physical assets. In rural areas, hazard impacts may include the loss of crops and livestock due to flood or drought with a consequent reduction in income from loss of cash crops and dairy output, or food intake from loss of staple foods. Similarly, loss of assets can affect income-producing activities, including transport, infrastructure, housing and livestock-raising; but can also lead to income or welfare reductions, for example reduced expenditure on education to fund house repair.

The effectiveness of assets to buffer household losses

If households have not lost assets these can be sold to buffer losses. However, asset prices tend to be depressed after a disaster, as many people

sell possessions at the same time, therefore compromising the effectiveness of the coping response. This is particularly the case for livestock or other possessions in remote rural areas or in conflict zones with limited access to markets. The limited success of asset-coping strategies translates into consumption or income shortfalls. The loss of a house can be particularly catastrophic, given that for many poor households it may represent the capitalized savings of multiple generations. It is often also the site of livelihood activities. House sales, however, are rare after disasters and in most cases this is a last resort strategy. Table 3.6 summarizes key findings from national cases.

Local and regional outcomes: poverty, income and consumption

The empirical evidence also confirms that disaster impacts have a direct and negative effect on welfare at the local and regional levels. Impacts may include reductions in income and consumption, an immediate increase in monetary poverty, both in terms of its depth and breadth, as well as deterioration in other welfare indicators. Table 3.7 gives examples of national case studies.

Human development outcomes: education, health and gender inequality

Disaster impacts, however, not only lead to reductions in income or consumption but can also negatively affect other aspects of human development. For example, in countries where the socio-economic status of women is low, disasters have a significant effect on the gender gap in life-expectancy given that disasters exacerbate previously existing patterns of discrimination that make women more vulnerable. Table 3.8 gives examples of national case studies.

Inequality outcomes

Disaster impacts translate into more severe poverty outcomes in poorer households, thus increasing inequality. Table 3.9 gives examples of national case studies.

Table 3.6: The effectiveness of assets to buffer household losses

Country	Findings
Burkina Faso	In a sample of rural farmers, livestock sales during the 1984–1985 drought only covered 20–30% of crop income short-falls due to rainfall deficiencies[31]. Increases in poverty occurred in the two main agro-ecological zones of the country: from 2 to 19% in the Sahelian region and from 12 to 15% in the Sudan region. Other studies, however, show livestock sales counterbalancing disaster losses: inequalities between household incomes actually fell in the Sahel, the most affected zone.
El Salvador	In the aftermath of the 2001 earthquakes, affected rural households had to sell productive assets such as animals or land, use savings or borrow, and stop or cancel planned investments in physical capital. Between 2000 and 2002 average household income per capita actually increased in El Salvador (from 5449 to 6957 colones per annum) and extreme poverty rates fell from 33.8 to 26.6%. In poor rural households affected by the earthquakes, average household income per capita was reduced by approximately one third of the pre-shock average (a reduction of 1,760 colones). Those most affected suffered higher loss of housing, productive assets (such as livestock, farm machinery) and other physical and human capital, which reduced their future earning capacity.
Ethiopia	During the 1999 drought in Ethiopia livestock herds declined by almost 40% and it was estimated that 25% of livestock reductions were distress sales where the seller received less than 50% of the normal price. In a 2004 study of Ethiopian rural households it was found that those affected by a serious drought in the last two years had consumption levels 16% lower per adult than other households, 80% of consumption being basic food[32].
Iran	Larger families suffered smaller decreases in expenditure following disaster losses in a number of provinces, notably Ardebil, Fars, Gilan, Khorasa, Kordestan, Lorestan and Tehran.
Peru	Rural families with more livestock holdings had less probability of being 'always poor'.
Zimbabwe	During the 1994–1995 drought in Zimbabwe, livestock holdings appeared to buffer drought impacts on children living in poor households[33].

Table 3.7: Summary of findings of case studies on local and regional outcomes

Country	Findings
Bolivia	A major flood in the city of Trinidad in 2006 increased poverty levels by 12% compared with pre-disaster levels. This increase was 5 times more than the national increment over the same period. A similar situation was observed with the poverty gap, which widened by more than 6%[34].
Iran	With an urban population of 69%, earthquakes affecting entire provinces are associated with most mortality (95%) and housing destruction (73%)[35]. The impact of disaster losses on the expenditure of urban households varied from province to province, according to hazard type, family size and kind of loss, including loss of life and housing damage and destruction. There were significant negative effects in Ardebil, Fars, Gilan, Golestan, Khorasa, Khuzestan and Kordestan, most of which are highly disaster prone provinces[36].
Mexico	Municipalities that reported disaster losses between 2000 and 2005 experienced a 3.6% increase in food poverty, a 3% increase in capacity poverty and a 1.5% increase in asset poverty[37]. Municipalities that reported losses associated with floods experienced an increase in food poverty of 3.5%, and with drought by 4.2%. Municipalities that reported disaster losses experienced an average reduction of 0.006 in their Human Development Index, equivalent to losing on average 2 years of human development gains over the same period: a very substantial reversal[38].

Table 3.8 Summary of findings of case studies on human development outcomes

Country	Findings
Bolivia	Following the 2006 floods in Trinidad, Bolivia, women's income fell more that that of men.
Côte d'Ivoire	In Côte d'Ivoire enrolment rates declined by about 20% between 1985 and 1988 for boys and girls in regions where rainfall deviated more than one absolute standard deviation from the historical mean, compared to regions without drought[39].
El Salvador	Following earthquakes in 2001 the probability of school enrolment for children in the most affected households decreased by 5.3%[40]. This decline was analogous to the worsening in school retention and progression in some areas of Nicaragua affected by Hurricane Mitch in 1998[41].
Ethiopia	Drought disasters (expressed through crop damage) in Ethiopia over the period 1995–1996 had a large detrimental effect on child health. Children in communities with 50% of their crop affected and aged 6–24 months at the time gained 0.9 cm less in height over a six-month period when compared to communities whose percentage of damaged crop area was 25%[42]. Evidence of short-term impacts on adults has also been found. For instance, a study on a group of 1,447 households in Ethiopia during the 1994–1995 drought found that the Body Mass Index in communities with poor rainfall and low landholdings had dropped by 0.9%[43].
Nepal	People living in areas that had been affected by floods in the past were more likely to suffer from wasting and low weight. Similarly the population in areas affected by landslides was associated with higher percentages of stunting.
Zimbabwe	Women along with young children were the most affected by the 1994–1995 drought[44]. Women's body mass fell by about 3% while no impact was found on men's health. With good rains the following year, women regained much of the lost body mass but the effects of drought on health might not always be temporary.

Long-term poverty outcomes

Short-term impacts can last a few weeks or months. Effective responses, through mechanisms such as food relief, cash transfers, microcredits, insurance and public health interventions, can all contribute to avoiding the translation of disaster impacts into poverty outcomes. The recovery of basic services such as water, sanitation and power is likewise critical. In contrast, if households and communities have few assets to buffer asset losses and if outside assistance is non-existent, late or poorly targeted, disaster impacts may lead to longer-term outcomes, particularly in the case of highly vulnerable groups such as children.

Table 3.9: Summary of findings of case studies on inequality outcomes

Country	Findings
Honduras	In 1998, Hurricane Mitch destroyed over a quarter of the household implements, tools or animals of the wealthiest 20% of households but only a tenth in the case of the poorest 20% of households. But because these latter had so few assets to start with, they experienced more severe outcomes due to hurricane losses. The poorest group lost nearly 18% of their pre-Mitch asset value and 40% of their total crop value, compared to just 3% and 25% respectively for the wealthiest group [45]. A different study showed that poorer households lost a greater percentage of their productive wealth (31%) than did wealthier households (8%) [46].
Indonesia	Following the 2005 tsunami in Aceh, a World Bank study identified two overlapping but distinct vulnerable groups: those who were structurally poor before the tsunami and those who lost assets due to the tsunami. After the tsunami, the recovery of this second group was facilitated because they retained capacities, such as their education, that facilitated recovery, which the structurally poor never had [47].
Mexico	The reduction in the HDI in those municipalities that had suffered disaster impacts was significantly greater in those that already had the lowest levels of human development.
Peru	Disasters between 2002 and 2006 had a drastic effect on the monthly per capita consumption of rural households in 2006. This impact was significantly greater in the poorest quarter of families, whose consumption was reduced by 3.85%, compared to the wealthiest quarter, whose consumption was reduced by only 1.2%.

Nutritional shortfalls in children can affect their human development later in life. Although there is evidence that children can catch up over time if they recover the lost nutrition[48], stunting is a serious problem with far-reaching consequences. Children with slow height growth are found to perform less well in school, score poorly on tests of cognitive functions and generally develop more slowly.

The permanent effects from disasters are not restricted to nutrition or health. Given the very low penetration of catastrophe insurance in rural areas in Africa, Asia and Latin America, many households have major difficulties in recovering productive assets lost in, or sold to cope with, a disaster. This means that many years after disaster rural households are still facing difficulties in recovery. When households start with very few physical assets, for example, livestock in a rural context, recovery is challenged.

Finally, it is clear that successive disaster impacts seriously undermine coping strategies[49]. This is particularly critical in areas exposed to multiple hazards or to recurring drought or flood. Table 3.10 presents key findings in the above contexts.

Table 3.10: Summary of findings from long-term effects of disasters

Country	Findings
Bangladesh	Improved targeting of assistance to the poor and the positive impact of food assistance after the 1998 floods meant that per capita consumption actually increased in the case of households whose head had less than four years of schooling and with less than median assets [50]. The 1998 floods had a lower impact on the affected population than the 1988 floods, even though the 1998 floods were of a considerably longer duration in most places. One of the reasons for this was that previous to 1988 there had been two major floods, in 1984 and 1987, which undoubtedly left many poorer households in a precarious situation and unable to recover their pre-disaster situation before the next disaster occurred [51].
Ethiopia	Children between the womb and 36 months of age at the time of the 1984 drought-induced famine in Ethiopia and living in drought shock villages were almost 3 cm shorter ten years after the disaster than their non-affected counterparts [52]. Ten years after the famines in Ethiopia in the mid-1980s, cattle holdings in asset-poor households were still only two-thirds what they were just before the famine [53]. Households that had most difficulty in coping with the droughts of the mid-1980s had about 4–16% lower growth between 1994 and 1997 – on average a period of substantial recovery of food consumption and nutrition levels [54].

Table 3.10 (continued): Summary of findings from long-term effects of disasters

Country	Findings
Honduras	Households without asset losses in the aftermath of Hurricane Mitch showed substantially higher growth 30 months later than those that suffered losses. Amongst the poorest quarter of households, those who had suffered losses had experienced growth of –5% by 2001 while those that hadn't experienced growth of 8.8%: a gap of 13.8%. This gap was much smaller (5.1%) in the case of wealthier quartile of households[55].
Indonesia	Poverty increased only slightly after the tsunami, probably reflecting the influx of humanitarian assistance compensating for losses. Since 2006, poverty has declined below pre-tsunami levels facilitated by reconstruction activities and the end of the conflict. At the household level, the receipt of government and non-government organization (NGO) aid increased the likelihood of escaping from poverty by 43% and 23%, respectively.
India (Maharashtra and Andhra Pradesh)	The proportion of households experiencing longer (3–5 year) spells of poverty increased from 5.5% to 14.8% in the case of households that had experienced crop losses due to deficient or delayed rainfall[56]. When crop shocks occur in three consecutive years there is an increase in the proportion of 'always poor' (6–7 years). Even relatively affluent households (i.e. owning large amounts of land, possessing a few years of education and affiliated to upper castes) are highly vulnerable to persistent poverty under consecutive droughts.
Iran	Housing damage and destruction had a positive impact on consumption in a number of provinces including Khuzestan (climatic disasters), Kerman and Lorestan due to assistance in recovery and reconstruction by the government.
Nicaragua	Households that experienced a drought between 1998 and 2001 had 10–15% more probability of a downward welfare trajectory, with a 10% higher probability of remaining at the bottom of the welfare distribution in 2005[57].
Peru	Between 2004 and 2005 households that experienced a disaster in those years were up to 4.6 times more likely to be 'always poor' than 'never poor'.
Zimbabwe	Coping actions in the 1991–1992 drought, the worst in living memory, both by households themselves as well as by the public sector were limited by the demands placed on such mechanisms by previous droughts in 1982–1984 and 1986–1987. Food consumption fell in spite of the variety of smoothing mechanisms employed by households and government. Quite dramatic negative impacts were found in a group of 400 households if nutritional deficiencies occur in children between the womb and about 2 years of age. In this case, temporary poor health and malnutrition during the drought lead to stunting, lower school achievement and levels of attainment later in life, as well as lower health and lower wages and productivity as adults. Sixteen years after the 1982–1984 droughts the affected children had 7% lower adult earnings than those not affected by the drought[58].

Endnotes

1 According to the political–administrative division of each country these are second or third tier administrative levels: for example the District in Peru; the Block in India and the Municipality in Colombia.

2 The Peru database covers the time period 1970–2006; the Mexico database covers the time period 1980–2006; and the Tamil Nadu database 1976–2007.

3 DesInventar: http://gar-isdr.desinventar.net/DesInventar/main.jsp

4 Floods, flash floods, urban floods, rains, fires, forest fires, mudslides, avalanches, landslides, tropical cyclones, storms, gales, strong winds, hailstorms, tornados, electric storms, lightning, thunderstorms, droughts, heat waves, cold waves, frost, snowstorms.

5 Earthquakes, tsunamis and volcanic eruptions are considered as geological hazards in the analysis that follows. Landslides may be either geological or weather-related and are often both. For the purposes of this report they have been classified as weather-related, although recognizing that many are related to earthquake occurrence.

6 Case studies on Bolivia, Ecuador, El Salvador, India, Iran, Mexico, Nepal, Peru and Sri Lanka were commissioned specially for this report by UNDP. Additional case study material was contributed by the World Bank on Indonesia and by SOPAC (Pacific Islands Applied Geoscience Commission) on Fiji.

7 In Japan, the threshold above which flood mortality increases has been calculated at 1,000 inundated buildings by Zhai, et al., 2006. Clearly this threshold will be different in other countries but suggests that in general extensive flood disasters are unlikely to cause major mortality.

8 Costs normalized using as a baseline the Indice de Precios de la Construccion, 2003 (Mansilla, 2008a) on the basis of an average sized social house of 42 m^2 and an average construction cost per m^2 of US$ 400.

9 In general post-disaster damage and loss assessments use a methodology developed by the Economic Commission for Latin America and the Caribbean (ECLAC), 2003.
10 Red Cross/Red Crescent Emergency Responses in 2004–2009, personal communication from IFRC, Disaster Information Senior Officer, Geneva, 12/02/2009.
11 UNEP GEO Data, 1970–2010 5-year average: http://geodata.grid.unep.ch
12 Office of the Registrar General and Census Commissioner, 2001
13 Office of the Registrar General and Census Commissioner, 2001
14 For example, see Figures 3.3 for Sri Lanka and 3.6 for Tamil Nadu
15 In some disaster databases, such as that of Colombia, systematic government reporting has contributed additional reports since the 1990s. The Peruvian Government has implemented, since January 2003, a new decentralized system for monthly reports of natural hazards at the local level.
16 Glave et al., 2008
17 IPCC, 2007b – see Chapter 2.1.4.
18 GPCC, 2008
19 Mansilla, 2008b
20 Contribution from the UN Institute for Training and Research (UNITAR) Operational Satellite Applications Programme (UNOSAT).
21 Action Aid International, 2006
22 Action Aid International, 2006
23 Acho-Chi, 1998
24 Diagne, 2007
25 Contribution from UNOSAT/UNITAR.
26 Office of the Registrar General and Census Commissioner, 2005
27 Fuente and Dercon, 2008; Dercon and Christiaensen, 2007
28 Fuente and Dercon, 2008
29 Randrianarisoa and Minten, 2003, as quoted in Fuente and Dercon, 2008
30 Mansilla, 2008a; Mansilla, 2008c
31 Fafchamps et al., 1998
32 Fafchamps et al., 1998
33 Hoddinott and Kinsey, 2001
34 Rada and Fernández, 2008
35 Given this pattern of major earthquakes affecting entire provinces and their urban centres, it was possible to identify correlations between disaster impacts and decreased household expenditure at a high provincial level of spatial aggregation.
36 Government of the Islamic Republic of Iran and UNDP Iran, 2009.
37 The Government of Mexico defined these three official poverty lines (food, capacity and asset poverty). Food poverty takes into account the population without enough income to buy a basic food basket. Capacity poverty considers the population without enough income to simultaneously satisfy their needs for food, health and education. Asset poverty considers the population without enough income to satisfy food, health, education, shelter, public transport, clothing and footwear needs.
38 Rodriguez-Oreggia et al., 2008
39 Jensen, 2000
40 Baez and Santos, 2008
41 Ureta, 2005
42 Yamano, et al., 2005
43 Dercon and Krishnan, 2000
44 Hoddinott, 2006
45 Morris and Wodon, 2003
46 Carter, et al., 2006
47 World Bank, 2008b
48 Dercon, et al., 2005
49 Deaton, 1992; Dercon, 2002
50 Quisumbing, 2005; 2007
51 Beck, 2005
52 Porter, 2008
53 Dercon, 2002
54 Dercon, 2004
55 Carter, et al., 2006
56 Gaiha and Imai, 2003
57 Premand and Vakis, 2009
58 Porter, 2008

Chapter 4

The heart of the matter: the underlying risk drivers

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Introduction

This chapter explores three underlying drivers of the disaster risk–poverty nexus: vulnerable rural livelihoods, poor urban governance and declining ecosystems. Additionally the chapter looks at the magnifying effect of climate change as a global driver of risk.

Summary of findings

1. Vulnerable rural livelihoods

Livelihood vulnerability is an underlying driver of disaster risk in many rural areas. Poverty and constrained access to productive assets mean that rural livelihoods that depend on agriculture and other natural resources are vulnerable to even slight variations in weather and seasonality. This vulnerability is accentuated by factors such as unequal land distribution, weakly developed markets and trade barriers. Very low resilience means that even small disaster impacts are translated into poverty outcomes. Resilience is further undermined by the impacts of other hazards such as conflict and HIV/AIDS.

2. Poor urban and local governance

Most cities in developing countries have only been able to absorb urban growth through the expansion of informal settlements. The location of such settlements in hazard prone areas, the vulnerability of housing and local services and the lack of provision of the infrastructure necessary to reduce hazard configure urban disaster risk. Poverty limits the capacity of many households in such cities to gain access to well-sited land and safe housing. However, the translation of poverty into risk is conditioned by the capacity of urban and local governments to plan and regulate urban development, enable access to safe land and provide hazard mitigating infrastructure and protection for poor households.

3. Ecosystem decline

Ecosystems have a declining capacity to provide both provisioning and regulating services in both rural and urban areas. Ecosystem decline increases hazard levels at the same time as it decreases resilience, acting as a third underlying risk driver.

4. Climate change

Climate change will have an asymmetric impact on disaster risk, magnifying its already disproportionate impact on the rural and urban poor. The interactions of climate change with hazard levels; exposure, vulnerability and resilience are mediated by the underlying drivers that translate poverty into disaster risk, such as vulnerable rural livelihoods, poor urban and local governance, and declining ecosystems. If the underlying drivers of risk are addressed then climate change impacts could also be addressed.

4.1 Rural livelihoods

Approximately 75% of the people living below the international poverty line of US$ 1.25 per day live and work in rural areas [1]: 268 million in sub-Saharan Africa; 223 million in East Asia and the Pacific, and 394 million in South Asia alone. Even in countries experiencing rapid economic development, such as China, there are 175 million rural dwellers below this poverty line. Rural poverty, therefore, not only characterizes least developed countries in regions such as sub-Saharan Africa, but also stagnating rural areas in countries that are developing rapidly [2].

In such contexts, disaster risk is associated with livelihoods unable to sustain minimum levels of welfare and which are often exposed and vulnerable to even minor weather variations. In poor rural areas, as demonstrated by the empirical evidence presented in Section 3.7, disaster impacts are then translated into both short-term and long-term poverty outcomes, which in turn

increase vulnerability and decrease resilience to future disaster losses. Disaster losses affect huge numbers of people in poor rural areas. In sub-Saharan Africa, during the 2001–2003 drought, it was estimated that 206 million people, or 32% of the region's population, were undernourished – a little less than the total 268 million rural poor in the region [3].

Poor rural areas, particularly isolated and remote regions, are often characterized by highly vulnerable housing, weak or non-existent emergency services and infrastructure (including health services and disaster preparedness and response organizations), as well as isolation and remoteness. Densely populated but poor rural areas, exposed to tropical cyclones, major floods and earthquakes, therefore have a very high mortality risk, as was documented in Chapter 2.

4.1.1 Rural livelihoods and poverty

In many rural areas across developing countries, people's livelihoods still depend heavily on agriculture and other natural resources. Rural farm-based livelihoods are generally characterized by low input and low output agriculture due to limited access to productive assets such as land, labour, fertilizers, irrigation, infrastructure and financial services. For households without the minimum assets necessary to support a viable livelihood, the result is poverty.

Without access to the necessary inputs, poor households harvest extremely low yields. Low crop yields result in low incomes and chronic food insecurity, leaving many rural households close to the poverty line. For example, average maize yields in Malawi are only one tenth of yields in the United States of America [4]. Opportunities for processing and adding value to agricultural production are also often limited, due to asset constraints, trade barriers and poor market access.

Economic poverty in rural areas is usually underpinned by a range of other factors including: lack of political participation; scant or non-existent provision of health and education services; geographical isolation or marginalization; discrimination and exclusion due to caste, race, gender or ethnicity; and the migration of the young to cities. Such factors often influence access to infrastructure, health and education, and either obliquely or directly determine economic entitlements. Economic poverty and lack of entitlements then reiterate these other poverty factors, which in turn further limit access to assets.

Livelihoods in rural areas are further limited by a lack of economic diversification, thin markets and weak and costly mechanisms of exchange. This exposes rural producers to price swings in response to local variations in production, that can drastically reduce the income that can be obtained from harvests and may encourage a risk-averse preference for subsistence rather than market-based agriculture. The strength of markets tends to be inversely related to their distance from urban centres. Remote rural areas are more likely to have imperfect or missing markets than those closer to urban centres, often due to a lack of access to decent roads [5]. Conversely, rural areas with strong urban networks have deeper markets and a more intense exchange of commodities and services, leading to enhanced livelihood opportunities.

Rural livelihoods are also subject to the operation of national and global markets for agricultural products. Some countries open domestic markets for imported food, which keeps prices low for urban consumers, while others protect national production through import tariffs. This affects rural households differentially, according to whether they are net producers or consumers of food. Import tariffs and subsidies to agricultural production in developed countries likewise have drastic impacts on rural livelihoods in developing countries. Box 4.1 illustrates how a food crisis in Niger was conditioned by the operation of markets.

In the light of all the above factors, and in the absence of formalized microfinance institutions in many countries, poor rural households are often forced into taking loans from money lenders at very high rates of interest. In India, close to 50% of farm households are indebted to a level that could thwart their long-term livelihood security [9]. In several Latin

Box 4.1: Niger food crises[6]

The 2005 Niger food crisis is an extreme manifestation of how structural problems and negative socio-economic conditions in countries such as Niger can create a risk nexus in the region.

Food production records for 2005 show a cereal shortfall of 9% or 250,000 tonnes in Niger mainly due to drought and locust infestations in 2004–2005. According to Oxfam, the Niger 2004 harvest was, in fact, not the lowest the country experienced in past years. It was only 11% below the 5-year average and food was available in the region during the crisis.

However, cereal shortage increased to about 16% due to a fall in purchasing capacity, especially among agropastoral populations who were isolated from trading networks and highly dependent on cereal traders especially near the Nigerian border. Weak socio-economic and political structures underpinned the very high vulnerability of these particular groups who were worst affected[7]. High market prices and increasing poverty (which increased from 40% of the population below poverty line in 1990 to 66% in 2004) provoked the food crisis in Niger, even though food was available for purchase.

Eventually, some 12 million people needed food aid in Niger and the surrounding region, with about 800,000 children affected[8].

American countries access to formal credit is only half as common in rural areas as in urban areas, while in Pakistan and in Cameroon less than 5% of the amount borrowed by poor rural households is obtained from formal lenders. Indebtedness further constrains access to assets, entrenching poverty [10].

4.1.2 High exposure and vulnerability to weather-related hazards and low resilience to loss

Agricultural livelihoods are highly sensitive to weather irregularities associated with seasonality per se. Even a brief break in rains at a key stage of the growing cycle can spell significant harvest loss. Localized weather-related hazards such as storms, frosts, floods, heat waves, cold spells and minor droughts can mean the loss of an entire harvest. Major drought events can destroy agricultural production and livestock over wide areas for several years.

Poor rural households are often disproportionately exposed to weather-related hazards. Historical patterns of land distribution and land tenure tend to discriminate against the poor who may only have access to marginal and unproductive land including areas prone to flooding, with erratic or minimum rainfall or with poor soil. Patterns of rural land distribution remain highly unequal in many regions, particularly in Latin America.

At the same time, poor rural households are more vulnerable. For example, they usually do not have access to improved seeds, irrigation technology and other inputs that can reduce the vulnerability of crops to drought, and are often dependent on rain-fed agriculture, which is far more sensitive to even small variations in weather than irrigated agriculture. Household dependence on a single main harvest for most annual requirements of food and income further increases vulnerability.

Poor and indebted households also have little or no surplus capacity to absorb crop or livestock income losses and to recover. They thus have very low resilience to even the smallest weather irregularity or hazard impact. A small loss in income may be devastating and set off a ratchet effect that feeds back into further poverty and future vulnerability, due to a lack of asset reserves, the absence of other income earning opportunities, and the non-existence of economic and social safety-nets.

Even in good rainfall years, the annual hungry season in rural areas can last for several months, characterized by high food prices, hunger, malnutrition and debilitating diseases such as diarrhoea and malaria. There are few employment opportunities; most available work is low-paid agricultural labour, which can only be undertaken at the cost of neglecting the household's own farm, again setting up a poverty ratchet effect of low-yielding harvests, working on neighbours' farms for food and further under-production in future years.

4.1.3 Disaster losses feeding back into poverty

Livelihood strategies to minimize risks include diversifying livelihoods to spread risk, farming in different ecological niches [11] and building social networks that pool risk. However, many such strategies are simply short-term responses to poverty and food insecurity that may exacerbate and increase poverty and reduce human development in the longer term. For example, farmers with insecure land tenure do not invest in land improvement. Families with limited access to formal employment prefer to send their children to work rather than to school. Entrepreneurs without access to microfinance or insurance do not undertake potentially lucrative, but high risk activities.

Box 4.2: Risk averse livelihood strategies

Farmers in rural Ethiopia between 1994 and 1999 were less likely to invest in fertilizer in drought prone areas, because the investment would be lost if the harvest failed due to drought [12]. However, without fertilizer productivity is very low, constraining the capacity of farmers to accumulate sufficient assets to absorb loss when a drought occurs. It was estimated that fertilizer application rates would have been 43% higher if variations in village level rainfall during this period were reduced by one standard deviation.

Livestock often act as a 'liquid asset', permitting their owners to undertake other, more risky, activities. A study in drought prone areas of Tanzania showed that livestock-poor households tended to grow sweet potatoes more than any other crop because it is drought resistant, despite the fact that its returns per hectare are about 25% less than sorghum, maize or cotton. In contrast, a household with an average number of livestock would have 20% less land allocated to sweet potatoes than a household with no liquid assets. As a consequence, the crop portfolio of the richest quintile yields 25% more per adult than that of the poorest quintile.

In Zimbabwe it was also found that exposure to hazards reduces growth, which in turn reduces the capital stock across households by 46%. Two-thirds of this loss was due to ex ante strategies by which households try to minimize the impact of risk (for example, by building up livestock holdings to cope with consumption risk) [13].

As Box 4.2 shows, households may concentrate on low risk and diversified activities, foregoing higher returns from specialization. For example, a shift from cash crops to subsistence farming, and from labour-intensive to less intensive but less profitable crops may reduce short-term risk but may exacerbate longer-term food availability and access, due to reduced production and income [14].

Furthermore, faced with scarcity, poor households may have to adopt depleting coping strategies, such as overgrazing, deforestation or unsustainable extraction of water resources that in the long-term magnify hazard levels and further aggravate disaster risk.

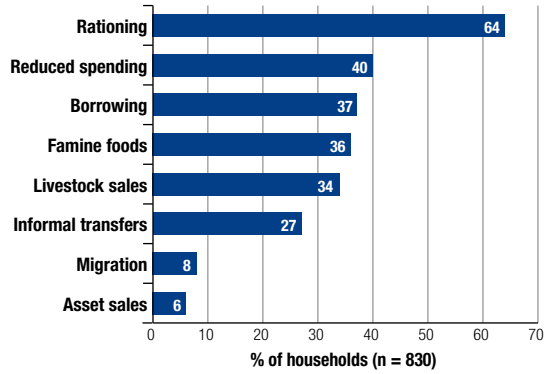
When such mechanisms fail, for example during an intensive drought event, households become acutely vulnerable to even minor losses. As Figure 4.1 shows, ex post coping typically follows a predictable and logical sequence, starting with strategies that are easily reversed, such as a mild reduction in food consumption, cutting back on non-essential spending or selling surplus livestock to buy food. These are followed by higher cost strategies that are less easily reversed, such as selling breeding livestock, borrowing at high interest rates or begging from friends and neighbours, with high social costs in terms of lost status and self-respect. Once these strategies are exhausted, families must sell their key productive assets (such as land) and migrate to survive.

As the empirical cases presented in Section 3.7 show, in general terms, households with more assets are less vulnerable because assets provide buffers against disaster loss. These include not only physical assets, such as land and livestock, but also financial assets like savings; human capital assets such as marketable skills; or social capital assets such as networks of influential friends [16]. For example, rural families that own many livestock can sell some animals to buy food if a drought devastates their harvest. The relationship between vulnerability and assets, however, is often not so simple. Intensive disasters may destroy all assets, reducing the value of asset buffers.

Converting future streams of income to buy food may ensure short-term survival but

Figure 4.1: Coping strategies during a drought in Namibia, 1992 [15]

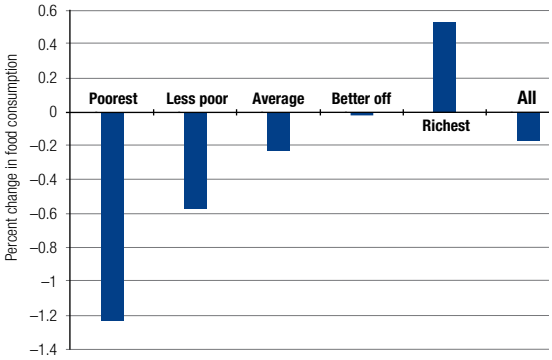
Source: Sabates-Wheeler, et al., 2008.



ultimately decreases livelihood viability and increases long-term poverty and disaster risk. Rather than coping strategies, they could perhaps be better characterized as a failure to cope with disaster risk, with far-reaching and damaging effects on other activities and asset holdings. Over time, repeated disasters have a poverty ratchet effect on increasingly weakened livelihoods, steadily undermining the ability to recover and pushing rural households further towards chronic poverty and deprivation. Again as highlighted by the empirical evidence presented in Section 3.7, pastoralists, in particular, take much longer to recover from asset depletion than crop farmers, as they depend on reproductive capital, which once eliminated takes a long period of time to recover. In the case of repeated droughts, pastoralists do not have time to recover before another event occurs [17].

Figure 4.2: Projected effect of a 10% increase in maize prices on the welfare of different wealth groups in rural Malawi

Source: FAO, 2008b



Distress sales of assets also act as poverty ratchets, with irrecoverable losses of productive resources, locking people into poverty traps from which they cannot escape without external support. For example, during the food crisis in Malawi in 2002, desperate rural families sold off their most valuable possessions such as livestock, radios, cooking utensils and furniture at distress prices of less than half their replacement cost [18]. This further polarizes rural societies because it enables wealthy households to accumulate assets at undervalued prices.

Households may be forced into selling some of their food production at low prices after harvest to meet urgent cash needs, only to buy this food back later in the year at two or three times the selling price in order to bridge the consumption gap before the next harvest. Surplus producers benefit from price rises because their income from crop sales increases but deficit producers are impoverished by having to buy food at high prices.

This issue is illustrated by Figure 4.2, which projects the effect of a 10% increase in maize prices on the welfare of different wealth groups in rural Malawi [19].

While such seasonal price variations are normal in tropical agriculture, they are magnified following disaster losses. If food is scarce and rural households are forced into selling assets to finance food purchases, usually food prices are forced up while asset prices are forced down. In intensive drought disasters that can affect entire regions over several years, the coping mechanism breaks down completely as households have no more assets to sell and food is not simply overpriced, but generally unavailable.

In many rural contexts, the loss of production and income due to weather irregularities is only one, and not necessarily the most important, of a number of risks. Households are often faced with other hazards such as market shocks, health risks including malaria, HIV/AIDS and diarrhoeal diseases, and conflict: these configure scenarios of compound risk, where the impact of one hazard increases vulnerability to another. Disaster impacts are magnified in households where resilience has been heavily reduced by these other hazards. In such multi-hazard scenarios, it

is difficult to attribute risk outcomes such as malnutrition, illness or mortality to a specific hazard, as the outcome is the result of a deadly interplay between the range of hazards and vulnerabilities over time. The impact of these other hazards is examined in Appendix 2, Note 2.3.

4.1.4 Non-farm income and social protection

Household and community-level coping strategies are increasingly supported by non-farm income. At present, non-farm activities provide up to 42% of rural household income and employ up to one third of the rural labour force in the developing world. Sources of non-farm income include agroprocessing, other manufacturing, trade and transport, construction, finance and personal services, and remittances. These latter now account for a large share of non-farm income in many countries [20]. Migration, both seasonal and more permanent, is another key coping strategy as it allows those household members who migrated to provide income to those who remain. For example, seasonal migration in Bangladesh has always been employed by poor rural households as a strategy to maintain livelihoods and cope with drought [21].

In addition, there is growing evidence, from South Asia in particular, that financial assistance from government and local institutions (see Box 4.3), such as NGOs, is becoming more widely available to strengthen rural livelihoods, including microfinance schemes and social protection measures [22]. When such schemes are available, rural households are less likely to reduce food intake or dispose of productive assets as coping mechanisms.

For example, decades before cash-for-work became a popular relief exercise, the Indian Government adopted a drought relief programme for rural communities affected by seasonal droughts. This gave them alternative seasonal employment in construction or other services with the aim of assuring a minimum wage for poor households in times of rural distress.

Subsidies towards or exemptions from fees for state services is another common channel of social assistance in low-income countries, as are programmes which target cash or in-kind benefits to children in school (e.g. the Bangladesh Food-For-Education or the Brazilian Bolsa Escola programmes). The effective application of exemption from user fees on the basis of poverty criteria is, like other forms of social assistance, a major administrative challenge – and the experience in the health field in poor countries is not always encouraging [24].

Similarly, as will be discussed in Chapter 6, financial mechanisms to increase resilience, such as microcredit and index-based crop insurance, are now becoming more widely available to rural households in many countries [25].

4.1.5 Disaster mortality risk in poor rural areas

The high structural vulnerability of housing, schools, infrastructure and other assets in poor rural areas exposed to floods, tropical cyclones and earthquakes is a direct consequence of rural poverty. Rural housing is usually built with local

Box 4.3: National Rural Employment Guarantee Programme (NREGP), India [23]

The National Rural Employment Guarantee Act was notified on 7 September 2005 with the aim of reinforcing the Indian State's commitment to livelihood security in rural areas. The programme is significant in that it creates a rights-based framework for wage employment programmes and makes the government legally bound to provide employment to those who seek it. The National Rural Employment Guarantee Programme (NREGP) marks a paradigm shift from previous wage employment programmes by providing a statutory guarantee of wage employment. The objective of the NREGP is to enhance the livelihood security of people in rural areas by guaranteeing 100 days of wage employment per financial year to any rural household whose members volunteer to do unskilled manual work. The Act further aims to create durable assets and strengthen the livelihood resource base of the rural poor.

The choice of works suggested in the Act address the causes of chronic poverty such as drought, deforestation, soil erosion, etc., so that the process of employment generation is on a sustainable basis. The experience with NREGP so far suggests that it is one of the main planks of rapid poverty reduction in India's Eleventh Five Year Plan.

materials and labour, but crucially with building techniques that do not provide hazard resistance. The collapse of heavy earth walls in rural housing in Kashmir in the 2005 earthquake and the lack of protection offered by flimsy bamboo and thatch houses in the 2008 Myanmar tropical cyclone, contributed to the massive mortality in both cases. The isolation of many poor rural areas combined with under-investment by government in infrastructure, such as roads, educational or health facilities, or in disaster preparedness and response capacities, further increases asset and mortality risk. For example, as highlighted in Chapter 2, mortality risk to floods is highest in remote rural areas in poor countries. High mortality risk in such areas is a direct consequence of an absence of development.

The direct economic cost of asset loss in rural areas may be very low, precisely because of the low monetary value and scarcity of rural assets and under-investment in infrastructure and services. The replacement of assets such as houses may be less of a challenge than in urban areas, precisely because so many of the inputs are non-monetary. However, the apparent rapidity of recovery is deceptive. Large-scale mortality and injury and the loss of livestock and household possessions can devastate rural livelihoods, feeding back into increased poverty and vulnerability in the face of more frequently occurring localized weather events.

Case studies from Pakistan (see Box 4.4) and Myanmar (see Box 4.5) illustrate how poor rural livelihoods in remote areas configure mortality risk for earthquakes and tropical cyclones.

Box 4.4: Earthquake impacts in rural Kashmir, Pakistan[26]

In 2005, the Kashmir region in Pakistan experienced an earthquake of 7.6 magnitude. Four districts – Bagh, Muzafarabad, Neelum and Rawlakot – in the Kashmir region were affected by the disaster. The earthquake killed over 46,500 people, while 33,489 were injured. Around 329,600 houses collapsed, which resulted in displacement of over 2 million people.

Casualties and injuries in the region were attributed to the collapse of poor quality, single storey, un-reinforced stone masonry buildings and reinforced concrete frame school buildings. The stone masonry walls consisted of irregularly placed undressed and mostly rounded stones that were laid in mud mortar or even dry in some cases. It was observed that local people did not have knowledge about earthquake resilient construction technologies, the cost of which was beyond the capacity of the majority.

Kashmir is a predominantly rural society, with the majority living in small settlements on mountain sides. The rural economy mainly depends upon agriculture and livestock rearing. There is no irrigation system and the crops are mainly rain-fed. Some households have orchards of fruit trees, such as apple and almond. The little income that people have from crops and orchards is barely enough for their subsistence. People do not have savings to use on improving their living or housing standards or to develop other income generating ventures. The second key source of income is remittances from migrants. In the earthquake affected area of Northern Kashmir, skilled people from the region migrate in search of better opportunities. Those left behind are mainly the unskilled, illiterate, women and the elderly. They are dependent for their survival upon remittances and are responsible for taking day-to-day decisions, such as about the construction of a house. Most of the mountainous settlements are not connected to paved roads and transport to and from cities is scarce. Given the geography of the region and the lack of proper road infrastructure, it is extremely difficult for people to bring in construction materials such as steel, bricks and cement from outside even if they could afford it.

In this scenario it is unrealistic to expect safer construction practices in Kashmir. In the aftermath of the earthquake, the Earthquake Reconstruction and Rehabilitation Authority, in collaboration with the National Society of Earthquake Technology, have trained thousands of masons in safer construction practices. However, since local people cannot afford the higher wages demanded by the trained masons, many have left for cities, such as Karachi, where they are better paid. This indicates the difficulty of promoting earthquake safety in Kashmir until development conditions such as income, education and road networks are improved.

Box 4.5: Tropical cyclone Nargis in the delta region of Myanmar[27]

Tropical cyclone Nargis was the worst disaster in the recorded history of Myanmar and the sheer magnitude of devastation typifies how lack of development configures disaster risk. On the 2nd and 3rd May 2008, the Ayeyarwady Delta region of Myanmar was battered by the tropical cyclone. Official government figures put the number of dead or missing at more than 130,000. About 2.4 million people were severely affected out of a total of 4.7 million people living in the affected areas.

During the Village Tract Assessment (VTA) carried out under the Post-Nargis Joint Assessment, more than a quarter of those interviewed at the community level cited late or incomplete warning as one of the primary reasons for widespread destruction. At the same time, Myanmar's Department of Meteorology and Hydrology indicates that it was continuously tracking the tropical cyclone and issued timely warnings of an impending landfall. However, the warning never reached the communities at risk. Delta residents can only access one radio channel and most residents do not even have a radio let alone money for expensive batteries since the electricity supply broke down. As a result, on the eve of the tropical cyclone making landfall in the delta, most residents were asleep when the last warning was issued on national radio.

More than 75% of those interviewed by the VTA cited weak buildings, particularly houses, as the primary cause of the widespread destruction. More than 80% of rural houses were made of poorly constructed wattle-and-daub walls (a coarse wooden lattice covered with clay) and thatch roofs providing barely adequate protection during normal monsoon months. More robust forms of construction, using brick, cement and steel and better building skills, have not penetrated the rural areas of the Ayeyarwady Delta.

The State plays a negligible role in the day-to-day life of most rural communities in the Delta. Even in a highly centralized system of governance and decision-making, the presence of the State below the township/district level is minimal. Communities rely on themselves for almost all the basic services – water supply, transport, health and basic agricultural extension services – and have devised their own coping mechanisms including rainwater harvesting and community managed seed banks and systems for production of building materials. These coping mechanisms have served them well in the cases of small- and medium-scale events that occur every three to five years. But a large-scale event like Nargis overwhelmed these community-level systems.

The unique development assistance context of Myanmar has meant that support is targeted almost exclusively at the lowest income households. While this has kept the targeted households just above the subsistence level, local small enterprises – such as rice mills that employ up to 50 workers each – are outside the net of most assistance. As a result, local economies have not developed resilience to absorb shocks from major natural hazards. In such a context, a discussion on disaster reduction – whether community-based or focused on country-wide system building – that is divorced from local development issues and resilience of rural livelihoods seems superfluous.

4.2 Urban and local governance, poverty and disaster risk

People, poverty and disaster risk are increasingly concentrated in cities. By 2008, over half the world's population was living in urban areas. Since 1950, the urban population of low- and middle-income nations has increased sevenfold. By 2010, it is projected that 73% of the world's urban population and most of its largest cities will be in low- and middle-income nations[28]. In Asia, 43% of the population (or 1,770 million people) will be urban; 79.4% (or 471 million people) in Latin America and the Caribbean, and 40% (or 412 million people) in Africa. Almost all global population growth until 2025 will be in urban areas in these regions[29]. How this large and rapid increase in urban population is governed will have major implications as to whether disaster risk can be reduced.

In 2000, it was estimated that there were 258 million urban poor[30]. However, as poverty becomes urbanized, the structure of household income and consumption changes dramatically. The proportion of income spent on housing, water, sanitation, health care, education and transport increases. The use of a US$ 1.25

poverty line disguises the real dimension of urban poverty, given the high monetary costs of non-food necessities. If poverty includes all those with insufficient income to cover basic needs and who are either homeless or live in poor quality, overcrowded and often illegal accommodation, at least 900 million urban dwellers were poor in 2000. Similarly, at least 900 million urban dwellers lack protection from common life- and health-threatening diseases and injuries[31].

Chapters 2 and 3 highlighted two concatenated processes through which the urban poor become prone to disaster risk. On the one hand, urban and economic development expanding *outwards* generates new patterns of extensive risk, associated mainly with flooding and other weather-related hazards and affecting informal settlements on the periphery of large cities, as well as those in small and medium urban centres. At the same time, as cities grow and develop there is an *inward* concentration, or intensification of disaster risk, associated mainly with earthquakes, tropical cyclones, floods and other major hazards and that causes major asset loss and mortality amongst the urban poor. In both processes, the damage to and destruction of assets, such as housing and local infrastructure, negatively impact the urban poor. For many poor households, houses are assets that not only represent the pooling of inter-generational savings, but also provide a base for livelihood activities.

The following section explores how poor urban and local governance in many rapidly urbanizing contexts is the underlying risk factor that shapes both these processes. Urban and local governance influences not only how and where cities develop, but in particular, whether the urban poor have access to safe land, housing and the essential infrastructure and services required to live in security.

4.2.1 From poverty to risk

Urbanization, understood as an increasing proportion of a nation's population living in urban centres, is strongly associated with economic growth. By 1940 more than half of global GDP was generated by industry and services. Currently this figure is 97%. By 1980 more than half the global labour force was working in industry and services, a figure that now stands at 65%[32]. The nations with the wealthiest economies are all heavily urbanized. Unless they are already predominantly urban, those with the fastest growing economies are urbanizing most rapidly. Nations with stagnant economies are generally those that are urbanizing least. There is also an economic logic to the location of large cities and where rapid city growth takes place; globally and within each continent, the largest cities are heavily concentrated in the largest economies[33].

Cities in low- and middle-income nations concentrate a large proportion of global urban poverty because their economic base does not generate sufficient employment and livelihoods to sustain a rapidly growing population. There are no precise figures on urban poverty because many aspects are not measured. Most poor urban households derive most or all their income from work in the informal economy for which there are no income data, while many poverty lines are set without data on the costs of non-food necessities[34]. If allowance is made for the cost of non-food necessities, it is common for 35–60% of the urban population in low- and middle-income countries to have incomes below the poverty line. Table 4.1 provides estimates for different aspects of poverty in low- and middle-income nations.

Cities in high-income countries typically have a life expectancy of 75–85 years, under-five mortality rates of less than 10 per 1,000 live births, no informal settlements and close to 100% coverage of water, sanitation and health services. In contrast, cities in least developed and low-income countries, particularly in sub-Saharan Africa and the poorer parts of Asia, often have an average life expectancy of only 40–55 years, under-five mortality rates of 80–160 per 1,000 live births, 40–70% of their population in informal settlements, and low levels of access to water, sanitation and health services. Within informal settlements in poor cities, these figures are usually higher still. For example, in Nairobi, under-five mortality rates were 150 per 1,000 live births in informal settlements but only 61.5 for the city as a whole[39]. Urban poverty is associated with a range of everyday risks including the

Table 4.1: Estimates for the scale of different aspects of urban poverty in low- and middle-income nations

Type of poverty	Numbers of urban dwellers affected	Notes
Inadequate income in relation to the cost of basic needs	750–1,100 million	No accurate figures are available on this and the total varies depending on the criteria used to set the poverty line (the 'income-level' required for 'basic needs')[35].
Inadequate or no provision for safe, sufficient water and sanitation	More than 680 million for water and 850 million or more for sanitation	These are estimates for 2000, drawn from a detailed global UN review of individual city/urban studies[36]. They differ from the official WHO/UNICEF statistics; however, these official statistics recognize that they are not measuring the proportion of people with access to adequate provision.
Under-nutrition	150–200 million	In many Asian and sub-Saharan African nations, 25–40% of urban children are underweight.
Living in housing that is overcrowded, insecure and/or of poor quality	924 million	Based on a global UN review of the proportion of people living in 'slums' in 2000[37].
Homelessness (i.e. living on the street or sleeping in open or public places)	Approximately 100 million	UN estimate[38]. There are also large numbers of people living on temporary sites (for instance construction workers and often their families living on construction sites) that are close to homeless.

impacts of house fires, traffic accidents, pollution and domestic and occupational accidents. These losses feed back into increased poverty and decreased resilience to disaster risk.

Informal settlement, inadequate housing, non-existent services and poor health, are reflections of poverty. However, they are also reflections of weaknesses in the way urban growth is planned and managed. The concentration of private capital and economic opportunity in a city does not of itself produce the institutional means to ensure that the supply of land for housing, infrastructure and services keeps up with population growth; nor does it produce the regulatory framework to ensure that the environmental, occupational and natural-hazard related risks generated through urban growth are managed. In poor countries, there is often a mismatch between the economic drivers of urban expansion and the institutional mechanisms to manage or govern the direct and indirect implications of this concentration. This mismatch may be aggravated in some cities by a lack of real will to engage with the urban poor by both national and local governments and by the relative voicelessness of the urban poor[40] including those at risk[41].

Many hazard prone cities in wealthy countries, such as in Japan or the United States of America, have been able to grow and adapt without an unmanageable explosion of disaster risk. Urban populations in high income nations take for granted that a web of institutions, infrastructure, services and regulations protect them from hazards. In contrast, only a very small proportion of urban centres in low- and middle-income nations have these capacities, although there are very large variations between cities. In such countries, the application of land-use planning and zoning regulations, infrastructure provision, and services such as refuse collections or emergency response are generally limited to wealthier formal areas of cities. Additionally, support for disaster response and recovery is often limited for the urban poor and may actively discourage the recovery of their land and the rebuilding of their homes and livelihoods.

As a consequence, urban expansion often occurs outside the legal framework of building codes and land use regulations and of officially recorded and legally sanctioned land transactions[42]. Land ownership patterns and the absence of public sector policies to provide access to land or housing in many cities, means that the

only way to absorb large increases in population is through the uncontrolled growth of informal settlements. Inevitably, those with the least purchasing power and least political influence have to occupy land or housing that no-one else wants.

Household and community-based action can help reduce disaster risk in urban areas but there are limitations to what this can achieve without government support and without the broader infrastructure and service framework into which community provision can integrate. Many of underlying factors, such as land tenure and the legal status of informal settlements are structural and cannot be addressed easily through local community initiatives. On its own, community-based action cannot finance and build trunk infrastructure, deal with the causes of flooding that are outside their community, equip and staff hospitals, and so on.

The translation of urban poverty into disaster risk therefore is related to the quality of urban and local governance: the risks faced by the urban poor have often been constructed and amplified by poor governance. As will be highlighted later in this Report, good urban governance both in the sense of competent, effective, accountable local government and good working relationships with civil society is perhaps the most important factor that can limit, reduce or break the relationship between poverty and disaster risk in cities[43].

Extensive risk

As documented in Chapter 3, extensive risk, in urban areas, is strongly associated with the impact of localized flooding, fires and landslides in informal settlements. The evolution of extensive risk patterns mirrors that of urban development and territorial occupation and is associated with the increasing hazard exposure of the urban poor, the vulnerability of housing and local infrastructure to hazards and a chronic under-investment in infrastructure such as drainage by city authorities.

In most cities, extensive disaster risk is configured by a significant proportion of the population living in informal settlements on dangerous sites and lacking infrastructure and services. Sites exposed to hazard include steep landslide prone slopes, ravine sides and river banks subject to erosion in areas with poor drainage and subject to flooding, and those on landfill and reclaimed land with high levels of seismic hazard. Informal settlements on landslide prone hillsides exist in cities such as Rio de Janeiro (Brazil), La Paz (Bolivia) and Caracas (Venezuela); in deep ravines in Guatemala City; or on land prone to flooding or tidal inundation in Guayaquil (Ecuador), Recife (Brazil), Monrovia (Liberia), and many others[44].

Informal settlements, and occasionally government sponsored, low-income housing[45], develop on such sites because the land is deemed unsuitable for residential or commercial development, and because city governments have usually been incapable of addressing the land needs of the urban poor. Because most informal settlements are illegal, they usually have serious deficiencies in infrastructure and service provision.

Those who settle and build their homes in such areas have more chance of avoiding eviction because of their proximity to income-earning opportunities. Accepting disaster risk may, in itself, be a strategy to cope with and minimize other kinds of risk. Access to employment, markets, transport and economic opportunities usually plays a vital role in defining where poor people choose to live in a city. Having to cope with periodic flooding may be considered a minor nuisance if livelihood security is increased.

This kind of urban development also magnifies hazard levels. In many urban areas flooding is a product of increased run-off due to building on green areas, an underinvestment in drainage with sufficient capacity to evacuate the run-off, and the encroachment by urban development on natural drainage channels or areas such as flood plains that dissipate flood waters. These factors are often aggravated by the lack of maintenance of existing drainage channels or their obstruction with garbage. As informal settlements are often located in low-lying areas with poor natural drainage and where investment in infrastructure is lowest it is unsurprising that

increasing flood risk predominantly affects the urban poor. Informal settlements often occupy steep slopes, which decreases slope stability and increases the risk of landslide and rockslide hazards, as described in Box 4.6. In other cases (Box 4.7) they may be located on garbage tips. Building on landfill sites or swampy areas is often extremely hazardous in earthquake prone areas. Closely packed settlements of wooden or thatch houses exacerbate fire hazard. The loss of mangrove ecosystems on urban fringes aggravates coastal erosion and increases exposure to storm surges.

Box 4.6: Hillside collapse in El Agustino, Lima[46]

The informal settlement called 9 October was founded in 1975 on a rocky hillside in the district of El Agustino, Lima. The hillside was urbanized informally from the bottom upwards by nearby agricultural workers. Early constructions of bamboo matting were soon replaced by multi-storey concrete and brick houses and by the 1990s, 9 October had a population of more than 1,300, as well as domestic electricity, water and telephone connections, and property titles. In 1999, a local development plan classified the area as a zone of environmental risk and social vulnerability due to high salinity in the soil which was eroding foundations and containing walls; two and three story houses occupying unstable sites without load-bearing capacity; and leaks from a deteriorated water and sanitation network, which were causing subterranean erosion. In June 2003, part of the hillside subsided and collapsed, damaging 280 houses of which 70 were destroyed.

The housing stock in informal settlements is often highly vulnerable to hazard events. Houses are built and modified informally and illegally and, therefore, without reference to hazard resistant building standards where these exist. The absence of land titles often means that households have neither the incentive to improve housing standards, due to the risk of eviction, nor access to housing finance and technical assistance. When land tenure is obtained it is common for additional stories to be added to buildings without reference to the bearing capacity of walls and foundations. Structurally weak and badly built houses are highly vulnerable to earthquakes, tropical cyclones and floods, further increasing the propensity of the urban poor to suffer loss.

The high vulnerability of housing usually extends to infrastructure and basic services. The development of infrastructure and provision of services, including emergency services, often ignore or discriminate against informal settlements, due to legal or other reasons. Much service provision (for example water, sanitation, health care, solid waste management, and sometimes even schools) is therefore private, informal and of poor quality or with inadequate coverage. A high proportion of urban economic activity and the livelihoods it provides, is also outside the formal, regulated economy.

Table 4.2 summarizes the different factors that increase both everyday as well as extensive and intensive disaster risk for the urban poor.

Intensive risk

Extensive risk characterizes areas, usually settled by the urban poor, in and around both large cities and small urban centres. Localized hazards may also cause intensive impacts as Box 4.7 illustrates.

Often, however, intensive risk affects entire cities – or large areas of cities – when they develop and expand on seismic fault lines, close to active volcanoes or on coastlines exposed to tropical cyclones, coastal flooding or tsunamis. Box 4.8 explains why cities grow in areas exposed to major hazards.

Urban growth in hazardous locations increases the intensity of risk. Given that a significant proportion of a country's population and GDP is often concentrated in one or two large cities, intensive risk may have national rather than local impacts. If the city plays a key role in global economic flows, intensive risk may have international implications.

Box 4.9 describes an example where a catastrophic hazard event affected everyone in a city, through the interruption of essential services such as water, sewerage, electricity and public

Table 4.2: Summary of disaster risk factors for the urban poor

Aspect of urban poverty	Implications for everyday risk	Implications for extensive and intensive disaster risk
1. **Inadequate and often unstable income** and thus inadequate access to necessities (food, safe and sufficient water, rent, transport, access to toilets, school fees); indebtedness, with debt repayments significantly reducing income available for necessities; and/or incapacity to afford rising prices of necessities.	Very limited capacity to pay for housing, which in urban areas means living in the worst quality homes and neighbourhoods in the least advantageous locations. This often means living in poor quality housing in illegal settlements on dangerous sites lacking provision for infrastructure and services.	In most cities and many urban centres in low- and middle-income nations, most low-cost housing is on land sites at risk from flooding, landslides or other hazards, in part because of the location, in part because of the lack of public provision for infrastructure and services. Housing is often of poor quality, so is at risk from storms/high winds and earthquakes.
2. **Inadequate, unstable or risky asset base** (non-material and material assets, including educational attainment and housing) for individuals, households or communities, including those assets that help low-income groups cope with fluctuating prices or incomes.	Very limited capacity to cope with stresses or shocks in everyday life, including rising prices or falling incomes, injuries and diseases.	Very limited capacity to cope with disaster events when they occur.
3. **Poor quality and often insecure, hazardous and overcrowded housing.**	High risk levels from physical accidents, fires, extreme weather and infectious diseases.	High risk of household accidental fires becoming larger settlement-wide fires; conditions favouring disease transmission may cause epidemics. Housing at risk of damage or collapse from storms and earthquakes.
4. **Inadequate provision of 'public' infrastructure** (piped water, sanitation, drainage, roads, footpaths, etc.), which increases the health burden and often the work burden.	High levels of risk from contaminated water, inadequate sanitation, house flooding from lack of drainage.	Lack of infrastructure often the main problem underpinning flooding. Lack of roads, footpaths and drains inhibit evacuation when disaster threatens or happens.
5. **Inadequate provision of basic services** such as day care/schools/vocational training, health care, emergency services, public transport, communications, law enforcement.	Unnecessarily high health burden from diseases and injuries because of lack of treatment including emergency response..	Lack of health care, emergency services and disaster preparedness that should provide rapid response to disaster (and should have a role in reducing disaster risk).
6. **Limited or no safety net** to ensure basic consumption can be maintained when income falls; also to ensure access to housing, health care and other necessities when these can no longer be paid for (or fully paid for).	Very limited capacity to cope with stresses or shocks in everyday life, including rising prices or falling incomes, injuries and diseases.	Very limited capacity to recover from disaster – for instance to afford sufficient food and water, rebuild homes and livelihoods.

Box 4.7: The Payatas garbage slide in Manila[47]

When the government authorities ordered the closure of the Smokey Mountain landfill in Tondo, Manila in 1993, a large portion of the 6,000 metric tons of garbage produced daily in Metro Manila were dumped on the Payatas Estate, a contested area claimed by urban squatters, big subdivision owners and by the government. The new gargantuan garbage mountain overlooked Lupang Pangako, a site in the estate where poor urban households had been relocated after their homes in other parts of the city had been demolished by the government. On 10th July 2000, a garbage slide affected the 15,000 residents in Lupang Pangako, leaving more than 300 people dead and missing and causing the destruction of more than 500 houses. This intensive risk disaster illustrates the causes of both extensive and intensive urban risk.

Box 4.8: Why cities grow in areas exposed to major hazards[48]

1. **Economic or political reasons outweighed considerations of risk:** Most of the world's major cities are on the coast or beside major rivers because they were already important urban centres before railways, new roads and air transport changed transport systems. Most relied on river or sea ports as their main transport and communication link with other places – and, of course, river and ocean transport is still a key part of the increasingly globalized economy.
2. **The city has outgrown its original site:** While the original city site may have been safe, the city has outgrown this site and expanded onto land that is at risk, for instance onto floodplains or unstable hillsides. Many city sites that were safe and well-chosen for cities of 50,000 inhabitants (a comparatively large city 200 years ago) are not safe when the city expands to several million inhabitants.
3. **City expansion and development can create new risks:** For instance, where urban development occurs without the necessary investments in protective infrastructure, it creates a fast-growing, concentrated, impermeable surface. A lack of investment in storm and surface drains and new urban developments encroaching on important natural drains, exacerbate the risk.
4. **Dangerous sites serve low-income households well** in that they are the only places where they can find accommodation close to income-earning/livelihood opportunities. The cost of urban housing is inversely related to distance from economic opportunity (which means long and expensive commutes). Low-income households can afford only poor quality, overcrowded and often insecure housing (lacking in infrastructure and services), subject to intensive or extensive risk (e.g. sites at risk of flooding, landslides or earthquakes).
5. **Once a city has developed, it rarely disappears**, even if it experiences some disastrous flood or earthquake, because there are too many individuals, enterprises and institutions with an interest in that city's economy. Most of the world's largest cities have been successful for hundreds of years; many have experienced catastrophic disasters but were rebuilt rather than being relocated.
6. **The wealthier groups and most formal enterprises do not face serious risks** from floods and storms, due to safer locations, well-built housing, infrastructure provision and insurance.

Box 4.9: The 2005 Mumbai flooding[49]

In July 2005 a week of incessant rainfall caused floods in several low-lying areas of Mumbai causing nearly 600 deaths, seriously affecting more than a million people, and dislocating the lives of many millions. Lifeline infrastructure and services including water, sewerage, drainage, road, rail and air transport, power and telecommunications stopped functioning across one of the world's largest cities.

The Government of Maharashtra had developed India's first urban Disaster Management Plan for Mumbai in the late 1990s, which highlighted flooding as a significant risk, pinpointed bottleneck locations in each ward, and identified vulnerable slums and settlements. However, no systematic action was taken over half a decade to mitigate the risk.

Effective mechanisms for disaster management operations were found to be missing; the Disaster Management Plan existed only on paper. Short-term development gains had been prioritized at the cost of the city's sustainability. Key development norms were bypassed with results that included rapid urbanization, a constant modification of building norms, the narrowing and congestion of the Mithi River by development, and the construction of informal settlements adjacent to the river. Additionally land reclamation continues to denude the city's mangroves, mudflats and creeks, which make up its natural drainage systems.

A strong political framework for long-term urban infrastructure development and risk reduction will need to be constructed in Mumbai. A culture of risk mitigation and emergency preparedness must be built, involving communities, the private sector, civil society, state and national governments.

transport, and the collapse of hospitals, schools and public administration buildings. However, housing destruction and mortality are usually concentrated in the same poor areas that manifest extensive risk. Similarly, the interruption or collapse of economic activities has a greater impact on the economy of the urban poor than on wealthier households with economic reserves.

4.2.2 Disaster impacts and poverty outcomes

The losses experienced by poor urban households, as manifestations of extensive and intensive risks, feed back into poverty. Housing is usually the principal economic asset of poor urban households, providing not only shelter and personal security, but also often their livelihood. Its damage or loss, together with essential domestic possessions, therefore, places enormous strain on household economies, given the high monetary cost of replacing lost assets, relative to low and irregular incomes, and the absence of insurance or safety nets.

Studies that measure the impact of intensive risk manifestations [50] normally focus on the macroeconomic impacts and aggregate losses, making it difficult to identify the impact on the urban poor. The apparently low economic value of lost assets in informal settlements is a reflection of the deficits in housing, infrastructure and services and understates the impact on poor households. In addition, many losses are qualitative and hard to measure – for instance work and school days lost and disruptions to informal income-earning activities [51]. The empirical evidence of disaster impacts on urban areas presented in Chapter 3, however, showed a resulting increase in poverty (for example in Trinidad, Bolivia) or reductions in expenditure (as in Iran).

Within poor urban areas, women are often particularly vulnerable as a result of a range of gender-related inequalities, affecting access to income, land tenure and services. A higher proportion of women's income is often generated from home-based activities, with the result that they are most affected when houses and neighbourhoods are damaged and destroyed. Existing gender inequalities are also frequently manifested in differential access to the resources and services available to support recovery and reconstruction. It is rare for women's and children's needs and priorities to be addressed adequately in the provision of temporary post-disaster settlement, for example, ensuring that health needs are met and protection given against domestic and sexual violence. In general, their needs are not adequately factored into post-disaster recovery and reconstruction planning.

4.2.3 The urbanization of risk in rural economies

Extensive disaster risk is not only a characteristic of large cities but also expands centrifugally within countries, mirroring patterns of territorial occupation and economic and urban development. Such patterns in turn reflect broader global economic change: for example, intensive agricultural development for export markets; the demand for biofuels or for drugs such as cocaine and heroine; the expansion of the agricultural frontier, through the construction of roads and settlements in previously sparsely populated areas; the decentralization of manufacturing to areas with low labour costs; and coastal and island tourist development.

While these processes manifest differently in each country, their outcomes often include increased migration from rural areas, attracted by income and livelihood opportunities, improved markets for surrounding rural areas, and the rapid growth of small and medium-sized urban centres. Such outcomes transform the risks faced by people in rural economies while configuring new risks in small and medium urban centres.

Transformed rural livelihoods

In rural economies, the opening of new urban markets may improve the viability of rural livelihoods, increase household incomes and contribute to a reduction in both vulnerability and poverty, through better and easier opportunities to sell agricultural products or to engage in non-agricultural work. Seasonal or permanent migration to urban areas by household members helps to diversify the livelihoods of rural households and remittances now provide an important source of income in many rural areas,

Box 4.10: Changing livelihood practices: urbanizing rural economies in Africa [52]

In many countries, farmers have ceased to grow traditional export crops and commercial staple foods in rural areas remote from roads and urban markets, and instead, diversification into non-farm activities and migration to urban areas have become important livelihood strategies [53]. In sub-Saharan Africa linkages between family members in urban and rural areas are traditionally very strong and represent a strategy to spread resources in a risk-prone environment.

Economic hardship in urban areas, however, affects such linkages. In Senegal and Zimbabwe, for example, economic downturns forced urban residents to decrease financial support to rural-based relatives, negatively affecting the remittance economy on which so many of the rural poor depend. In Botswana and South Africa, however, urban dwellers' investment in livestock and housing in home rural areas is a safety net and has continued despite growing uncertainty in the urban centres. Economic crisis may also be encouraging urban to rural movement, especially among retrenched formal sector workers, but the evidence for this remains anecdotal [54].

as described in Box 4.10. Worldwide remittance flows are estimated to have exceeded US$ 318 billion in 2007, of which developing countries received US$ 240 billion. The true size, including unrecorded flows through formal and informal channels, is believed to be significantly larger [55]. The risks associated with vulnerable rural livelihoods, highlighted in Section 4.1, are rarely found to the same degree in rural areas that are integrated into a strong urban network.

Urbanization, however, may also have negative effects on surrounding rural areas. Towns and cities often displace their environmental burdens and risks to rural hinterlands, including pollution, waste and over-extraction of water resources. Migration to urban areas may increase the risk of HIV/AIDS transmission. Household decomposition and depopulation lead to the breakdown of traditional rural coping and risk management mechanisms. At the same time, urbanization often radically restructures social and gender relations, meaning that potential changes in risk affect men and women, the old and young, the wealthy and the poor in different ways. Evidence from Thailand and the Philippines, for example, suggests that more and more migrants are moving alone, either temporarily or permanently, and leaving their families behind due to increasing livelihood pressures. In India, there has been a rapid increase in the number of female headed households as men migrate to cities in search of employment [56]. Surveys by the Development Bank of South Africa show that three out of four rural respondents (76%) wanted to remain in their area, despite high levels of poverty. That so many migrate to cities underlines the fact that they move only when they have the means, and see a clear advantage to doing so, in the context of the information and contacts they have available.

Emerging disaster risk in small and medium urban centres

The economies of most small urban centres are linked to the provision of goods and services for local agricultural, fishing or forestry enterprises. Rapid growth both in economic activity and population occurs through the exploitation of new economic opportunities in sectors such as tourism, agro-industry, decentralized manufacturing and illegal drugs, often enhanced by improved communications through the construction of new roads and airports. Already, far more people live in small and medium urban centres in low- and middle-income countries than in mega-cities. In these countries, urban areas with fewer than 500,000 inhabitants account for 22.1% of the population, compared to only 6.6% in large cities with over 5 million inhabitants. However, not all small urban centres are growing rapidly. Isolated towns serving stagnating rural economies may be declining, while at the other extreme urban population growth rates of 20% a year or more have been recorded, for example in the coca growing regions of the Andes [57]. Economically dynamic small and medium urban centres attract migrants not only from surrounding rural areas but also from other cities and regions, due to the promise of potentially lucrative income-generating activities.

Almost all small and at least some medium urban centres, have weak and poorly resourced local governments, large backlogs in provision of infrastructure, little investment capacity and

limited technical capacity and knowledge in managing urban development in general and disaster risk in particular. Informal settlements in small urban centres are likely to be poorer and even less well served by infrastructure and services than their counterparts in large cities. While land constraints may be less apparent, many informal settlements exist around small urban centres in hazard exposed locations, due to rapid and haphazard growth, an absence of urban planning policies and instruments, and a lack of awareness of local hazard patterns by arriving migrants. Housing is also likely to be more vulnerable. This reflects not only the fact that households may be poorer than in large cities: the adaptation of traditional rural building typologies to the realities of urban economies often produces new structural vulnerabilities, as households have to buy materials and labour on the market and have to adapt to a reduced plot size[58]. Additionally, as Box 4.11 shows, infrastructure and services provided by and for the poor, in both urban and rural areas, often do not meet even minimum safety standards.

The environmental transformation of surrounding rural areas through deforestation, mineral extraction, and the construction of roads and other infrastructure, often dramatically increases the incidence of hazards, such as floods, flash floods and landslides. The processes through which disaster risk evolves in such contexts are far from linear. Risk arises over time through a concatenation of a large number of different individual and collective decisions often involving land speculation, settlement by the poor of some areas and their eviction from others, the mismanagement of environmental resources and many others, in an overall context of weak local governance. The case of Pereira in Colombia (Box 4.12) illustrates these processes in all their dimensions.

Box 4.11: Poorly constructed schools kill pupils during earthquakes[59]

Experiences in the recent past have highlighted the urgent need to increase attention to the threat of earthquakes and other natural hazards that expose students to hazards in schools. The 7.9 magnitude earthquake in Sichuan, China in 2008 caused damage to more than 10,000 school buildings and almost 7,000 schools were completely destroyed. UNICEF estimates that millions of school children were affected; 9,000 children and teachers died. Unfortunately this is not the first such loss. In October 2005, the earthquake in Kashmir was yet another cruel reminder of how vulnerable the region's schools actually are. In Pakistan over 8,000 out of 9,000 schools were either destroyed or damaged beyond repair by the earthquake. Over 17,000 school-age children died in the collapsed schools, approximately 23% of the total deaths in the earthquake, and over 20,000 more suffered serious injury. Over 80% of schools in Pakistan are unprotected from similar risks[60].

Box 4.12: Risk accumulation in Pereira, Colombia[61]

The earthquakes of 1995 and 1999 caused significant destruction and damage to housing built on former landfills in the Egoya and other watersheds in the city of Pereira, where there are high levels of seismic hazard. While this area represents only 7% of the urbanized area of Pereira, it concentrated 43% of the damages in the 1999 earthquake. This manifest disaster risk, however, had been gradually constructed over 65 years, through multiple decisions by a wide range of stakeholders, none of whom were aware of the risk accumulation process. Due to high levels of contamination, the river Egoya had been channelled into a culvert. Given the shortage of landfills, the area had then been levelled with garbage and rubble, permitting its urbanization. In parallel, traditional lightweight construction in bamboo and mud in the watershed was gradually replaced by more vulnerable brick housing. Most of these changes were justified at the time for other reasons: the river was made into a culvert for environmental health reasons; the city required land for urban expansion; building in brick rather than bamboo was a sign of modernity. By the time of the 1995 and 1999 earthquakes, the area's residents had forgotten this history and were unaware of the seismic risk or even that the river Egoya and the landfill had existed. Subsequently, the municipality of Periera carried out a study of seismic microzoning, prohibiting rebuilding in the most hazard prone areas, meaning that at least legally the risk cannot be rebuilt.

4.3 Ecosystem decline

People receive substantial benefits or services from ecosystems, categorized as provisioning services (such as food and fibre), cultural services (such as a sense of place or tourism), and regulating services (such as climate moderation or flood reduction). Most ecosystems have been intentionally or unintentionally modified to increase the supply of certain categories of services, and institutions have been developed to govern access to, and use of, these services. However, because ecosystems produce many services simultaneously, an increase in the supply of one service, such as food, can frequently lead to declines in other services, such as flood protection.

The Millennium Assessment found that the supply of approximately 60% (15 of 24) of the ecosystem services evaluated were in decline (Table 4.3), while consumption of over 80% of the services was found to be increasing. In other words, the flow of most ecosystem services is increasing at the same time as the total stock is decreasing. In particular, the Millennium Assessment identified that while people have modified ecosystems to increase the supply of food and fibre, these modifications have unintentionally led to the decline of regulating ecosystem services, including those responsible for reducing people's exposure to hazards, such as fires and floods. An increase in landslide hazard on deforested slopes and of storm surges in areas where mangroves have been destroyed, are other examples of how an increase in provisioning ecosystem services may decrease regulating ecosystem services. While such changes in the distribution of ecosystem services often benefit specific economic interests, the costs are frequently borne by poor urban and rural households.

Changes in the supply of ecosystem services may also increase livelihood vulnerability, particularly when livelihoods depend on common pool resources. As Box 4.13 highlights, the destruction of mangroves not only reduces protection against coastal erosion and storm surges but negatively affects artisanal coastal fisheries and the communities that depend on them.

The Fourth Global Environment Outlook[63] highlighted the declining capacity of many ecosystems to provide regulating services, including the regulation of flood, drought,

Table 4.3: Use and supply of ecosystem services[62]

Source: Millenium Assessment, 2005

Provisioning ES		Regulating ES		Cultural ES	
Crops	+	Air quality control	+	Spiritual and religious values	+
Livestock	+	Global climate regulation	+	Aesthetic Values	+
Capture fisheries	–	Local climate regulation	+	Recreation and ecotourism	+
Aquaculture	+	Water flow regulation	+		
Wild foods	–	Erosion control	+		
Timber	+	Water quality regulation	+		
Cotton	+/–	Disease control	+		
Wood fuel	+/–	Pest control	+		
Genetic resources	+	Pollination	+		
Biochemicals	+	Natural hazard regulation	+		
Freshwater	+				

ES = ecosystem service. Numeric sign shows change in use. Colour shows change in supply: green= increasing supply, red = decreasing supply, yellow = supply more or less stable

Box 4.13: Mangroves in Myebon, Myanmar

Myebon is located in the coastal state of Arakan, where many of Myanmar's mangrove forests are found. Several large areas of mangrove were cleared for agriculture and other uses (e.g. paddy fields and salt pans) between 1979 and 2000. The large areas of grey and tan that appear in the previously deep green areas in Figure 4.3 show where the mangroves have been cleared. Mangrove ecosystems occur at the transition between marine and terrestrial ecosystems and provide important services to both. They provide nursery and breeding areas for many marine species and are essential for maintaining healthy fisheries. They are also a prime habitat for migratory birds, amphibians and many terrestrial species. In terms of their regulating services, mangroves play a vital role in protecting coastlines from storm surges, flooding and erosion.

Mangroves are under pressure throughout much of coastal South Asia where they are being cleared for agriculture, aquaculture and urbanization. Protection of mangroves, as part of overall coastal zone management, will become increasingly important.

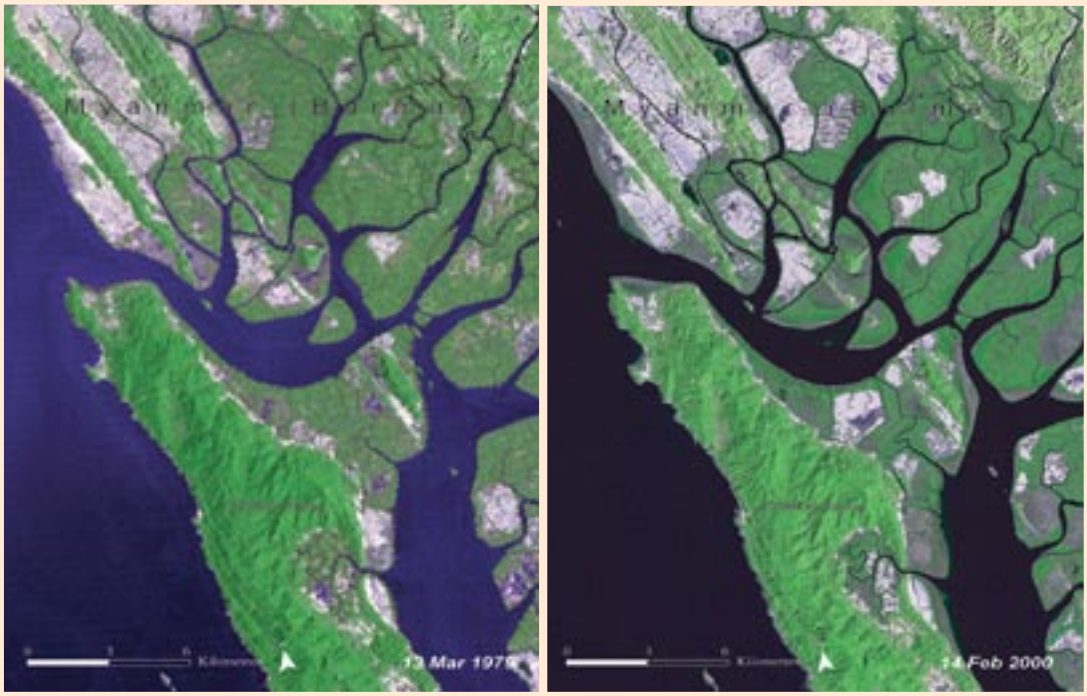


Figure 4.3: Destruction of mangroves and coastal vegetation in Myebon (Arakan, Myanmar), comparison between 1979 and 2000

Source: United Nations Environment Programme (UNEP), 2005

landslide and other weather-related hazards, as well as to support the livelihoods of poor households through provisioning services. Key examples of ecosystem decline include the decrease in supply of tropical forest ecosystem services, land degradation in the form of soil erosion, nutrient depletion, salinity, the disruption of biological cycles, and increasing water scarcity.

Between 1995 and 2005, the global forest area shrank at an annual rate of 0.2%. However, this global figure hides critical regional differences. It is estimated that over the last 15 years approximately 50,000 km^2 of primary forest were lost per year, while the area of planted or semi-natural forest has increased by 30,000 km^2 [64]. The loss of primary forest was greatest in Latin America and the Caribbean, Asia and the Pacific, and Africa. Given that forests play a key role in the protection and regulation of soil as well as water catchments, their decline in many countries in these regions may be contributing to the intensification of flooding and drought cycles, as well as landslides due to the deforestation of steep slopes.

In addition, forests play a key role in sustaining rural livelihoods. A recent synthesis of data from 17 countries found that 22% of

Figure 4.4: Deforestation in Iguazú (Argentina, Brazil and Paraguay), comparison between 1973 and 2003

Source: UNEP, 2005

rural household income in forested regions comes from harvesting wild food, firewood, fodder and medicinal plants, generating a much higher proportion of income for poor rather than wealthy households.

Poor rural households in developing countries also suffer disproportionately from land degradation. The direct effects include losses of soil organic content, nutrients, and water storage and regulation, which in turn lead to a loss of productive capacity and wildlife habitat, as well as increases in salinity. The Fourth Global Environment Outlook report[66] indicates a considerable increase in land degradation between 1981 and 2003, characterized by an absolute decline in net primary productivity or biomass production across 12% of the global land area, with an absolute decrease in rain-water efficiency affecting 29% of the global land area.

Approximately 15% of the global population of 1 billion people live in the affected areas. The impact of land degradation on rural livelihoods is greater in those areas where livelihoods are already characterized by poverty and vulnerability, such as in sub-Saharan Africa. In the low input–low output agricultural systems common to poor rural areas in such regions, nutrient inputs to the soil are almost always less than the outputs, due to reduced fallow periods and insufficient use of inorganic fertilizer, which may be only 5% of the levels applied in developed countries. Land degradation is, therefore, both a cause and an effect of rural poverty and vulnerability. In sub-Saharan Africa, for example, it is estimated that land degradation is responsible for an annual loss of 3% of agriculture's contribution to the region's GDP.

Water management also affects the provision of ecosystem services in ways that modify levels of disaster risk. For example, the increasing demand on rivers for irrigation, as well as extraction of water for industrial and domestic use, reduces the sedimentation that reaches the coast. This can affect downstream agricultural

Box 4.14: Rural livelihoods and ecosystem services[65]

In the Makanya catchment in Tanzania, people's livelihoods are marked by a lack of infrastructure, public services and market access, and are subject to a semi-arid climate with frequent drought episodes. During the 2005–2006 drought, 85% of households earned 42% of their income from local provisioning ecosystem services, in the form of fibre, wood products, wild fruits and fodder. This income was as important as the proportion provided by non-agricultural sources, such as remittances and short-term wage labour.

yields and fish productivity, damage the health of coastal wetlands, and increase coastal flood hazard levels. Excessive groundwater extraction is leading to a potentially irreversible degradation of aquifers, again with compound effects on rural livelihoods. Coastal and inland wetlands have a critical influence on both livelihoods and the regulation of flood and drought (see Box 4.15).

Box 4.15: The Mississippi wetlands[67]

The drainage of approximately 4,800 km^2 of wetlands in the Mississippi Delta in the United States of America was one of the underlying factors behind the scale of the flooding associated with Hurricane Katrina. Many areas formerly above sea level were below sea level at the time of Katrina, due to wetland drainage, while the capacity of the wetlands to dissipate storm surge and absorb flood waters had diminished. The forested riparian wetlands adjacent to the Mississippi River during pre-settlement times had the capacity to store about 60 days of river discharge. Today, the few remaining wetlands have a reduced storage capacity of less than 12 days discharge, implying an 80% reduction of flood storage capacity. This loss of wetlands also contributed substantially to the severity and damage experienced in the 1993 flood in the Mississippi Basin.

4.4 Global climate change

Global climate change represents environmental inequity in a most pervasive form, since it is driven by historical levels of emissions that have brought enormous benefits to affluent individuals and societies, yet most of the resulting burdens fall on poorer individuals and societies. A large number of global reports already published or in preparation have described in detail the current and projected changes in climatic factors and the likely impacts[68].

As highlighted by the empirical evidence presented in Chapters 2 and 3, disaster risk associated with weather-related hazards is disproportionately concentrated in developing countries and within these countries in poorer sectors of the population. Climate change will act on this uneven and asymmetric distribution of risk and therefore further magnify the disproportionate social and economic impacts of disaster loss on the rural and urban poor.

The Fourth Assessment Report of the IPCC states that the Earth's climate system has been undergoing warming over the last 50 years. Mean temperatures are likely to increase, mean precipitation will fluctuate, and mean sea level will rise. By the decade 2090–2099, global average surface temperature is predicted to be 1.1–6.4°C higher than the 1990–1998 average. Sea levels are predicted to rise 18–59 cm by the same decade[69]. The IPCC indicates that any increase in mean global surface temperature of more than 2°C above pre-industrial levels, or 1.5°C above 1990 levels, would lead to a dangerous degree of climate change. The IPCC has developed a set of six scenarios identifying plausible emissions pathways for the rest of this century. None of the IPCC scenarios points to a future below the 2°C threshold. The possibility is real that a change of 3°C or more will occur, leading to ecosystem collapse, drastic sea level rise, severe water insecurity and other catastrophic outcomes on a global scale.

Changes in climate can decrease the resilience of households and communities, while at the same time increasing hazard. Some of the projected impacts of climate change in Africa, Asia and Latin America are shown in Table 4.4.

In general the IPCC has predicted decreasing agricultural yields in warmer environments due to heat stress, aggravated by increased insect outbreaks and wildfires; increased soil erosion and land degradation due to extreme precipitation events; greater livestock deaths caused by an increase in the area affected

Table 4.4: Projected impacts of climate change in Africa, Asia and Latin America [70]

Africa	By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change. Yields from rain-fed agriculture could be reduced by up to 50% in some countries. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition.
Asia	By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease. Coastal areas, especially heavily populated mega-delta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some mega-deltas, flooding from the rivers.
Latin America	By 2050, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savannah in eastern Amazonia. Semi-arid vegetation will tend to be replaced by arid-land vegetation. Productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security. In temperate zones, soybean yields are projected to increase. Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.

by drought; and increased stresses in water availability and quality.

The implications are severe. The 2007 Human Development Report [71] estimated that, at the global level, aggregate agricultural output potential will be relatively unaffected by climate change; however this masks significant regional variations. By the 2080s, agricultural potential could increase by 8% in developed countries, primarily as a result of longer growing seasons. In contrast, in developing countries it would fall by 9% with sub-Saharan Africa projected to experience the greatest fall.

Yields from rain-fed agriculture in Southern Africa could be reduced by up to 50% between 2000 and 2020 according to the IPCC. The size of arid and semi-arid areas is projected by the Hadley Centre to increase by 60–90 million hectares. In Malawi for example, the production potential for maize is expected to fall by over 10% due to reduced water availability. Maize is the source of 75% of calorie consumption, so this will aggravate the country's already extreme vulnerability to existing hazard levels. In a normal year, two-thirds of households in Malawi are unable to produce enough maize to cover household needs, and declining soil fertility has reduced maize productivity from 2 tonnes per hectare to 0.8 tonnes over the last 20 years.

As described in Section 4.1, the livelihoods of the rural poor often rely heavily on climate sensitive sectors. Climate change will therefore translate into decreased resilience, particularly in areas such as sub-Saharan Africa. Apart from reduced agricultural productivity, resilience will also be affected by direct health impacts from water-borne diseases and malnutrition and indirect impacts for parents who must tend to sick children and the elderly.

Rising sea levels also pose a challenge by increasing hazards in low-lying coastal areas. As was discussed in Chapter 2, the population living in coastal areas has grown faster than the overall increase in global population. GDP growth has also been faster in coastal regions. Currently 10% of the world's total population (over 600 million people) and 13% of its urban population (over 360 million people) live on the 2% of the world's land area that is less than 10 metres above sea level, known as the Low Elevation Coastal Zone (LECZ) [72]. In Asia, 18% of the urban population lives in the LECZ; in small island states this is 16%; in Africa, 12%; and in Latin America, 7%.

There are evident risks associated with increased flooding and storm surges exacerbated by sea level rise in cities such as Dhaka, Mumbai and Shanghai, large sections of which are only 1–5 metres above sea level. Box 4.16 illustrates the kind of impacts that can be expected in a number of cities in Africa. Apart from those mentioned, others such as Abidjan, Banjul, Port Harcourt and Mombassa are at high risk [73].

The impacts of climate change in rural and urban areas are intimately linked. As the

Box 4.16: Impacts of sea level rise in urban areas in Africa

Alexandria, Egypt: An assessment of the vulnerability of the most important economic and historic centres along the Mediterranean coast (the cities of Alexandria, Rosetta and Port-Said) suggests that, for a sea level rise of 50 cm, over 2 million people will have to abandon their homes; 214,000 jobs would be lost, and the cost in land and property value and tourism income lost would be over US$ 35 billion. Alexandria alone has more than 3 million inhabitants. However, it is not really possible to put a monetary value on the loss of the world-famous historic, cultural and archaeological sites[74].

Lagos, Nigeria: With a total population of around 10 million inhabitants[75], Lagos has very inadequate provision for basic infrastructure to cope with flooding. 'Normal' rainfall brings flooding to many areas of the city, largely as a result of the inadequate provision of sewers, drains and wastewater management. Any increase in the intensity of storms and storm surges is likely to increase such problems; much of the land in and around Lagos is less than 2 metres above sea level. In many areas, roads have been built without complementary gutters for rainwater. Where a drainage system exists, it is often not properly constructed and maintained. The lack of solid waste collection compounds the problem as waste blocks gutters and drains. In addition, many buildings have been erected in ways that block storm-water routes. Little attention is given to clearing the drains in advance of periods of the year when rain is expected. Many low-income settlements are built in areas at high risk of flooding (many on stilts), largely because safer sites are too expensive[76].

Cotonou, Benin: Cotonou is Benin's largest urban centre, its main port and a key part of the national economy; it has around 700,000 inhabitants. The continued advance of the sea, coastal erosion and the rise in sea level, exacerbated by human activity on the coast, have medium- and long-term consequences that are already threatening vulnerable communities and disrupting the least-protected sensitive ecosystems. Some roads, beaches and buildings have already been destroyed by the coastline's regression in the last ten years[77]. In addition, provision for drainage is inadequate; the city has no sewer system and only a small proportion of solid wastes are collected; in addition, most of the population lives in informal settlements[78].

sustainability of rural livelihoods declines and disaster risk increases, it is possible that increased rural to urban migration may occur. In countries such as India, where the urban population is projected to grow by approximately 500 million over the next 50 years anyway, increased drought and flooding in the very densely populated Indo-Gangetic and Brahmaputra basins and in the coastal plains, may precipitate waves of migration that Indian cities are not well placed to absorb. Already major metropolitan areas such as Delhi, Mumbai-Pune and Kolkata are suffering from water stress, breakdown of environmental services and other risks, which can only increase under the influence of climate change[79].

Existing patterns of extensive risks, for example flooding and landslides, affecting urban informal settlements may intensify due to more severe and frequent extreme precipitation events and increases in the population and assets exposed, as a result of migration from rural areas. New patterns of risk may also emerge as a result of changes in the geographic distribution of weather-related hazards. In addition, climate change will lead to decreasing resilience, which is likely to disproportionately affect poorer countries and communities. Climate change is therefore also a driver of increasing poverty.

However, it is not inevitable that climate change leads to increasing disaster risk. As Chapter 3 illustrated, the rapid increase in the number of extensive floods reported in urban areas in Latin American countries is driven by factors such as the growth of informal settlements in low-lying areas and a chronic underinvestment in the construction and maintenance of drainage infrastructure by both city and national governments. These factors in turn reflect deficiencies in urban and local governance. Increases in the number or severity of extreme precipitation events, due to climate change, will lead to more urban poor households being more affected by more floods. But the changing climate is not responsible for the growth of informal settlements in flood prone areas nor for the lack of investment in urban infrastructure such as drainage. This finding has been reiterated in recent research on the impact of ENSO in the Americas[80].

In rural areas more frequent and extreme droughts as well as changes in mean temperatures and precipitation levels will cause further stress to already vulnerable livelihoods. The risk levels faced by rural households will increase as both the number and intensity of hazard events and livelihood vulnerability increase. But again, the changing climate cannot be blamed for risk factors such as chronic rural poverty, lack of market access, HIV/AIDS and the absence of social safety nets. If these factors were addressed, climate change would not necessarily lead to worsening risk for the rural poor.

It is important therefore to differentiate between climate change per se and the disaster risks associated with climate change. To reduce the latter, it is necessary to address the underlying drivers that configure risk in the first place. If these drivers are not addressed disaster risk will continue to increase even if climate change is successfully mitigated. Conversely if the drivers can be addressed not only will disaster risk be reduced but also the impacts of climate change. Addressing the underlying risk drivers, therefore, is key not only to disaster risk reduction but also to climate change adaptation. This conclusion has very important policy implications that will be examined in Chapters 5, 6 and 7.

Endnotes

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11 In parts of the Peruvian Andes for example, households have traditionally farmed numerous small parcels of land in different altitudinal ranges and ecological niches in order to minimize risk to natural hazards and to increase the diversification of production.
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28 Satterthwaite, 2007a
29 UNDESA Population Division, 2008
30 This estimate is based on the US$1 per day poverty line; World Bank, 2007. The World Bank has not released updated figures for the US$ 1.25 per day poverty line, proposed as of February 2009.
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33 Satterthwaite, et al., 2007
34 Satterthwaite, 2004
35 Ravallion, et al., 2007 suggest a lower figure.
36 UN-HABITAT, 2003a
37 UN-HABITAT, 2003b
38 UN-HABITAT, 1996
39 APHRC, 2002

40 Chambers, 1995; Satterthwaite, 1997
41 Bartlett, 2008
42 This does not mean with no official influence, since there may be widespread government collusion in informal land developments.
43 Bull-Kamanga, et al., 2003
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45 OSSO, 2008
46 Material compiled by Silvia de los Rios, CIDAP (Centro de Información, Documentación y Asesoría Popular), Lima, Peru on the basis of reports by Defensa Civil y Servicios Educativos El Agustino, a local NGO
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48 Dodman, et al., 2008
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57 Maskrey et al., 1991
58 For example, research by Monzon (1990) indicated that the traditional thickness of earth walls in informal settlement housing was greatly reduced to cope with small plots and the high cost of labour, greatly increasing the structural vulnerability of the houses.
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75 Many sources suggest that Lagos has a much larger population than this, but these may overstate its population. The preliminary census data for 2006 suggest that Lagos State in which the city is located had 9 million inhabitants. The 1991 census suggested that the Lagos urban agglomeration had around 5 million inhabitants. The movement of the federal capital to Abuja will also have removed one of the key drivers of Lagos's growth.
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Chapter 5

Review of progress in the implementation of the Hyogo Framework for Action

The on-line HFA Monitor was conceptualized by Shefali Juneja with Craig Duncan, Sujit Mohanty, Sylvain Ponserre and Joel Margate of the UNISDR Information Management Unit.

UNISDR regional offices coordinated the regional and national HFA progress reporting: Seth Vordzorgbe, Pedro Basabe, Rhea Katsanakis and Helene Lafferty (Africa); Jerry Velasquez, Angelika Planitz, Madhavi Ariyabandu and Abhilash Panda (Asia and Pacific); Paola Albrito (Europe); Dave Zervaas, Haris Sanahuja and Jennifer Guralnick (Latin America and the Caribbean); Mostafa Mohaghegh, Luna Abu Swaireh, Osama Hamad, Mohamed Sadatinejad and Goulsara Poulatova (West Asia and North Africa) in close collaboration with the following regional inter-governmental organizations: Jeremy Collymore (CDERA); David Smith (CEPREDENAC); Ana Campos (PREDECAN); H.E. Mr Khorshid Anwar (ECO); H.E. Mr Amr Musa (League of Arab States); Mohammed Ibrahim on behalf of Executive Secretary Mohammed Ibn Chambas (ECOWAS Commission), Charles Elie Mbonguy-Doumambila on behalf of Executive Director Louis Sylvain-Goma (ECCAS Secretariat), Dhar Chakraborti (SAARC); Surin Pitsuwan (ASEAN); and Cristelle Pratt (SOPAC).

A detailed listing of national interim HFA progress reports prepared by 62 countries is available in Appendix 3.

In-depth case studies were also contributed by Egypt, the Philippines and Tajikistan. In Latin America, a study of best practices in disaster risk reduction governance was coordinated by Alberto Aquino (GTZ), Haris Sanahuja (UNISDR Panama) and Angeles Arenas (UNDP/BCPR) and authored by Milton von Hesse (GTZ), Joanna Kamiche and Catherine de la Torre (advisors). Additional case studies on Colombia, Nicaragua, St. Lucia and Yemen and on the Central American Probabilistic Risk Assessment were contributed by the World Bank, coordinated by the Global Facility for Disaster Reduction and Recovery. A case study on the reconstruction of Bam, Iran was contributed by Hossein Kalali (UNDP/BCPR).

A thematic review of progress of early warning systems was coordinated by Maryam Golnaraghi and Jean Baptiste Migraine (WMO) with inputs from the FAO, the Global Fire Monitoring Centre, the IFRC, the Platform for the Promotion of Early Warning of the ISDR, the International Telecommunication Union, UN OCHA, United Nations University, UNDP, UNEP, the Intergovernmental Oceanographic Commission of UNESCO, UNICEF, the United Nations Office for Outer Space Affairs (UNOOSA), UNOSAT of UNITAR, the World Bank, WFP, WHO and WMO.

Other thematic progress reviews were undertaken on urban disaster risk reduction by Fouad Bendimerad (EMI); on recovery by Jennifer Worrell and Anita Shah (IASC Early Recovery Cluster), Yuki Matsukoa (IRP secretariat) and Dusan Zupka (UN OCHA); and on gender in disaster risk reduction and recovery by Feng Min Kan, Madhavi Ariyanbandu and Ana Cristina Thorlund (UNISDR) with inputs from Rory Mullan (UNDP DRM-Practice Network). Thanks to Michel Matera for reviewing French translations of the HFA Monitor tool.

Introduction

In 2005, 168 countries adopted the Hyogo Framework for Action (HFA), a comprehensive set of three strategic goals and five priorities for action. The expected outcome of the HFA is the *"substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries"* [1]. The strategic goals and priorities for action are shown in Box 5.1, which also sets out the 22 core indicators and five levels of progress against which countries have assessed their implementation of the HFA during the first biennial progress review process (2007–2009).

This chapter reviews countries' progress towards the achievement of the strategic goals and priorities for action. The analysis is based on interim national HFA progress reports completed by 62 national authorities for the period June 2007 to May 2009 (referred to as 2007–2009). The methodology and tools adopted for facilitating the global 2007–2009 HFA progress review are summarized in Appendix 3, which includes a description of progress and challenges against each of the core indicators and benchmarks applied. The Appendix also contains a list of countries that have completed interim national HFA progress reports as of February 2009.

The chapter also examines the extent to which disaster risk reduction is being addressed in strategies for poverty reduction and adaptation to climate change.

Summary of findings

1. Areas of HFA progress reported

Significant progress has been made in strengthening capacities, institutional systems and legislation to address deficiencies in disaster preparedness and response. Good progress is also being made in the identification, assessment and monitoring of disaster risks and in the enhancement of early warning systems. However, little progress is being made in the use of knowledge, innovation and education and in particular in the mainstreaming of disaster risk reduction into economic, social, urban, rural, environmental and infrastructure planning.

2. Progress by income and regional classification

High-income countries have achieved greater progress across all HFA Priorities for Action than middle- and low-income countries. However, while disaster risk reduction considerations are well integrated into different sectors, many countries lack a holistic policy and strategic framework for addressing disaster risk. Some least developed countries report major gaps in institutional, technical, human and financial capacities, which limit their ability to address the HFA. While many low- and middle-income countries have made good progress in developing national policies, legislation and institutional systems, they are challenged by the issue of mainstreaming disaster risk reduction into sectoral and local development.

3. Challenges reported

Specific challenges were highlighted by the review, including an ad hoc and dispersed approach to hazard monitoring and risk identification that does not facilitate comprehensive multi-hazard risk assessments; difficulties faced by national disaster risk reduction organizations in engaging development sectors; and a lack of accountability and enforcement in implementation. At the same time, however, the review highlights innovations in disaster risk reduction governance, showing that some of these challenges can be addressed.

4. Climate change and disaster risk reduction

Adaptation to climate change faces many of the same challenges as disaster risk reduction. In addition, implementation is still incipient and its policy and planning frameworks are rarely integrated with those for disaster risk reduction.

5. Poverty reduction and underlying risk drivers

Many poverty reduction strategies have potential to address the underlying risk drivers and do recognize disaster impacts as a contributing factor to poverty. However, the disaster risk reduction components in such strategies are often limited to preparedness and response aspects. In many countries, poverty reduction and disaster risk reduction are not strongly integrated in terms of policy and planning.

This first biennial HFA review has some limitations that must be made explicit at the outset. The national reports provide a reasonable sample of all regions and income classifications, but many countries remain unrepresented. While in some countries consultation exercises were held as part of the review process, the progress reports are self-assessments by the national authorities and in most countries prepared by the designated HFA focal point or organization responsible for disaster risk management. Reports do not always fully reflect the perspectives of other stakeholders, such as the private sector or civil society, or all sectors of government. Similarly, while some international organizations have contributed thematic reviews of progress for different areas, this iteration of the biennial review did not include modules for regional and international progress reporting. Nevertheless, as the first comprehensive global exercise in reporting progress on the Hyogo Framework's implementation, this review does provide a unique insight into the current level of commitment to and achievement of the HFA's strategic goals.

Box 5.1: The Hyogo Framework for Action: Strategic goals, priorities for action, core indicators and levels of progress

Source: (UNISDR, 2008a).

Three Strategic Goals

1. More effective integration of disaster risk consideration into sustainable development policies, planning and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction.
2. Development and strengthening of institutions, mechanisms and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards.
3. Systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response and recovery programmes in the reconstruction of affected communities.

Five Priorities for Action and 22 Core Indicators

HFA Priority for Action 1: Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation.

Core Indicator 1: National policy and legal framework for disaster risk reduction exists with decentralized responsibilities and capacities at all levels.
Core Indicator 2: Dedicated and adequate resources are available to implement disaster risk reduction plans and activities at all administrative levels.
Core Indicator 3: Community participation and decentralization are ensured through the delegation of authority and resources to local levels.
Core Indicator 4: A national multisectoral platform for disaster risk reduction is functioning.

HFA Priority for Action 2: Identify, assess and monitor disaster risks and enhance early warning.

Core Indicator 1: National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.
Core Indicator 2: Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities.
Core Indicator 3: Early warning systems are in place for all major hazards, with outreach to communities.
Core Indicator 4: National and local risk assessments take account of regional/transboundary risks, with a view to regional cooperation on risk reduction.

HFA Priority for Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Core Indicator 1: Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems, etc).
Core Indicator 2: School curricula, education material and relevant training include disaster risk reduction and recovery concepts and practices.
Core Indicator 3: Research methods and tools for multi-risk assessments and cost–benefit analysis are developed and strengthened.
Core Indicator 4: Countrywide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.

HFA Priority for Action 4: Reduce the underlying risk factors.

Core Indicator 1: Disaster risk reduction is an integral objective of environment related policies and plans, including for land use, natural resource management and adaptation to climate change.

Core Indicator 2: Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk.
Core Indicator 3: Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities.
Core Indicator 4: Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.
Core Indicator 5: Disaster risk reduction measures are integrated into post-disaster recovery and rehabilitation processes.
Core Indicator 6: Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.

HFA Priority for Action 5: Strengthen disaster preparedness for effective response at all levels.
Core Indicator 1: Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective are in place.
Core Indicator 2: Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.
Core Indicator 3: Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.
Core Indicator 4: Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.

Levels of Progress:
Level 1: Minor progress with few signs of forward action in plans or policy.
Level 2: Some progress, but without systematic policy and/or institutional commitment.
Level 3: Institutional commitment attained, but achievements are neither comprehensive nor substantial.
Level 4: Substantial achievement attained but with recognized limitations in capacities and resources.
Level 5: Comprehensive achievement with sustained commitment and capacities at all levels.

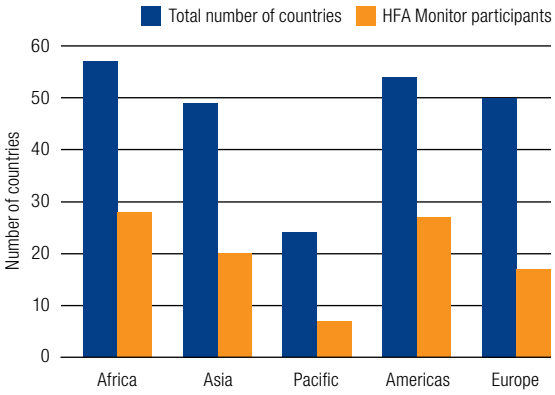
5.1 A global overview

Overall findings from the 2007–2009 HFA review broadly confirm the global trends identified in the Disaster Risk Reduction: Global Review 2007 [2]. Commitment to addressing disaster risk and achieving the strategic goals of the Hyogo Framework continues to gain momentum. By February 2009, 99 countries were in the process of preparing national reports using the online HFA Monitor tool, of which 62 provided completed interim progress reports as of 28 February 2009.

Proportionally, the Americas and Africa were the regions where most countries initiated reporting in 2008. In the Americas, 50% of countries participated; 49% of countries from Africa; 40% from Asia; 34% from Europe, and 29% from the Pacific. Absolute numbers of participants by region are shown in Figure 5.1.

As Figure 5.2 indicates, more countries participated from the medium (64%) and low (54%) human development categories than high (40%). The participation of countries with low

Figure 5.1: Participation in 2007–2009 HFA Progress Review: regional distribution



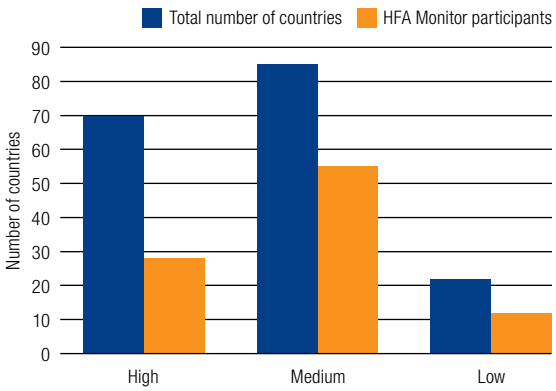


Figure 5.2: Participating countries: distribution by human development indicators

human development, particularly from Africa, is noteworthy and indicates growing commitment in the region to reducing disaster risk.

According to interim results provided online (and illustrated in Figure 5.3), progress has been significant under HFA Priority for Action 1 – ensuring that disaster risk reduction is a national and local priority with a strong institutional basis for implementation – particularly in the development of policy and legislation, and in strengthening multi-sector institutional systems and platforms for disaster risk reduction.

Significant progress has also been reported on HFA Priority for Action 5 – strengthening disaster preparedness for effective response at all levels – particularly in the development of technical and institutional capacities for disaster preparedness, putting disaster preparedness and contingency plans in place, and facilitating information exchange before and during disasters. In other words, there is an overall improvement of capacities, policy, legislation, plans and mechanisms for the reduction of mortality risk, in particular for weather-related hazards. This is consistent with the findings of Section 2.5 that mortality risk is increasing at a slower rate than economic loss risk, and is actually decreasing in relation to the size of the exposed population.

Consistent progress has been reported across HFA Priority for Action 2 – identifying, assessing and monitoring disaster risks and enhancing early warning – although all countries acknowledge the need for more focused efforts on this front. Countries are still challenged to compile comprehensive risk assessments in a way that can inform disaster risk reduction, link early warning with disaster preparedness and response planning, and use national information to inform local action.

Average global progress is weak across most areas of HFA Priority for Action 3 – using knowledge, innovation and education to build a culture of safety and resilience at all levels – particularly in the development and application of research methods and tools for

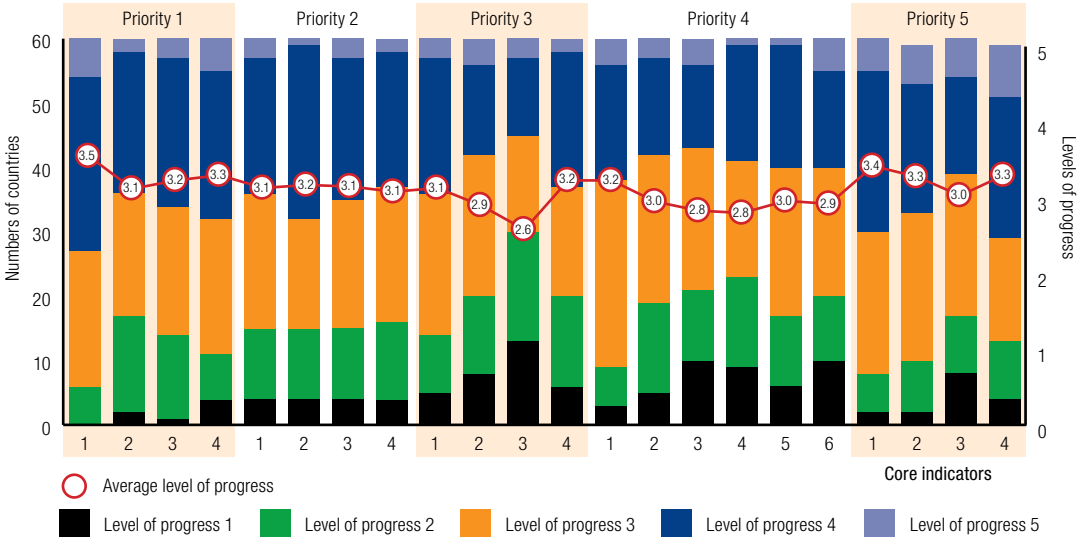


Figure 5.3: Illustration of average global progress across each of the Hyogo Framework Priorities for Action

multi-risk assessments, inclusion of disaster risk reduction and recovery concepts and practices in school curricula and education material, and the development of a countrywide public awareness strategy to stimulate a culture of disaster resilience. It is important to interpret this trend as a marker of the extent of progress being made relative to efforts in the respective areas of education, development of tools and research methods, and public awareness. In other words, a lot is being done with regard to each of these indicators, but countries report the need to do more and better.

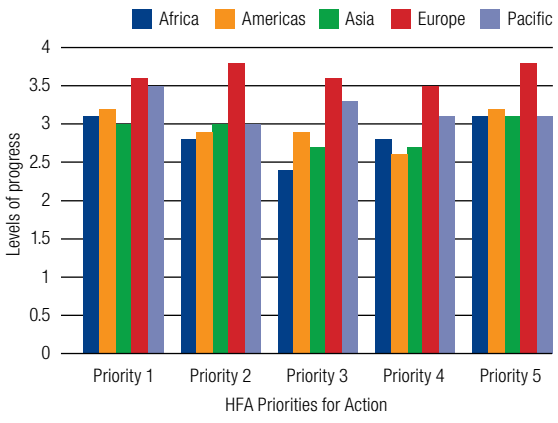
Critically, average global progress is also weak on HFA Priority for Action 4 – reducing the underlying risk factors – which refers to the integration of disaster risk reduction into social, economic, environmental and urban development, and into the planning of infrastructure projects. This is consistent with the trends reported in Section 2.5 that in many low- and middle income countries, economic loss risk is increasing faster than mortality risk, and in Section 3.3 that there has been a rapid increase in housing damage. As described in Chapter 4, these increases are often a consequence of badly planned and weakly regulated development. It would appear that countries have difficulty addressing underlying risk drivers such as poor urban and local governance, vulnerable rural livelihoods and ecosystem decline in a way that leads to a reduction in the risk of damages and economic loss. At the same time, the governance arrangements for disaster risk reduction in many countries do not facilitate the integration of risk considerations into development. In general, the institutional and legislative arrangements for disaster risk reduction are weakly connected to development sectors.

Globally, therefore, the results indicate that national efforts remain focused on strengthening policy, legislation, institutional frameworks and capacities for disaster preparedness, response, risk assessments, and early warning (HFA Priorities 1, 2 and 5). In contrast, much more effort needs to be made in using knowledge, education and innovative outreach programmes to stimulate a culture of disaster resilience, and to address the underlying drivers that configure disaster risk in social, economic and infrastructure development across rural and urban contexts (HFA Priorities 3 and 4).

The regional distribution of reported results (Figure 5.4) indicates that Europe, which is mostly represented by high-income and some upper–middle-income countries, reports higher progress than all other regions and across all priorities. Africa, with a majority of low-income countries, has made similar progress to other developing regions, except in Priorities for Action 2 and 3. The Pacific, weighted by the presence of high income countries like Australia and New Zealand, has made more progress in Priorities for Actions 1, 3 and 4 than all other regions except Europe. The Americas have made more progress than Asia, except in Priorities for Actions 2 and 4.

When the distribution of results is examined by income class (Figure 5.5), high-income countries, including most European countries, the United States of America, Canada, Australia, New Zealand, Bahrain and the Cayman Islands perform well across all Priorities for Action, whereas low-income countries, mainly in Africa, underperform in Priorities for Action 1, 2, 3 and 5. This result is coherent with the findings of Chapter 2 that, as countries develop, the governance capacities to reduce disaster risk generally improve. Middle-income countries outperform low-income countries in all Priorities for Action except Priority 4, though

Figure 5.4: Regional progress on HFA implementation



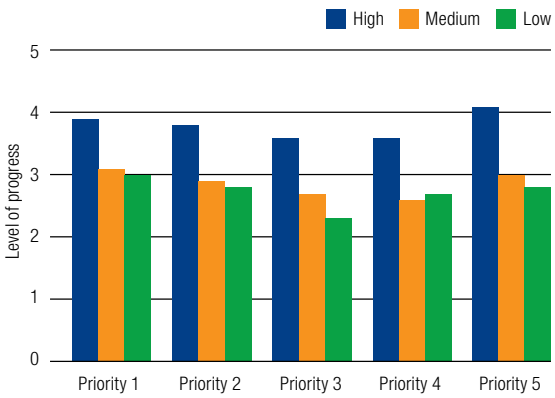


Figure 5.5: Hyogo Framework progress by income classification

the differences between middle and low-income countries are far less significant than between high-income and the other two categories. This reinforces the finding that fast growing low- and low-middle income countries have not been able to improve their risk-reducing capacities in a way that compensates for the rapid increase in exposure. As highlighted above, capacities to reduce mortality risk have been strengthened more effectively than capacities to reduce damage and economic loss.

5.2 Trends in progress: Implementation of the Hyogo Framework for Action

The sections below discuss the trends in progress and challenges reported in relation to the 22 indicators for the five Hyogo Framework Priorities for Action. While the analysis is illustrated by examples drawn from interim national reports, a more detailed description is provided in Appendix 3. Interim national reports are available in the accompanying CD and online[3]. Detailed regional reports cataloguing country-level progress prepared for the ISDR Global Platform for Disaster Risk Reduction[4] are also available online[5].

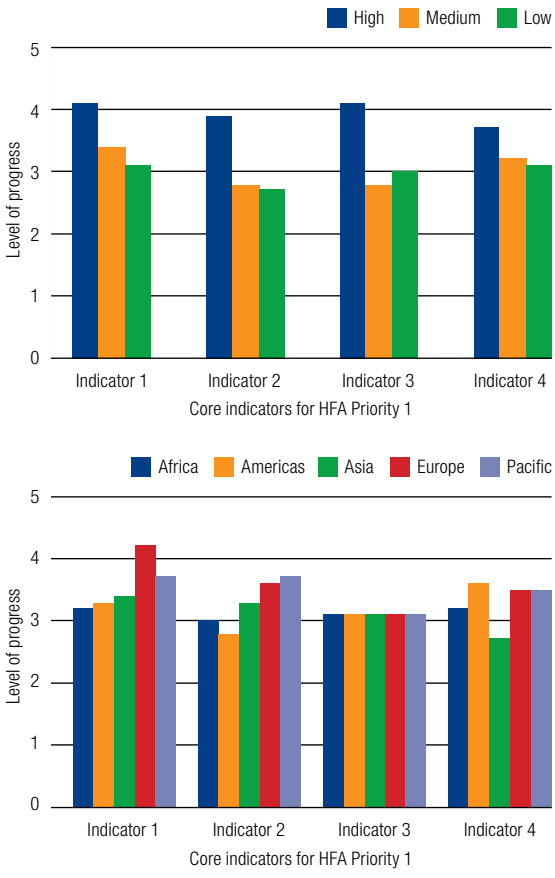


Figure 5.6: Average progress towards indicators for Priority for Action 1 by income class and region

5.2.1 Hyogo Framework Priority for Action 1: Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation

Countries that develop policy, legislative and institutional frameworks for disaster risk reduction and are able to develop and track progress through specific and measurable indicators have greater capacity to manage risks and to achieve widespread consensus for, engagement in and compliance with disaster risk reduction measures across all sectors of society.

Figure 5.6 shows the average progress towards the four indicators for this priority for high-, medium- and low-income countries, and the average progress by region. Table 5.1 details the challenges and progress reported.

Table 5.1: Challenges and progress reported for HFA Priority for Action 1: Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 1 National policy and legal framework for disaster risk reduction exists with decentralized responsibilities and capacities at all levels.	1. Lack of an overarching national policy and legal framework on disaster risk reduction, which does not facilitate a holistic approach, particularly in high-income countries. 2. Political inertia in approving legislation and in developing the necessary technical and legal instrumentation and administrative arrangements for its implementation. 3. Lack of adequate financial, human and technical capacities to address disaster risk reduction is reported as the major reason for underachievement in this area, particularly in low-income countries. 4. No explicit link between national policies on disaster risk reduction and sector policies (such as for land use, building, social and economic development and environment) and which leads to confusion regarding mandates and responsibilities for implementation, gaps and overlaps.	1. Cayman Islands is formulating a new Strategic Framework for Disaster Risk Management, backed by a new structure, the Hazard Management Cayman Islands. 2. Bahrain has instituted a National Committee on Disaster Management but also recognizes the need for a national policy. 3. Ecuador has included disaster risk management in its new constitution and, like Colombia, in its national development plan. 4. Decentralized systems of governance for disaster risk reduction in countries across Asia (the Philippines, Sri Lanka, and Iran, among others) provide opportunities for participation at the local governance and community levels.
Indicator 2 Dedicated and adequate resources are available to implement disaster risk reduction plans and activities at all administrative levels.	1. No systematic policy or institutional commitment has been made to providing dedicated or adequate resources for disaster risk reduction. 2. Competing national priorities, the absence of legislation that makes financial allocations legally binding, and lack of political will if the short-term benefits of disaster risk reduction are not visible. 3. Disaster risk reduction still heavily depends on resources from bilateral and multilateral cooperation. As a result, it is often implemented using short-term, stand-alone project or programme modalities, which generally do not facilitate its institutionalization or sustainability.	1. In Vanuatu the National Action Plan clearly tasks the Ministry of Finance and Economic Management with allocating ministerial budgets for disaster risk reduction to different ministries and departments. 2. Only a few countries, such as Colombia and Iran, report the inclusion of disaster risk reduction in their national budgets.
Indicator 3 Community participation and decentralization are ensured through the delegation of authority and resources to local levels.	1. Countries from Asia, Africa and Latin America report a substantial number of community-based risk reduction initiatives. However, coverage and quality is often uneven and projects are yet to be linked into a wider risk reduction system integrating the local, provincial and national levels. 2. Reporting indicates a growing dedication of efforts and resources towards strengthening capacities at both the local government and community levels. 3. Existence of national decentralization processes has been identified as a key success factor in strengthening and sustaining disaster risk reduction capacities at the local and community levels. 4. Active coordination of NGOs interested in work at the community level remains a challenge for national and local governments, particularly in those countries with limited resources to strengthen community capacities. 5. Local governments, particularly in rural and isolated areas lack the human, technical, financial and institutional capacities to address disaster risk.	1. In Europe and many high-income countries, municipalities and local governments often have mandatory responsibilities for disaster risk reduction, as well as the necessary capacities and resources. 2. Large, relatively wealthy urban municipalities such as Bogotá, Medellín (Colombia) and La Paz (Bolivia), have well-functioning city disaster risk reduction systems and are now as effective and in some cases better resourced than those at the national level. 3. In Asia, Bangladesh, Indonesia, Lao People's Democratic Republic, Nepal and the Philippines highlight budgets for risk reduction, but since these may often be centralized and/or prioritized for response and preparedness-related expenditures this can be an obstacle to strengthening local capacities for disaster risk reduction.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 4 A national multisectoral platform for disaster risk reduction is functioning.	1. Challenges exist in the creation of an integrated multi-sector institutional system for disaster risk reduction that could bring greater cohesion and synergy to ongoing sector-based approaches. 2. Difficulties in gaining commitment to disaster risk reduction from development sectors and local governments, as well as other stakeholders such as the private sector or civil society, due to a lack of political authority and the necessary technical capacities.	1. Countries such as Egypt[6] have created national committees, while in other countries such as Colombia, Costa Rica, Panama and the United States of America, national platform mechanisms have been adopted. 2. Central African states have addressed disaster risk management in a common strategy undertaken by the Economic Community of Central African States (ECCAS)[7], which adopted an environment and natural resources policy with a sub-regional plan of action in October 2007. The strategy aims to build the capacity of national and sub-regional authorities; review and enforce legal frameworks and disaster risk reduction strategies within ECCAS and member states; and to formulate and implement national strategies for disaster risk reduction. This includes the establishment and reinforcement of national platforms, inter-ministerial committees and an intergovernmental committee for the ECCAS region. 3. The National Controller's Office of Colombia carried out an audit of disaster risk reduction implementation across government, indicating a commitment by the state as a whole to ensure implementation across sectors and local governments.

5.2.2 Hyogo Framework Priority for Action 2: Identify, assess and monitor disaster risks and enhance early warning

The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in knowing the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face, and the ways in which hazards and vulnerabilities are changing in the short- and long-term, followed by action taken on the basis of that knowledge. Figure 5.7 shows the average progress towards the four indicators for this priority for high-, medium- and low-income countries, and the average progress by region. Table 5.2 details the challenges and progress reported.

Figure 5.7: Average progress towards indicators for Priority for Action 2 by income class and region

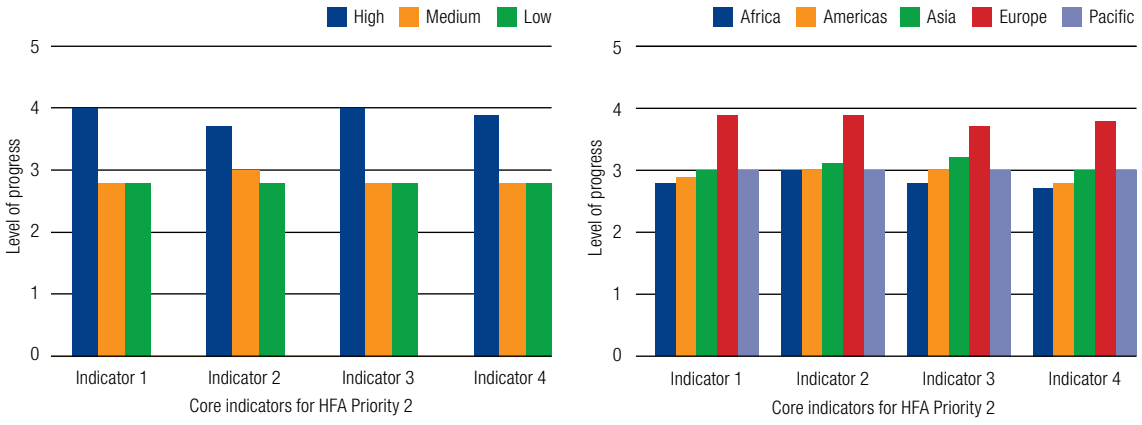


Table 5.2: Challenges and progress reported for HFA Priority for Action 2: Identify, assess and monitor disaster risks and enhance early warning

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 1 National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.	1. Most reports acknowledge that national and sector emergency plans are not based on risk assessments. Challenges include a generalized absence of sub-national or local data, particularly for new or less frequent hazards; weak or non-existent specialized institutions; financial constraints and a dependency on external partners that sometimes do not respond to national priorities. 2. While progress is being made in single hazard, sector and territory specific assessments, there is far less progress in achieving comprehensive national multi-risk assessments. 3. Experiences of institutionalization and application of such assessments in development and territorial planning, or for the design of building codes, is rarer still. 4. Responsibilities for both hazard monitoring and risk assessment are split between multiple institutions in most countries. Multi-risk assessment has no institutional 'home'. 5. Lack of standardized data sources and methodologies is a challenge reported, for example, by Indonesia that makes it difficult for results to be applied systematically across sectors.	1. Australia and New Zealand report a comprehensive, integrated, multi-hazard approach to risk assessment. Other examples include the state Government of Gujarat in India and the Cayman Islands. 2. Switzerland aims to cover the entire country with hazard maps and assessments by 2011, for both geological and hydrological hazards, and have them applied in land-use planning and building regulation by municipalities. 3. In Bangladesh progress has been made in the agriculture sector, while hospitals, schools, water and sanitation have been identified as urgent priorities. 4. Progress in community-level risk assessment is also reported, for example in the Philippines through the Hazards Mapping and Assessment for Effective Community-based Disaster Risk Management project[8]. 5. The IADB (Inter-American Development Bank)[9] is enabling the development of indicators for disaster risk management for 12 countries in the Americas. The Central American Probabilistic Risk Assessment[10] is another ongoing initiative which is a comprehensive disaster risk assessment for Central America. 6. In Africa, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Madagascar, Malawi, Mauritius, Mozambique, Seychelles, South Africa and Tanzania, all report undertaking disaster risk assessments for specific sectors and hazards.
Indicator 2 Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities.	1. Difficulties occur in coordination, sharing information and adopting common data standards and methodologies, when hazard monitoring is spread across many specialized institutions. 2. Lack of resources to acquire and maintain equipment and the general lack of human technical capacities is reported as a constraint. 3. Governmental responsibilities for hazard monitoring often rest with a wide range of scientific and technical bodies responsible for meteorology, geology, seismology, oceanography etc.	1. Hazard monitoring is recognized as a key activity that underpins both risk assessment and early warning. 2. Development of a seismic monitoring network in Tajikistan[11] is illustrative of the progress being made by many countries in improving hazard monitoring. 3. The National Service of Territorial Studies, El Salvador[12] has created a single institutional platform that brings together all the specialized scientific organizations under one framework and integrates hazard information to feed into risk assessments. Other countries are considering similar initiatives.
Indicator 3 Early warning systems are in place for all major hazards, with outreach to communities.	1. There is a lack of technical capacities, equipment, human and financial resources. 2. Difficulties occur in communicating early warning information to poor and vulnerable communities. Coordination is lacking between the institutions responsible for disaster preparedness and those responsible for hazard monitoring. 3. Strengthening of local capacities and the linking of hazard monitoring to disaster preparedness systems is reported as a common challenge.	1. Institutional commitment to developing end-to-end early warning systems for major and frequent hazards has been secured in all reporting countries in Asia. 2. Good progress has been reported in the use of both technology and local capacity to develop effective early warning systems for frequent hazards, such as cyclones and floods, in Lao People's Democratic Republic, Sri Lanka and Bangladesh. 3. Italy reports that early warning has been improved since the National Warning System has been in place. Information is compiled by a Central Functional Centre and Regional Functional Centres, and is circulated daily among decision makers of the National Civil Protection System.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 4 National and local risk assessments take account of regional/ transboundary risks, with a view to regional cooperation on risk reduction.	1. Transboundary initiatives are mainly dependent on member states' contributions, which implies that the signing of cooperation agreements is not necessarily reflected in implementation, or incorporated into national disaster risk reduction planning. 2. There is an absence of common databases and equipment to monitor and assess transboundary risks. Countries report unwillingness to share sensitive information with neighbours on particular hazards.	1. Germany is an active member of several transboundary international commissions for the protection of the Rhine, Danube, Elbe and Odra Rivers, which all carry out flood risk assessments. 2. In September 2007 government representatives of Albania, Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, Montenegro, Moldova, Romania, Slovenia and Turkey took an important step forward in their efforts to improve the region's disaster preparedness, prevention and response capability and coordination by signing a Memorandum of Understanding on the Institutional Framework of the Disaster Preparedness and Prevention Initiative for South Eastern Europe[13]. 3. Armenia has signed an intergovernmental agreement on seismic risk reduction with the Islamic Republic of Iran and the Republic of Tajikistan; an international Armenian–Russian project on seismic hazard prediction in the Caucasus has been renewed between Armenia and the Russian Federation. 4. Angola, Burkina Faso, Côte d'Ivoire, Ghana, Mauritius and Togo report substantial progress in cooperation with neighbouring countries to reduce transboundary risks, including flooding in shared watersheds, tsunami early warning systems, locust infestations and health-related risks. 5. Collaboration on transboundary risk management is often institutionalized through Regional Economic Councils such as ECOWAS[14], the Southern African Development Community (SADC) and the African Union (AU), as well as through regional meteorological services such as the Comité permanent inter-États de lutte contre la sécheresse dans le Sahel. However, it is recognized that a more prominent lead by the Regional Economic Councils would serve to enhance and regulate cooperation and information exchange amongst member countries. 6. Progress has been possible in the Americas due to the large number of sub-regional and regional initiatives aimed at improved coordination, information sharing and collaboration. These include CDERA, Association of Caribbean States, CAPRADE, PREDECAN, and the regional programme of the European Union – Programma regionale di Programma regionale di riduzione della vulnerabilità e del degrado ambientale. 7. Regional frameworks for disaster risk management in Asia to address transboundary risks for hazards across the Asian sub-regions are advancing through cooperation agreements in the context of ASEAN and SAARC.

Box 5.2: Status of early warning systems[15]

A global report on the status of early warning systems has been prepared, based on an extensive survey of national capacities for meteorological, hydrological and climate-related forecasting and warning services conducted by the WMO, and a survey carried out by the ISDR Platform for the Promotion of Early Warning and the United Nations University's Institute for Environment and Human Security, with input from international agencies that support the development of early warning systems.

The report presents a comprehensive analysis of capacities of national stakeholders with a focus on governance and organizational coordination; capacities for forecasting, detection and monitoring of hazards; international, regional and national dissemination and communication capacities; and capacities for linking warnings to emergency preparedness and response mechanisms at national to community levels. The report also examines the level of international and regional cooperation in support of strengthening national early warning systems.

The report states that while there has been some progress in strengthening early warning systems, greater commitment to addressing the development of these capacities is needed. Key issues highlighted in the report include:

1. Existing national and local emergency preparedness and response plans need to be re-evaluated, based on hazard and vulnerability mapping, and must be supported by enforceable legislation. These plans need to clearly indicate the line of command, roles and responsibilities of different agencies engaged in different components of early warning systems. They must also be aligned across community, provincial, and national levels, ensuring that financial and operational resources are routed to communities for improving preparedness and response operations on the ground.
2. There is a need for further strengthening of the monitoring and forecasting infrastructure and staff skills of technical agencies (for example, national meteorological, hydrological, geological, and ocean services) that are responsible for monitoring and forecasting of hazards. This needs to be further complemented by strengthened cooperation, coordination and knowledge-sharing among the technical agencies and with their disaster risk management counterparts.
3. National technical agencies could benefit from strengthened regional cooperation on access to data and the latest tools and technologies for monitoring and forecasting of hazards. Such cooperation has been demonstrated by a number of existing regional cooperation mechanisms such as the Pacific and the Indian Ocean Tsunami Warning System (coordinated by UNESCO Intergovernmental Oceanographic Commission) and the WMO Global Tropical Cyclone Programme, which provides tropical cyclone and storm surge forecasts and bulletins through six regional specialized centres to all countries at risk. Furthermore, strengthened cooperation is needed among neighbouring countries to establish standards, procedures and protocols for warnings on transboundary issues.
4. Standardized hazard and impact databases need to be established, and technical capacity needs to be built at the national level in the use of hazard and risk mapping tools to support emergency response and preparedness planning and the integration of risk information in warning messages.
5. In most countries, dissemination channels that link national warning systems to communities need to be significantly strengthened, taking into consideration cultural norms and communities' requirements, and the resources available. Feedback mechanisms to verify that warnings have reached the appropriate authorities and at-risk communities must be established. Furthermore, there is a need for training programmes targeted at the authorities, emergency response staff and the public to assist them to understand the source and content of warning messages, and to link this information to concrete actions on the ground, based on risk level (for example, the establishment of risk readiness levels).
6. Emergency preparedness and response plans need to be developed utilizing hazard and vulnerability maps. More drills and public awareness programmes are needed at the community level, particularly when the community does not experience hazards frequently.
7. Concept of operations and standard operational procedures need to be developed for early warning systems for different hazards, enabling effective coordination and cooperation across various components of the systems from national to local levels.
8. Early warning system programmes should be complemented by an effective regional–national–local, multi-agency operational evaluation and feedback mechanism to improve the systems over time.
9. Strengthened cooperation, coordination and strategic planning among international agencies could lead to a more effective approach for the development of national early warning system programmes.

5.2.3 Hyogo Framework Priority for Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Disasters can be substantially reduced if people are well informed and motivated to adopt a culture of disaster prevention and resilience, which in turn requires the collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities. Figure 5.8 shows the average progress towards the four indicators for this priority for high-, medium- and low-income countries, and the average progress by region. Table 5.3 details the challenges and progress reported.

Figure 5.8: Average progress towards indicators for Priority for Action 3 by income class and region

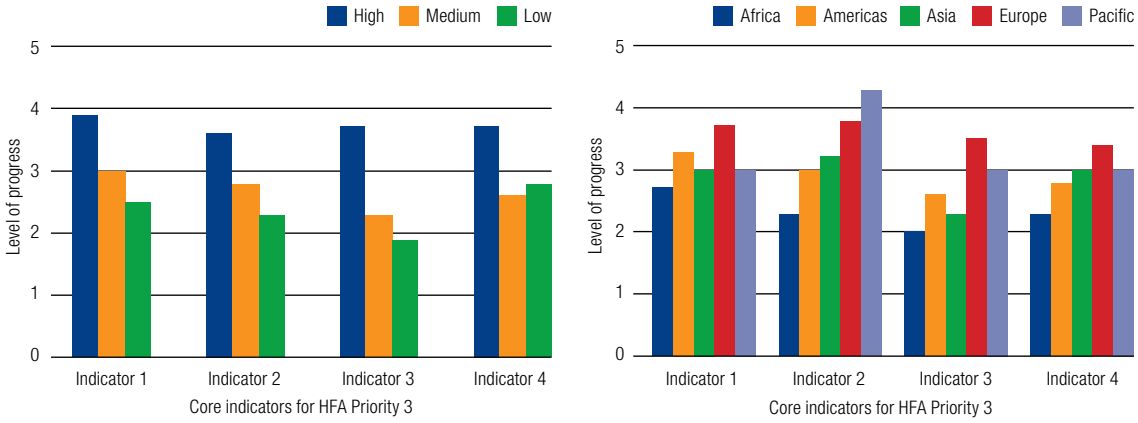


Table 5.3: Challenges and progress reported for HFA Priority for Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 1 Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems, etc).	1. Challenges include the need to make information appropriate and specific to risk and cultural contexts. 2. Difficulties were reported in ensuring that databases are updated and maintained. 3. There is a need to move from disaster preparedness and response to a focus on new emerging themes such as adaptation to climate change, environmental degradation and urban risks. 4. Few countries can ensure that households have easy access to accurate information on the risks they face. Lack of progress in the development of comprehensive risk assessments and early warning systems undermines the value of information systems.	1. Ghana publishes 'handbills' for distribution to all stakeholders nationwide that show where disasters occur, the extent of the impact and recovery initiatives undertaken. 2. Internet-based tools and databases, including disaster databases[16] and the results of hazard and risk assessments, are now increasingly accessible to both national and local stakeholders. The Swedish Emergency Management Agency[17] for example has developed a national, Internet-based information system, called WIS. The system was created to facilitate information sharing between players in the national emergency management system before, during and after emergencies. 3. Regional knowledge networks across Asia are active in producing information relating to 'learning from disasters' and 'preparing for disasters' and materials are widely disseminated across countries that have experienced recent major earthquakes, flooding, cyclones or tsunami events. Knowledge fairs and international campaigns are other tools that have been used for information dissemination.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 2 School curricula, education material and relevant trainings include disaster risk reduction and recovery concepts and practices.	1. Challenges include the lack of capacity among educators and trainers. 2. Difficulties were noted in addressing needs in poor urban and rural areas. 3. There is a lack of validation of methodologies and tools and little exchange of experiences. 4. Some countries report the absence of policy and guidelines on how to integrate disaster risk reduction into curricula, education materials and training, despite there being systematic policy and institutional commitment. 5. Most of the countries that have not yet integrated disaster risk reduction into the school curriculum, cite the lack of educational materials, especially in vernacular languages, as a major obstacle.	1. The 2006–2007 international disaster risk reduction campaign Disaster Risk Reduction Begins at School [18] has furthered and raised awareness of the importance of the education agenda across some countries. 2. The Central American and Dominican Republic Framework for Education and Disaster Risk Reduction has been established as a Latin American regional thematic educational platform, with the support of UNISDR, a network of universities, and regional and international agencies. 3. Systematic policy or institutional commitment has been achieved in Australia, Indonesia, the Islamic Republic of Iran, Lao People's Democratic Republic, Nepal, New Zealand, the Philippines, the Republic of Korea and Syria. 4. Yemen reports difficulties with language barriers because much material has not been translated into Arabic. An active Knowledge and Education for Disaster Risk Reduction Platform is now functional in the region, which may contribute to increasing future capacities in this area. 5. In Angola and Burundi, UNICEF has collaborated with the Ministries of Education in arranging workshops and promoting the integration of disaster risk reduction into education. 6. In Madagascar, the Ministry of Education and the UN have jointly developed school materials on disaster risk reduction and manuals that are used in all schools throughout the country. 7. Mozambique has started pilot projects in primary schools, to train teachers and children how to live with disasters. 8. In Burkina Faso, environmental education has been adopted at primary school level and disaster risk reduction is partly integrated into higher education.
Indicator 3 Research methods and tools for multi-risk assessments and cost–benefit analysis are developed and strenghtened.	1. Constraints were reported in financial, technical and human capacities. 2. The strong dependency on external funds and partners, with a lack of transfer of skills and competency, is seen as an obstacle. 3. Progress in some regions like the Americas and Asia has mainly depended on a range of specific initiatives through universities and research institutions, insurance companies and development banks, rather than coherent national programmes. 4. Tools are available but, due to the lack of a functional institutional and policy framework linking the disaster risk reduction and development sectors, most research has not led to mainstream applications in development planning and investment decisions.	1. Bangladesh reports success in the development of community risk assessment methods and tools. Up-scaling is challenged by the absence of a centralized agency that could act as a repository of technical information and advice on the suitable application of tools across the territory.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 4 A countrywide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.	1. Increased awareness does not necessarily lead to a reduction in disaster risks. For instance, poor rural and urban households are faced with severe livelihood and environmental constraints on their ability to reduce risk that cannot be addressed by awareness alone.	1. Tools and guidelines include RiskPlan[19] in Switzerland, to learn about and implement disaster risk reduction, and EconoMe[20], to justify investments in risk reduction. 2. In New Zealand, a long-term public education programme and social marketing campaign, 'Get Ready, get Thru', was launched in 2006, aimed at greater individual and community preparedness for disasters[21]. 3. In Africa, almost all reporting countries state that they have public awareness campaigns in place which cover national, regional and community levels. Many of the countries with awareness campaigns utilize media such as radio, newspapers and television, with Mauritius, Mozambique and Madagascar reporting a high level of public awareness for the main risks. 4. Examples of effective impacts from international campaigns include the Safe Hospitals Campaign, launched by the WHO, ISDR and the World Bank, to raise awareness that disaster damage to health systems can have an enormous impact on economic and human development. At the same time, even small investments in making health facilities safer can considerably reduce the impact of disasters. The campaign provides a platform for strengthening hospitals, health facilities and systems in the context of risk reduction and emergency preparedness and response.

5.2.4 Hyogo Framework Priority for Action 4: Reduce the underlying risk factors

Disaster risks related to changing social, economic and environmental conditions and land use, and the impact of hazards associated with geological events, weather, water, climate variability and climate change are addressed in sector development planning and programmes as well as in post-disaster situations. Figure 5.9 shows the average progress towards the four indicators for this priority for high-, medium- and low-income countries, and the average progress by region. Table 5.4 details the challenges and progress reported.

Figure 5.9: Average progress towards indicators for Priority for Action 4 by income class and region

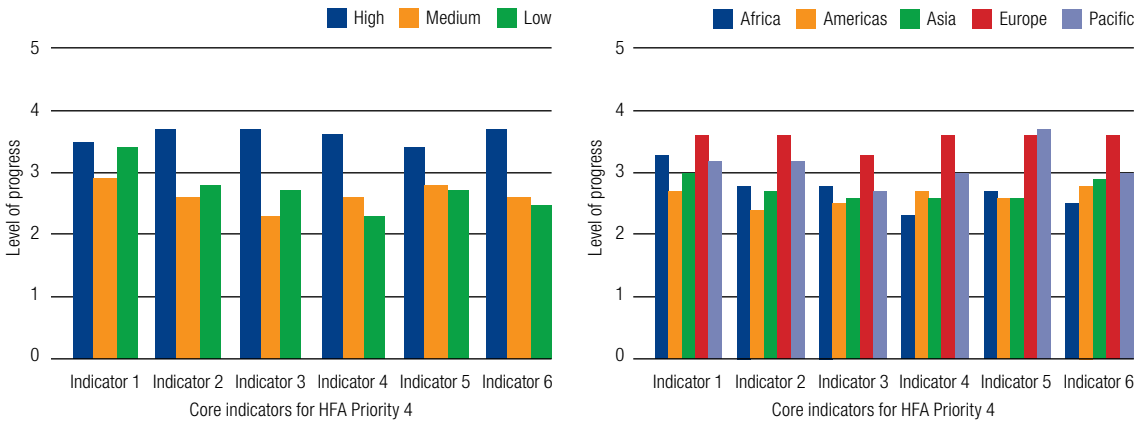


Table 5.4: Challenges and progress reported for HFA Priority for Action 4: Reduce the underlying risk factors

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 1 Disaster risk reduction is an integral objective of environment related policies and plans, including for land use, natural resource management and adaptation to climate change.	1. There is a general lack of application and enforcement of environmental standards, norms and regulations. 2. There is little synergy between land-use planning, strategies to adapt to climate change, environmental protection laws, other similar instruments, and policy and legislation addressing disaster risk. 3. Organizations responsible for disaster reduction often have neither the political authority nor the technical capacity to intervene in environmental planning and regulation. While disaster risk reduction and environmental policy and legislative frameworks may acknowledge each other, real integration in practical terms is lacking.	1. Many countries in the Americas and Asia have established environment and climate change as national priorities and have developed relevant legislation, policy and institutional frameworks. 2. Environmental protection and adaptation to climate change have been established as priorities in all regions, and most countries have legislation, policies and institutional frameworks to address a range of environmental and natural resource management concerns. 3. Most countries are signatories to the United Nations Framework Convention on Climate Change (UNFCCC) and to the Kyoto Protocol, and are developing strategies and plans to address climate change, an issue that will be revisited later in this chapter. 4. The Marshall Islands report that the implementation of Environmental Impact Assessment (EIA) regulations started only in 2005, with a constantly increasing number of large projects complying with the requirements (up from five in 2005 to 40 in 2007). A test case for the EIA process was a dry dock project which was denied on the basis of the inappropriate nature of the site. 5. Other countries have adopted a regional, transboundary approach. For example, disaster risk reduction in East Africa[22] presents a good example of how East African countries are working together to tackle concerns emanating from climate change processes.
Indicator 2 Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk.	1. While PRSPs and similar instruments mention disaster risk reduction, this may not reflect a real integration of poverty and disaster risk reduction policy frameworks and programme initiatives in practice. As with environment, the organizations responsible for disaster reduction may not have the political authority or the technical capacity to intervene in the design of social development and poverty reduction plans and programmes. It should be noted that very few countries report a substantial reliance on social equity considerations as a driver of progress.	1. A considerable number of countries report that social development plans to reduce the vulnerability of disaster risk prone communities are in place. 2. Many countries reporting from Africa have social development policies, plans or programmes that address vulnerability and poor living conditions through improving water supply, sanitation, food security, health and literacy. Some countries, such as Burkina Faso, Côte d'Ivoire, Guinea, Swaziland and Togo, report having integrated disaster risk concerns into their PRSPs. Mauritius and Tanzania have special emergency assistance funds in place, while Mozambique is working to create alternative income activities for vulnerable sectors and invest in drought resistant crops. 3. In the Americas, most countries report that commitments to the MDGs, poverty reduction and social inclusion are included in development plans and strategies as well as in institutional mechanisms. 4. Countries in Asia report the increasingly targeted action of national and local plans to reduce social and economic vulnerability. The Philippines reports the efforts of the National Poverty Commission, which has designed a poverty reduction strategy for people in hazard prone areas that incorporates interventions ranging from microfinance and insurance instruments to rice credits, cheap food and burial benefits.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 2 continued		5. Australia and New Zealand report that an explicit 'social inclusion agenda' must be incorporated into all national and local development policies and plans. 6. Bangladesh reports growing diversification of social safety net programmes, with an active role for NGOs. Some reports cite the need for detailed evaluations to identify the exact benefits for communities and to better understand the interrelation between microfinance and risk reduction.
Indicator 3 Economic and productive sectorial policies and plans have been implemented to reduce the vulnerability of economic activities.	1. The costs of disaster risk are not normally factored into public investment decisions. As a result, disaster risk reduction considerations become factored into economic and productive development on an ad hoc rather than a systematic basis. 2. Underlying problems include the difficulties surrounding economic development planning itself. African countries, for example, highlight political instability, poverty and weak governance as factors which endanger the implementation of economic development plans. 3. There is little systematic integration of economic development and disaster risk reduction policies and legislation. As in other sectors, it seems that in most countries disaster risk reduction organizations do no have the political authority or technical capacity to intervene in economic development planning.	1. In the Republic of Korea the Support for Enterprises Voluntary Disaster Mitigation Activities Act of 2007 provides small and medium businesses with guidelines and standards for disaster risk reduction. 2. Australia's Trusted Information Sharing Network provides a forum in which the owners and operators of critical infrastructure can work together by sharing information on security issues. 3. In Peru, the Ministry of Economy and Finance has fully incorporated disaster risk reduction into the National System for Public Investment[23], which requires a risk evaluation to improve all public investment across sectors and in both central and local government (see Box 5.3). 4. The Planning and Economic Policy Ministry in Costa Rica has recently added disaster risk evaluation to its requirements for approval of public investment projects.
Indicator 4 Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.	1. Weak implementation and enforcement mechanisms are common to all countries where most urbanization is informal. The lack of coverage of this issue in reports suggests that there is less activity now in introducing hazard resistant building into risk prone, informal urban and rural housing (for example, through mason training and the introduction of appropriate technologies) than there was in the 1970s and 1980s, with some notable exceptions such as Pakistan.	1. Senegal and Cape Verde report the inclusion of disaster risk reduction into their building codes. 2. Angola, Congo, Mozambique, and Togo report that risk considerations are factored into land-use planning and settlement siting decisions. 3. Algeria is involved in efforts to improve building codes and planning laws to reduce future risk. 4. A large number of cities, including Amman, Aqaba, Bogota, Caracas, Istanbul, Kathmandu, Kerman, La Paz, Lima, Manila, Mumbai, Quito and Tehran have developed a comprehensive understanding of their exposure to hazards and are in the process of taking steps to improve their capabilities to respond and reduce disaster risks. Some have done so under their own initiative – others with support from national governments; international organizations, such as the World Bank and UNDP; or NGOs such as EMI and Geo-hazards International. 5. Progress is also being made in some countries to ensure that public facilities such as schools or hospitals are either retrofitted or built to hazard resistant standards. Significant investments by Colombia and Iran to retrofit schools to seismic resistant standards are excellent examples of this kind of initiative. In 2007, Iran also initiated retrofitting residential buildings in rural areas, aiming to retrofit around 300,000 houses annually.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 4 continued		6. Disaster resilient schools and health facilities are being built in cooperation with the World Bank in Madagascar, while in the Americas increasing concern for the safety of schools and hospitals and critical infrastructure is also reported. 7. The priority given to emergency preparedness and risk reduction by national governments and communities in Latin America and the Caribbean has reduced vulnerabilities and risks, and turned previously frequent hazardous impacts with disaster potential into more manageable events. This has been achieved with strong and sustained support by the WHO/Pan American Health Organization, multilateral and non-governmental organizations.
Indicator 5 Disaster risk reduction measures are integrated into post-disaster recovery and rehabilitation processes.	1. Overall, most counties report that there has been much discussion around this issue in past years, in the aftermath of recent, large-scale disasters. However, thorough and consistent implementation of these recovery principles is yet to be seen. 2. Recovery and reconstruction projects and programmes are generally stand-alone initiatives with clearly bounded limits. Therefore, even when disaster risk is effectively incorporated, it does not necessarily lead to a more mainstream adoption of disaster risk considerations into ongoing planning and regulation systems. 3. Lack of political will and initiative to recognize disaster risk, the pressure to rebuild quickly and the absence of pre-existing mechanisms and capacities to support hazard resistant, owner-driven housing, are all obstacles that inhibit the use of reconstruction as a window of opportunity for disaster risk reduction. It is found that even if hazard resistant construction is promoted and achieved, this does not always address the needs of poor urban and rural households, nor of specific social groups such as women headed households.	1. The reconstruction of Bam, Iran, following the 2003 earthquake is a good example of how reconstruction processes have provided good entry points for the introduction of hazard resistant construction if the necessary political will and institutional commitment are present[24]. 2. The early recovery model in Mozambique[25] shows that it is possible to integrate disaster risk reduction into post disaster recovery and reconstruction, provided that this is factored into the design of recovery plans and strategies from the beginning. 3. A number of initiatives are now beginning to address the issue, through mechanisms such as IRP and the Cluster Working Group on Early Recovery[26]. For example, the IRP is promoting an Earthquake Risk Reduction Preparedness and Recovery Programme[27], through UNDP. This aims to promote regional partnerships and enable appropriate and fast implementation of recovery activities with SAARC, including Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.
Indicator 6 Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.	1. While environmental impact assessments of major development projects are carried out, these do not necessarily include disaster risk considerations. 2. Procedures and regulations may be in place but insufficient technical and human resources exist to evaluate and approve projects or for enforcement. Only 35% of African countries state that they conduct impact assessments and, again, these mainly focus on environmental impact. 3. Awareness of the role that inappropriate development projects may have in increasing disaster risk is very low (except in the case of some infrastructure projects, such as dams) while the political and economic interests at stake may be very high. It is still rare for the opportunity costs and co-benefits of alternative ways of providing infrastructure to be identified in a way that reduces the disaster risk faced by poor urban and rural households.	1. In Peru, mandatory evaluations of disaster risk reduction have been incorporated into the National System for Public Investment.

Box 5.3: Investing in disaster risk reduction, the case of Peru

Table 5.5 shows detailed estimates of the cost of factoring disaster risk reduction considerations into public sector investments in Peru (prepared by the Ministry of Economy and Finance)[28] in comparison with the avoided losses and reconstruction costs over a period of ten years for different probabilities of disaster occurrence, ranging from a 25% to 100% probability of a disaster occurring in ten years.

This indicates that at a 75% probability of disaster loss in 10 years, all the investments in disaster risk reduction were cost-effective. At a 25% probability four of the six investments were cost-effective. Furthermore at the 75% probability level, the ratio of benefits to costs ranged from 1 to 37.5. This indicates that the much quoted estimate that investments in disaster risk reduction produce benefits of seven times the cost needs to be nuanced, according to the kind of investment and the probability of loss. The key point is that most disaster reduction investment should be viewed as a very effective way of reducing the real costs of addressing the underlying risk factors.

Table 5.5: Cost–benefit analysis of public investment projects in Peru[29]

Note: Shaded cells indicate that value of avoided losses exceeds additional costs of disaster risk reduction investment

		Estimated value of avoided losses and reconstruction costs			
Public investment project	**Additional cost of disaster risk reduction (US$)**	**25% probability of disaster in 10 years**	**50% probability of disaster in 10 years**	**75% probability of disaster in 10 years**	**100% probability of disaster in 10 years**
Reconstruction of housing and water infrastructure following the 23 June, 2001 earthquake in Castilla Province	382,788	132,601	265,202	397,802 Benefit / cost ratio = 1	530,403
Prevention and preparedness for mudslides and floods in the upper Rimac Valley	95,616	330,986	661,971	992,957 Benefit / cost ratio = 10	1,323,942
Extension of the Pampacolca health centre (module to attend pregnant women)	15,570	6,789	13,579	20,368 Benefit / cost ratio = 1.3	27,158
Rehabilitation and construction of dykes in the Cansas Valley	1,958,539	24,441,946	48,883,891	73,325,837 Benefit / cost ratio = 37.5	97,767,783
Rehabilitation of the Machupicchu hydroelectric plant	9,276,153	57,452,287	114,904,573	172,356,860 Benefit / cost ratio = 19	229,809,147

5.2.5 Hyogo Framework Priority for Action 5: Strengthen disaster preparedness for effective response at all levels

At times of disaster, impacts and losses can be substantially reduced if authorities, individuals and communities in hazard prone areas are well prepared and are equipped with the knowledge and capacities for effective disaster preparedness and response. Figure 5.10 shows the average progress towards the four indicators for this priority for high-, medium- and low-income countries, and the average progress by region. Table 5.6 details the challenges and progress reported.

Figure 5.10 : Average progress towards indicators for Priority for Action 5 by income class and region

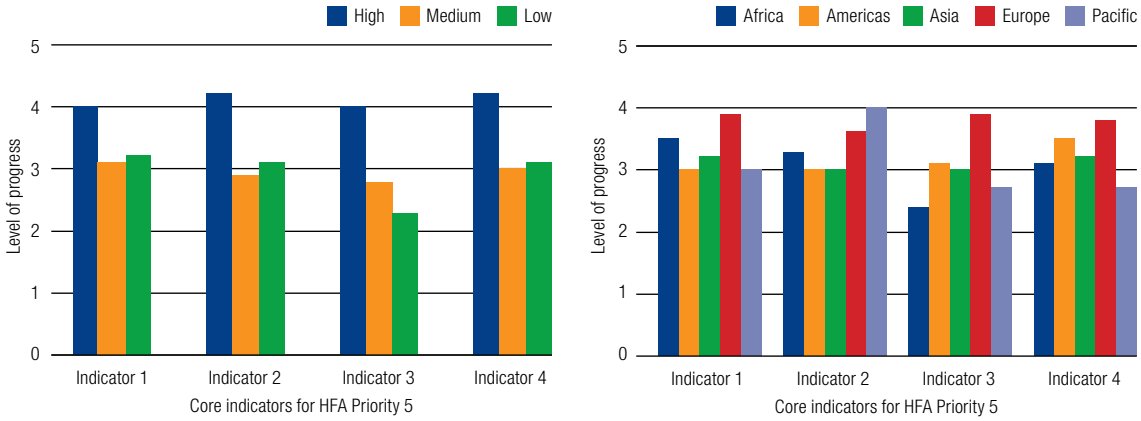


Table 5.6: Challenges and progress reported for HFA Priority for Action 5: Strengthen disaster preparedness for effective response at all levels

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 1 Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective, are in place.	1. Countries report a lack of appropriate policies and legislation for disaster risk management with a decentralized allocation of capacities and resources. 2. While a disaster risk reduction perspective has been introduced into the language of many national disaster management institutions and into a range of activities, in practice it is usually consistent with a shift in emphasis from response to preparedness and from an ad hoc to a planned approach, complemented by specific investments in hazard mitigation, for example the construction of river defences. 3. Needs identified in this area include increased and permanent budgetary allocation and financial support, resources, and capacity development, particularly at the local level. Some countries still report a lack of political commitment to move the focus from emergency response towards disaster risk reduction. Germany and Norway explicitly note the integration of disaster risk reduction measures.	1. All countries, and particularly those in Asia and the Americas, report overall progress in strengthening their capacities to manage disaster risks. 2. The Government of Saint Lucia has worked with the World Bank to strengthen DRM capacities since 1998. Over the past ten years, two of its projects have reduced the country's vulnerability through a range of investments in risk mitigation activities, including the construction of sea defences, the reinforcing and retrofitting of key infrastructure and strengthening the capacity of the National Emergency Management Office. 3. Most countries in Africa report the establishment of institutions for disaster management and deem capacities and mechanisms 'sufficient', but with scope for improvement. 4. UNOCHA[30] has been promoting disaster preparedness and prevention at the national, regional and global levels through its initiatives with the Capacity for Disaster Risk Reduction Initiative and the Guidance and Indicator Package for Implementing Priority Five of the Hyogo Framework for Action with UNISDR, among other activities.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 2 Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.	1. Emergency plans exist in all countries but the extent to which they are implemented systematically at all levels varies widely. 2. Drills and simulations occur but not methodically nor necessarily in all areas. 3. There is a need to systematize experiences, coordinate efforts at the different levels to ensure consistency in carrying out simulations, as well as for developing and/or updating contingency plans. 4. Major weaknesses are identified in local capacities in many high risk areas, in the absence of methodical and regular drills and simulations, outdated contingency plans, and a lack of accountability.	1. Italy reports that a National Civil Protection Fund has been set up, with the allocation of regional funds and contingency mechanisms. 2. Syria reports that contingency plans are available for all administrative levels and field training is conducted by using crisis management techniques listed in contingency plans. The training is evaluated in order to identify strengths and weaknesses. 3. Progress reported from Mozambique shows that the implementation of plans has as much to do with political will and good organization as with the availability of financial resources. 4. Following a regional survey, the WHO Office for the Eastern Mediterranean Region has developed a model for planning emergency preparedness and risk reduction programmes, with community capacity enhancement as the ultimate goal. Broad goals and specific skills for local disaster planning programmes have been identified. Training tools on emergency preparedness, response and recovery for use in community-based intervention areas are being developed. An optimum package for risk reduction, emergency preparedness and response is in development. A multi-hazard and risk atlas is being developed.
Indicator 3 Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.	1. Experience with contingency funds is varied. Governments may use the funds to cover other contingencies or budget deficits, while they are often insufficient to cover the response and recovery costs of a large-scale disaster. 2. Emergency programmes are often dependent on external funds because those allocated at the national level are ad hoc or, in some countries, no core funding is allocated for such contingencies. 3. Often, government responsibility for household level disaster loss is not explicitly defined, which is a major obstacle to the development of insurance-based mechanisms. In particular, small scale recurrent losses associated with extensive risk may not be addressed at all. 4. Across much of Africa, Asia and the Americas, countries still have to rely on unpredictable international humanitarian assistance to address response and recovery needs.	1. Some countries report the establishment or existence of contingency funds. In Africa, for example, Kenya, Malawi, Mozambique, Seychelles, South Africa and Tanzania, report the existence of a fund, as do a number of countries in the Americas (Colombia, Costa Rica and El Salvador) and in Asia (Iran, the Philippines) and the Pacific (Australia, New Zealand). In Bolivia, 0.15% of the national budget is dedicated to a contingency fund. It is important to highlight that disaster risk reduction, however, requires sustainable ongoing investments not dependent on emergencies. 2. Insurance and new mechanisms such as catastrophe pools and bonds are now being increasingly adopted in upper middle-income countries in order to replace traditional relief and reconstruction funding from government and international sources. Mexico has issued a catastrophe bond to provide a funding mechanism for response and recovery in the case of a major earthquake. Such mechanisms are an emerging good practice that will be examined in greater detail in the next chapter.
Indicator 4 Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.	1. Overall progress in this area is often a result of ad hoc initiatives rather than institutionalized practices or strategies per se. In the recent past, there has been increased recognition of the need for coordination on information management and dissemination functions in post-disaster scenarios. However, it has been challenging to coordinate information both within and between multilateral organizations such as the UN and the World Bank, and the national authorities responsible for disaster management, relief, recovery and rehabilitation.	1. Ghana has established a website and regions are linked by VHF radio. Kenya has put in place a National Disaster Operation Centre. The Mauritius Meteorological Centre has established an effective communication system for use during disasters. These achievements, however, may refer to emergency communication rather than information management in a broader sense. The Marshall Islands report that securing resources for continuous information exchange is a challenge.

Indicators	Challenges reported	Progress reported: trends and examples
Indicator 4 continued	2. Standardized information systems, protocols and procedures for information management need to be in place before disasters occur and must be able to manage damage and loss information, and recovery-need information, as they arise. 3. Evaluations, such as a recently completed study of the ten years following Mitch in Central America by the World Bank[31], show how both affected countries and donors alike may quickly forget about commitments made in the aftermath of a regular disaster. Frequent post-disaster evaluations with broad stakeholder participation are therefore critical to promoting greater accountability.	2. Post-disaster evaluation is becoming more widespread, highlighted by the experience of the Tsunami Evaluation Coalition. 3. Countries such as Armenia and Turkey report taking into account the experiences of past disasters to prepare emergency response plans, development and research projects, purchase new equipment, and educate and train members of rescue and relief forces, as well as the public. 4. In Jamaica, information and lessons learnt are shared and communicated through reports from all sectors after a disaster event.

5.3 Drivers of progress

'Drivers of progress' are the factors that catalyse the achievement of substantial progress in disaster risk reduction. These factors vary across national and local contexts, but typically emphasize the issues that countries consider important for integration into plans, policies and programmes as a means of achieving disaster risk reduction goals.

Member states were requested to assess the extent to which disaster risk reduction efforts rely on drivers of progress such as multi-hazard integrated approaches; integrating gender perspectives into risk reduction and recovery; capacity development for disaster risk reduction; human security and social equity approaches; and engagement and partnerships for disaster risk reduction. The information reported is too generic to permit an in-depth analysis of these drivers, but does indicate some general tendencies.

More than 45% of countries report substantial and ongoing reliance on engagement and partnerships as a driver of progress in reducing disaster risks. While major differences between countries and regions exist, there is increased participation by NGOs, the private sector, academic and scientific organizations and civil society in general. This may also be due to the large number of disaster risk reduction initiatives in low- and middle-income countries that rely heavily on international partnerships, technical assistance and resources from bilateral and multilateral organizations. The reliance on engagement and partnerships may also reflect the growing role of sub-regional and regional cooperation between countries in all regions.

35% of countries report substantial reliance on capacity development as a driver, a low figure, considering that many countries highlight capacity deficiencies as a reason for their lack of achievement. Few countries report dedicated budgets and systematic national and local initiatives to build capacity on an ongoing basis. Local-level efforts are usually dependent upon external funding and NGOs that work through civil society organizations. This dependency often leads to significant imbalances in coverage with funding and activities typically restricted to areas recently hit by major disasters, while highly vulnerable areas that may experience smaller-scale disasters on a much more frequent basis remain uncovered. It also undermines sustainability.

Only 31% report substantial reliance on multi-hazard integrated approaches. This may reflect the difficulties of mainstreaming disaster risk considerations into development sectors, and of coordinating the efforts of a large number of specialized scientific and technical institutions.

Reliance on human security and social equity approaches for disaster risk reduction and recovery activities is low with 35% of the countries reporting substantial reliance on this driver. This indicates that there is probably not explicit recognition of the impacts of disaster risk on poverty, highlighted in Chapter 3, which translates into a lack of concern for social protection and longer-term impacts.

While progress has been made in integrating gender into disaster risk reduction, it has been slow and inconsistent. Only 20% of the reporting countries mention substantial reliance on this driver. Lack of understanding of gender issues, an absence of political accountability and weak institutional capacities on gender and disaster risk reduction pose great challenges. The important role played by NGOs and the academic community in advocating gender sensitive disaster risk reduction and recovery practices has indeed had some positive impacts at the grassroots level and this influence is mentioned in some national reports. Box 5.4 takes stock of the progress being made at the regional and international levels in this area. Replicating such practices will be crucial to the fulfilment of this Hyogo Framework 'cross-cutting' issue.

Box 5.4: Progress on mainstreaming gender considerations into disaster risk reduction[32]

Disasters highlight gender imbalances in society, revealing vulnerabilities and capacities, along with other social and economic imbalances arising from class, caste, disability and minority status. Gender cuts across all segments of society and thus has implications for every aspect of disaster risk reduction. International efforts by the UNDP, UNISDR and UNDESA, together with experiences from disasters such as the Indian Ocean tsunami or Hurricane Katrina, have raised awareness of gender issues amongst the international and academic communities. However, progress at national and regional levels has not kept pace. Regional intergovernmental policies and strategies on disaster risk reduction rarely include an explicit commitment to gender. Any increase in recognition of gender issues in disaster risk reduction at the regional level is mostly due to the dedicated work of a handful of organizations and women's activist groups.

The Delhi Declaration[33] from the Second Asian Ministerial Conference on Disaster Risk Reduction in 2007 was an exception to this, with the stated aim to *"encourage the national governments to make special efforts to mainstream gender issues in disaster risk reduction so as to reduce the vulnerability of women and to recognise the important role women can play in disaster risk reduction."* Some progress has also been made at the regional level in producing information, guidelines and capacity building on the subject. For instance, Duryog Nivaran/Practical Action, the International Centre for Integrated Mountain Development and the Asia Pacific Forum on Women, Law and Development produced guidelines for addressing gender issues in disaster management.

UNDP has supported a number of regional initiatives. In Latin America, the Risk Management with Gender Equity Learning Community organized a first regional meeting in 2007 and has conducted a knowledge management project. The Community identifies, systematizes, disseminates and strengthens existing resources and services to integrate a gender focus within disaster risk management.

A current UNDP Caribbean Risk Management Initiative project, Enhancing Gender Visibility in Caribbean Disaster Risk Management, uses research from five selected countries in the Caribbean, which is expected to shed light on the extent to which disaster risk reduction governance mechanisms incorporate gender considerations. UNDP has also supported capacity development in South Asia by making policy and practical guidelines on gender and disaster risk reduction available in local languages. In 2008, the United Nations Development Fund for Women initiated the Thematic Group on Gender in Asia that includes disaster risk reduction as a focus area.

5.4 Poverty reduction

Disaster risk reduction was not included amongst the MDGs. However, as highlighted by UNDP[34], the achievement of the MDGs would address many of the underlying risk drivers, and conversely reducing disaster risk would contribute to the achievement of many of the MDGs.

Poverty reduction frameworks, strategies, policies and programmes configure a constellation of local, national, regional and international actions. Multilateral cooperation on poverty reduction is provided through many different channels including PRSPs and United Nations Development Assistance Frameworks (UNDAFs)[35].

PRSPs describe a country's macroeconomic, structural and social policies and programmes to promote growth and reduce poverty, as well as associated external financing needs. PRSPs are prepared by governments in low-income countries which receive either debt relief under the Heavily Indebted Poor Countries Initiative[36] or concessional lending from the World Bank, through the International Development Association, or the International Monetary Fund (IMF). It is a participatory process involving civil society and external development partners, including the World Bank and the IMF[37]. By the end of 2008, 59 completed and 8 interim PRSPs were available on the World Bank's website[38]. Of the completed PRSPs, 20 countries had submitted progress reports.

It is beyond the scope of this Report to comprehensively survey whether the progress made in poverty reduction has contributed to addressing the underlying factors of disaster risk. However, in order to obtain some measurement of the strength of this relationship, a desk survey was carried out of a sample of 67 PRSPs and 67 UNDAFs, to examine whether disaster risk reduction is recognized in the documents.

For this study, 59 completed and 8 interim PRSPs were reviewed, 35 from African countries, 19 from Asia, 6 from Europe and 7 from Latin America and the Caribbean. The findings show that approximately 20% of the PRSPs analysed devote a whole chapter or section to disaster risk; 55% of the reports mentioned the relationship between disaster risk and poverty, while 25% do not mention disaster risk at all. There is a notable difference in the extent to which disaster risk is reflected in the strategies: 29% of the PRSPs prepared in Latin America and the Caribbean countries dedicated a whole chapter to disaster risk, whereas no European PRSPs dedicated a chapter and 33% did not mention disaster risk reduction at all (Table 5.7). Countries that have integrated disaster risk reduction into their PRSPs include Bangladesh (2005), Malawi (2006), Mozambique (2006) and Viet Nam (2006).

The review of 67 UNDAFs from Asian countries showed that 65% of the UNDAFs reviewed included disaster risk in one of their outputs or outcomes and 15% recognized the relationship between poverty reduction and disaster risk reduction. However, 20% did not mention risk reduction at all. See Appendix 6 for a complete list of UNDAFs and PRSPs studied for the desk review.

In principle, the result is encouraging as it indicates that many PRSPs and UNDAFs at

Table 5.7: Overview of PRSP recognition of disaster risk reduction as a tool to reduce poverty

	Total %	Africa %	Asia %	Europe %	LAC %
Disaster risk reduction not mentioned	25	23	20	33	14
Disaster risk reduction mentioned	55	54	65	67	57
Whole section/chapter on disaster risk reduction	20	23	15	0	29

least recognize some of the underlying factors of disaster risk, in particular the vulnerability of rural livelihoods and that the poor are most at risk. Areas prioritized include food security, agriculture, early warning systems, drought, climate change issues, rural (infrastructure) development and disaster preparedness and response. Such poverty reduction instruments, therefore, clearly have an enormous potential to address the underlying risk drivers described in Chapter 4. It is less clear, however, whether they explicitly target these drivers. In particular, urban poverty is given far less attention than rural poverty, a critical gap given its scale and the growth of urban disaster risk.

It is also unclear whether PRSPs are linked to policies and institutional frameworks for disaster risk reduction. If not informed by disaster risk reduction information and expertise such as hazard assessments, they may not target the communities with the highest disaster risk. It is also possible that mainstream poverty reduction and social development investments may inadvertently increase rather than decrease risk, and may be ineffective in reducing the impact of disaster losses on the poor. A school built in a relatively poor settlement in an earthquake prone country offers to improve access to education and contribute to the fulfilment of MDG targets. However, if it is not built to seismic resistant standards, the school may collapse in an earthquake, as was tragically highlighted by the deaths of at least 9,000 children and teachers in the Sichuan earthquake in China in 2008. The short- and long-term effects of disasters on attainment of the MDGs have implications that cannot be ignored. In the same way, a lack of awareness of how development shapes disaster risk may mean that opportunities to use poverty reduction and social programmes to proactively reduce risks may be lost.

5.5 Climate change adaptation

Since countries signed the UNFCCC in 1992, multilateral negotiations have focused on the challenge of mitigating climate change by reducing GHG emissions, through instruments such as the Kyoto Protocol. Climate change mitigation is essential as all the evidence points to the probability that a 'business as usual' approach to development will lead to catastrophic global outcomes. Even if mitigation is successful, however, climate change impacts will continue to increase until stocks of GHGs in the atmosphere stabilize. As both governments and the international community recognize that some degree of climate change is inevitable, the need to assist countries to adapt to climate change has taken on a greater prominence. The term adaptation appeared in the First Assessment Report of the IPCC in 1990 and was captured in Article 4 of the UNFCCC, which calls upon states to *"cooperate in preparing for adaptation to the impacts of climate change, develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods".* [39]

Furthermore the Article recognizes the responsibility of the developed countries with the largest carbon footprints to assist those developing countries that suffer the consequences. It goes on to state: *"developed country Parties . . . shall . . . assist developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting the costs of adaptation to those adverse effects. [. . .] The extent to which developing country Parties will effectively implement their commitments under the Convention . . . will fully take into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties".*

As described in Section 4.4, climate change magnifies the existing unevenness in the geographic and social distribution of disaster risk, meaning that its effects are disproportionately felt by the rural and urban poor in developing countries. Adaptation to climate change,

however, is fundamentally similar to disaster risk reduction. Many countries face difficulties in addressing the underlying risk drivers, and they are also, therefore, badly adapted to existing climate patterns. If the underlying drivers can be addressed, then disaster risk will be reduced and at the same time the magnifying effect of climate change will be lessened. Similarly, strengthening capacities to address the underlying drivers of disaster risk will strengthen capacities to adapt to climate change.

5.5.1 Existing linkages in practice and policy

The Fourth Assessment Report of the IPCC lists a large number of possible adaptation measures, classified as anticipatory, autonomous and planned adaptation, that are fundamentally disaster risk reduction measures[40]. Despite the existence of parallel policy and institutional frameworks at both the international and national levels, many adaptation initiatives developed under the UNFCCC in practice focus on disaster risk reduction. Of the 36 NAPAs submitted to the UNFCCC Secretariat by least developed country parties since 2004, most justify potential adaptation activities in terms of their effectiveness with respect to reducing vulnerability to disasters and alleviating poverty. In practice, some NAPAs have already led to a greater integration of disaster risk reduction and adaptation to climate change at the national level. Disaster risk reduction has also been recognized in the Bali Action Plan[41] and in the Adaptation Fund[42].

The Maldives' Safe Islands Strategy is a good example of how adaptation and disaster risk reduction can be linked. It is an official government policy intended to address expected sea level rise over the course of this century which gained momentum after the 2004 Indian Ocean tsunami submerged the entire small island nation for several minutes. Residents of hard-to-reach outlying islands are being voluntarily relocated to Hulhumale, a man-made island near the country's capital that sits at a higher elevation than the rest of the Maldives' 200 inhabited islands[43].

However, while disaster risk reduction and climate change adaptation may be closely linked in practice, the functional linkages between the respective international frameworks (the HFA and the UNFCCC) are far weaker. The weak linkages between these frameworks inhibits the integration of climate change adaptation with disaster risk reduction, and of both with poverty reduction and development. The existence of parallel frameworks involves different counterparts in developing countries in complex and overlapping international processes on policy formulation, negotiation, monitoring and reporting.

This lack of integration is replicated at the national level, where responsibilities for climate change adaptation are usually vested in environment ministries. As in the case of disaster risk reduction, this does not facilitate its integration into mainstream national planning and budgeting. In turn, this can lead to the perception that adaptation is an environmental problem and result in the packaging of adaptation initiatives as a series of small stand-alone projects (for example, strengthening coastal defences or managing a particular watershed) that are disconnected from both disaster and poverty reduction planning and implementation. UNDP, for example, reports that in a review of 19 PRSPs, only four identified specific links between climate change and future vulnerability[44].

5.5.2 Resources and implementation mechanisms

Several financial mechanisms exist under the UNFCCC, the Kyoto Protocol and the Global Environment Facility (GEF) to support adaptation, particularly in least developed, low- and middle-income countries (see Figure 5.11).

The UNFCCC mechanisms include the Least Developed Countries Fund (LDCF), which has supported the development of NAPAs and should assist countries in implementing activities identified in those plans. As of October 2008, cumulative net allocations approved by the Council of the LDCF amount to US$ 53.45 million. Of this, US$ 48.49 million is for projects and project preparation activities, including US$ 15.48 million that has been committed, and US$ 12.77 million already disbursed[45]. While the fund was designed to *"support projects addressing the urgent and immediate adaptation needs of the*

least developed countries (LDCs) as identified by their NAPAs"[46], 49 of the 50 activities funded to date have been for the preparation of NAPAs. As of September 2008, of the 38 NAPAs submitted, 21 contemplate disaster risk reduction[47]. In Ethiopia's NAPA, for example, the three highest-ranking adaptation activities are: 1) promoting drought–crop insurance; 2) strengthening the drought and flood early warning systems; and 3) developing small-scale irrigation and water-harvesting schemes in arid parts of the country[48]. So far, in total only 2 out of 19 projects funded under the LCDF are at implementation stage: a project that reduces climate change-induced risks and vulnerabilities from glacial lake outbursts in Bhutan, and a community-based coastal afforestation project in Bangladesh.

The Special Climate Change Fund (SCCF) is available for all low- and middle-income countries, covering adaptation and other activities such as technology transfer, mitigation and economic diversification. So far, 15 SCCF Adaptation Program projects have been approved, but only one – a water-resource management initiative in Tanzania – is under implementation[49]. As of October 2008, cumulative net allocations approved by the Council of the SCCF amount to US$ 68.58 million, of which US$ 26.53 million have been committed to projects and project preparation activities, and US$ 15.29 million have been disbursed[50].

The Adaptation Fund, established under the Kyoto Protocol, is based on private-sector replenishment through a 2% levy on Clean Development Mechanism (CDM) projects plus voluntary contributions from high-income countries, currently amounting to US$ 5 million pledged by Canada. Potentially, it is considered that the levy could generate US$ 160–950 million by 2012[51]. While the Adaptation Fund board outlined a work plan at its second meeting, it has not finalized its 'specific operational guidelines' nor begun disbursing funds. It was agreed at the June 2008 session that the board would begin reviewing submitted projects in June 2009[52].

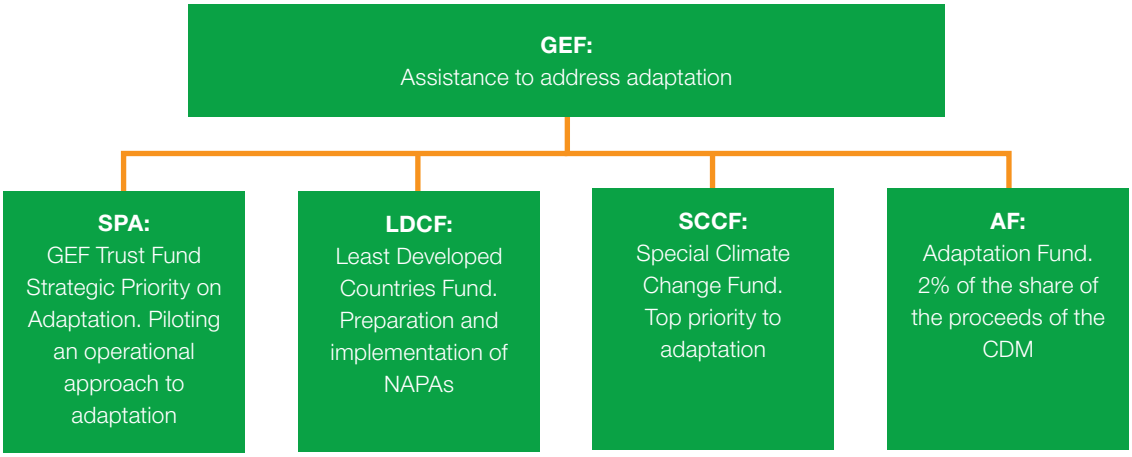
The Strategic Priority on Adaptation contains about US$ 50 million[53] from GEF trust funds to support pilot adaptation projects of which, to date, some US$ 14.8 million have been disbursed.

In contrast to the resources available through the above mechanisms, UNDP estimates the total resources required for climate change adaptation at US$ 86 billion per year by 2015, representing approximately 0.2% of GDP of developed countries[54]. This figure is consistent with estimates by Oxfam[55], which calculated an annual requirement of US$ 50–80 billion per year for adaptation in low- and middle-income countries.

More resources are flowing into adaptation from other bilateral and multilateral donors. It

Figure 5.11: GEF mechanism to support adaptation to climate change

Source: GEF, 2008a



has been estimated that bilateral resources total approximately US$ 110 million for 50 projects in 17 countries. As of December 2008, the World Bank funds ten adaptation projects at a cost of approximately US$ 94 million[56]. UNDP also reports a growing adaptation portfolio totalling approximately US$ 200 million. More resources are probably flowing directly to adaptation activities in developing countries through large international NGOs, and the Red Cross and Red Crescent movement. However, it seems unlikely that total international resource flows for adaptation in developing countries currently exceed US$ 50–100 million per year, which represents less than 0.2% of that required.

At the same time, a review of the portfolios of six major bilateral and multilateral donors[57] has illustrated that much development assistance is failing to take into account the potential losses from the magnified risks posed by climate change. According to UNDP[58], between US$ 16 and US$ 32 billion of existing development assistance is currently at risk from climate change. This implies that 1,000 times more development assistance is at risk from climate-related hazard than has been committed by donors to support climate change adaptation through the multilateral mechanisms described above.

There is a mismatch, therefore, between the estimated costs of adaptation, the resources committed and the speed of implementation. Given the urgency posed by climate change, there is clearly an urgent need to increase the investment and the speed of implementation.

5.5.3 Adapting to climate change or adapting to poverty?

In developed countries, it is difficult but not impossible to calculate the costs of adaptation. The cost of climate proofing buildings and infrastructure can be calculated, as can that of the investments in irrigation and water management necessary to enable agricultural production to adapt to longer periods of drought. The cost of maintaining flood defences in London over 100 years, taking into account climate change, has been calculated at US$ 3–6 billion[59], for example. When this approach is applied to developing countries, UNDP has estimated (building on earlier calculations by the World Bank)[60] that the cost of climate proofing development investments and infrastructure will be approximately US$ 44 billion annually by 2015. A recent UNFCCC paper[61] has also addressed this cost.

An approach based purely on climate proofing infrastructure, however, does not address the underlying risk drivers in many developing countries, given that disaster risk for both the rural and the urban poor is characterized by a deficit of assets that could be adapted. As described in Chapter 4, the climate-related disaster risks faced by poor rural households are closely associated with their lack of access to productive assets to sustain their livelihoods. Poor urban households in most developing countries occupy unsafe makeshift homes on illegally sub-divided and occupied land and with deficient or non-existent infrastructure and public services.

As the Archbishop Emeritus of Cape Town , Desmond Tutu, wrote for the 2007/2008 Human Development Report[62]: *"Adaptation is becoming an euphemism for social injustice on a global scale. While the citizens of the rich world are protected from harm, the poor, the vulnerable and the hungry are exposed to the harsh reality of climate change in their everyday lives. Put bluntly, the world's poor are being harmed through a problem that is not of their making. The footprint of the Malawian farmer or the Haitian slum dweller barely registers in the Earth's atmosphere."*

Many NGO initiatives, and some bilateral efforts, in rural areas implicitly recognize this issue. At the local level, despite the disconnection between the scale of the need and the funds available for investment, much climate change adaptation is building on existing efforts to strengthen rural livelihoods and to protect and manage ecosystems. Less attention, however, is being given to the adaptation needs of the urban poor. The Fourth Assessment Report of the IPCC notes that urban centres, the infrastructure that they concentrate, and the industries that form a key part of their economic base are often capable of considerable adaptation to reduce the risks from the direct and indirect impacts of

climate change[63]. This is certainly true of many well-governed cities in high-income countries. However, its relevance to the several hundred million poor urban residents living in informal settlements in flood prone and exposed coastal locations in developing countries, for example, is highly questionable. How city governments that have historically proved incapable of protecting the majority of their citizens from existing climate hazard will be able to adapt, is difficult to envisage.

The implications of this analysis are threefold. First, the linkages between the frameworks for disaster risk reduction, poverty reduction and climate change adaptation need to be strengthened, at the international and national levels. Second, disaster risk reduction and climate change adaptation should both give priority to addressing underlying risk factors such as vulnerable rural livelihoods, poor urban governance and ecosystem decline, if the magnifying effects of climate change on disaster risk are to be avoided. Third, there is a need for increased investment and more rapid implementation, given the urgency of the challenge.

While the linkages between disaster risk reduction and climate change adaptation need to be strengthened, both face common challenges. Many low and middle income countries still have weak capacities to address the underlying risk drivers and lack suitable governance arrangements for integrating risk reduction into development.

Endnotes

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Chapter 6

Addressing the underlying risk factors

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Introduction

This chapter reviews practice in five areas that address the disaster risk–poverty nexus: strengthening livelihood sustainability in rural areas, partnerships for urban and local governance, innovative financial mechanisms, environmental management, and community- and local-level disaster risk reduction.

The chapter does not comprehensively review practices in other areas that address the underlying risk factors, for example in social protection. Nor does it comprehensively review practices in each of the areas above but rather describes salient trends, which are illustrated by examples from different countries. However, the chapter does underline key practices that would make a significant difference if they were incorporated into policy considerations.

The chapter finds that it is possible to address the underlying risk factors that contribute to the translation of poverty into disaster risk and disaster impacts into poverty, and that many of the necessary tools and approaches are already being applied in practice across all regions, including in low-income countries. This has an important policy implication, since it is possible to reduce risks without waiting for high levels of economic development. It also means that there is much that can be done, even in low-income countries, to adapt to climate change.

Summary of findings

1. Strengthening livelihoods increases resilience among rural communities.

Strengthening livelihoods through natural resource management and the generation of microenterprises, infrastructure development and basic service provision can reduce risk and increase resilience, particularly in rural contexts.

2. Good urban and local governance: critical to reducing risk in urban settlements.

Good urban and local governance is critical to the reduction of disaster risk in both cities and small urban centres. Competent and accountable local governance structures in partnership with an active civil society have developed innovative approaches to assure land supplies, provide basic infrastructure, secure land tenure and provide housing finance for poor households. Improvements in urban and local governance provide the foundation for incorporating disaster reduction considerations into urban development.

3. Adopting microfinance and microinsurance initiatives can increase resilience.

Emerging practices based on microfinance, microinsurance and catastrophe financing do not necessarily lead to a reduction in disaster losses. However, they can increase resilience in both urban and rural areas and therefore can play a key role in avoiding the translation of disaster impacts into poverty outcomes.

4. Ecosystem services improve hazard regulation and provisioning services.

Ecosystem services can be enhanced through a range of practices, including integrated planning, protected areas and payment for ecosystem services. This improves both hazard regulation and provisioning services for rural and urban communities.

5. Community- and local-level approaches increase sustainability of disaster risk reduction practices.

Community- and local-level approaches, particularly when supported by effective decentralization processes and government–civil society partnerships, can increase the relevance, effectiveness and sustainability of disaster risk reduction across all practice areas, reduce costs and build social capital.

6.1 Strengthening livelihoods

As highlighted in Chapter 4, the poor deal with risk and insecurity, in the context of a range of different hazards, as a central part of their livelihood strategies [1]. Strengthening livelihoods and increasing their resilience is thus crucial to reducing both disaster risk and poverty, particularly in rural areas where livelihoods are sensitive and vulnerable to weather fluctuations and extremes.

Over the past decade, rural livelihoods have become increasingly supported by non-farm income earning activities (for instance, agroprocessing, small-scale trade and services) [2]. However, a significant proportion of the rural poor in Africa, Asia and Latin America still depend heavily on agriculture and farm-based activities [3]. While the livelihood strategies of rural poor households may vary across contexts they generally involve three complementary components: intensification of agricultural inputs where possible; income diversification from non-farm sources; and seasonal or permanent migration to other rural or urban areas.

While livelihood strengthening can have many dimensions, this section will review practices in two complementary areas that support and strengthen the livelihood strategies of the rural poor:

- *Natural resource management* and microenterprises implemented at the community level, particularly for the conservation and protection of 'common resources' (forest management, agroforestry, livestock rearing, beekeeping, water resource management, coastal protection and microcredit schemes).
- *Infrastructure development programmes and basic services provision* implemented at the local level with rural and peri-urban community involvement (watershed management, drought proofing, flood risk management, rainwater harvesting, cash for public works, construction of irrigation systems, canals, roads, disaster recovery and reconstruction, etc.).

It has not been possible in this Report to comprehensively review practice in a third area, that of social assistance and protection, which includes different approaches to welfare provision including livelihood guarantee schemes, cash transfers, subsidies for public services, such as education and health, and others – although it clearly could play a key role in increasing household and community resilience to disaster impacts in developing countries.

6.1.1 Natural resource management

The rural poor are heavily dependent on natural resources and therefore most severely affected by deteriorating environmental conditions and by factors limiting resource access, including those associated with climate change. Resource access is often complicated through non-existent or ambiguous legal rights to the resources on which they are dependent, or because they have no feasible way to exercise their rights. Contradictions between traditional and contemporary systems of property rights are often at the root of livelihood and environmental insecurities, marginalizing the poorest communities. The regions affected by these conditions are also where environmental insecurity is most likely to lead to conflict[4].

Natural resource management can positively affect both sides of the disaster risk–poverty nexus: reducing weather-related hazard and the vulnerability of agriculture, fisheries, forestry and livestock production while increasing resilience through strengthening incomes and the capacity to access assets. However, while success usually builds on strong community-level involvement, as in the case of urban governance, local and national government involvement is crucial to address issues concerning property rights and land and water management.

An instance of combining community action with government responsiveness can be found in the Mashreq and Maghreb project, which linked the Mashreq (Iraq, Jordan, Lebanon and Syria) and Maghreb (Algeria, Libya, Morocco and Tunisia) countries to combat desertification. The project catalysed the creation of community-based organizations to develop

'negotiated action plans' that set standards for land management in their domains. They also function as communication and advocacy channels to promote policy and institutional reforms affecting property rights, land and water management, marketing and credit[5]. Awareness of legal provisions for natural resource management and use can benefit communities in local decision-making with government development agencies[6].

Watershed and forest management often offer another common entry point. Examples from China and Korea demonstrate particularly vigorous approaches to engaging communities in forest management as a part of flood risk reduction measures. Other countries have introduced measures to reduce the risk of devastating wildfires. Examples of using natural resource management to strengthen livelihoods are shown in Boxes 6.1–6.3.

6.1.2 Infrastructure development and basic services provision

Given the damage and destruction of housing and infrastructure, such as irrigation channels, roads, bridges and transport networks, in disasters, particularly in the case of manifestations of extensive risk, the links between infrastructure development, disaster risk and poverty reduction are explicit.

Safe infrastructure is critical to human, livelihood and asset security. At the same time, investment in infrastructure provision and rehabilitation is also an opportunity to generate additional employment and income in rural areas, which can increase household and community resilience.

The rehabilitation of local infrastructure is frequently included in post-disaster recovery and rehabilitation programmes. Box 6.4 offers an example of integrated livelihood and

Box 6.1: Dryland agroforestry and livelihoods regeneration: towards more resilient communities[7]

Trees, shrubs and specialty crops have historically played a vital role in dryland agriculture in developing countries. Trees are preserved on farms because they are valued for fuelwood, construction material, fodder, medicines, cosmetics, enhancing soil fertility and shade. In the drylands of West Asia and North Africa trees have long been domesticated and orchards (e.g. olive, citrus, pistachio) are widespread. Contrary to expectations that urban expansion would result in deforestation, tree density increased in the surroundings of Kano, Nigeria from 1972 to 1985 as farmers protected and planted trees to meet the demands of the growing fuelwood market. Diversified crops, shrubs, trees, rangelands and other farm operations can also catalyse diversification in local agroenterprises. New ways to process and market foods create new opportunities for a wider variety of income-generating enterprises, creating a ripple effect that multiplies the benefits broadly through rural communities, making the environment and communities resilient to drought and desertification processes.

Box 6.2: Good irrigation enhances climate change adaptation and boosts harvest in Peru[8]

The people of the village of Coyllur, in western Peru, are mostly farmers. Farming takes place on steep land, with few attempts to control erosion. Irrigation, where available, is by flooding with little terracing. Extensive clearance of indigenous vegetation has further destabilized the land. Intense rainfall in the wet season leads to extensive soil erosion and the destabilized slopes exacerbate landslide risk. The dry season is becoming lengthier, impacting on crop yields. Poor housing and a location in a high-risk area have led many people to migrate from the countryside to the city seeking employment. Those remaining have adopted increasingly unsustainable farming practices in a desperate bid to survive. There is little or no remaining local knowledge of how to best cultivate steep land or of appropriate irrigation technologies.

A livelihood enhancement project by Practical Action demonstrated that low cost irrigation techniques make better use of water, increase production and generate higher returns. The techniques also help solve problems linked to slope cultivation, such as soil erosion, landslides and flooding. Demonstration plots showed that appropriate irrigation techniques promoted good water management, helped disease management, preserved soil nutrients and reduced risks of soil erosion that previously put their precarious infrastructure at risk.

Box 6.3: Watershed restoration and development in Maharashtra State, India[9]

In the semi-arid region of Maharashtra State in India, the Watershed Organization Trust is assisting poor, rural communities to increase their livelihood security by supporting watershed restoration projects. With rain-dependent livelihood systems, these communities survive on limited water supplies to feed their crop and livestock production and cottage industries. The combination of recurring droughts and human pressures on the surrounding land has degraded watersheds. Barren and eroded lands are unable to absorb and retain water, thereby accelerating surface runoff and soil erosion and inhibiting ground water recharge. The resulting decrease in soil fertility and water availability has created drought-stressed communities vulnerable to the impacts of climate change.

Working on a microcatchment basis, rigorous watershed restoration measures designed to regenerate and conserve microcatchments have been undertaken, including: soil, land and water management, e.g. trench building to control erosion, improve soil fertility and enhance groundwater recharge; crop management; afforestation and rural energy management, e.g. ban on tree-felling – instead planting shrubs and grass to meet household fuel needs; livestock management and pasture/fodder development, e.g. grazing restrictions leading to the natural regeneration of grass and shrubs. These projects have been supported by other measures, including microlending, training in new techniques and the formation of self-help groups, to diversify livelihoods.

Increased soil cover, improved soil moisture regimes, increased well water levels, biomass regeneration and dramatic increases in fodder availability, milk production and vegetable farming are some of the results reported by participating villages. Coupled with microenterprise development and an increase in savings groups, these results have translated into more secure livelihoods, diversified asset bases and reduced exposure to climate-related shocks.

Box 6.4: Support through rehabilitation and reconstruction activities for landslide- and flood-affected communites in Nepal[10]

The monsoon floods and landslides that started in late August 2006 left about 16,000 families in need of assistance. To respond to the emergency situation, Rural Reconstruction for Nepal mobilized volunteers and resources to help the victims of the devastating floods and landslides in different districts of Nepal and is currently implementing a rehabilitation project in three districts: Achham, Banke and Bardiya. The main purpose of the project is to support those affected by the floods and landslides through rehabilitation activities.

Amongst other activities, the project supported repair and operation of community drinking water schemes, 40 hand pumps were installed in Banke district, 6 schools were repaired and two irrigation canals were rehabilitated. Special consideration was given while re-establishing and reconstructing community infrastructure, in particular drinking water pumps, canals and culvers, so that women and socially marginalized and poor community members would have equal access to these resources. Consultations with women and disadvantaged groups were conducted before re-establishing drinking water pumps and irrigation facilities in terms of location and accessibility.

infrastructure rehabilitation within poor, flood-affected communities in Nepal.

Infrastructure rehabilitation can also be used as an ex ante strategy to reduce risk and increase resilience and security as outlined in Box 6.5.

The development and rehabilitation of local infrastructure is also supported through social funds. Social funds are community grant programmes that provide block grants for projects to build community assets such as community facilities, infrastructure or improved services, including microfinance and microinsurance, to increase livelihood security and resilience for poor and vulnerable households (see Box 6.6). Social funds provide a flexible mechanism that can be adapted to undertaking a variety of projects[14]. The funds are typically guided by project management committees which bring together different stakeholders in the community and have the potential to play longer term roles in providing a community voice in local development decision-making. The use of social funds has grown over recent years. They now

Box 6.5: Strengthening livelihoods in Sri Lanka and Bangladesh

Plan Sri Lanka implemented a Small Tank Rehabilitation and Farming System project in drought-hit Anuradhapura district. Food insecurity in this region is high, leaving 30% of children under the age of 10 malnourished. The project improves water security by rehabilitating and restoring the physical structures of traditional age-old small tank[11] systems. Introducing crop diversification (to secure better incomes), home gardens (for better family food security and nutrition) and inland fisheries (for food and profit), the project positively affects the welfare and resilience of drought-affected families. The project engages government at district level through agencies related to agriculture, irrigation and district planning.

Bangladesh Disaster Preparedness Centre manages a project that concretely links risk reduction with livelihood support at household level in very low-income, disaster prone neighbourhoods. The project makes sure that 50% of the beneficiaries are women. It funds skills development and provides investment in livelihoods activities on the condition that part of the income generated is used for household risk reduction measures such as raising the plinth of houses, strengthening structures, storing grain in attic rooms, etc. This programme is an interesting mix of government financial commitment (the Ministry of Food and Disaster Management directed their funds for rehabilitating flood victims to the project) and NGO implementation – a combination that has worked very well for the programme and beneficiary community.

Box 6.6: Social funds for post-disaster recovery

After Hurricane Mitch, the Honduras Social Investment Fund (HSIF) was used as the foundation for responding to requests from both local and central levels to help rebuild the country's critical local infrastructure. By simplifying the application procedure and increasing the use of standardized subprojects, HSIF was able to respond to the crisis very quickly. Similarly the Kecamatan Development Program (KDP) in Indonesia was adapted to support a variety of community infrastructure reconstruction and rehabilitation projects building on the established KDP network of 600 village facilitators and 35,000 village volunteers[12]. The Tanzania Social Action Fund has even made this role permanent through the establishment of community foundations that are formally registered and function as partnerships with local civil society organizations, the business community and local governmental agencies. By engaging a range of constituencies within the community it is thought that the community foundations will also help to mobilize additional local resources[13].

represent a portfolio of US$ 14 billion for the World Bank[15], and similar programmes have been implemented by a variety of other agencies (sometimes under the name of community grants or block grants).

In conclusion, investment in rehabilitating or improving rural infrastructure has enormous potential to reduce disaster risk and increase household and community resilience, including but not exclusively in post-disaster contexts. However, significant challenges remain. As in the case of urban and local governance, disaster risk reduction considerations are not automatically factored into many initiatives due to a lack of awareness of hazard patterns and the cost of disaster impacts and the lack of formalized procedures to factor disaster risk reduction into investment decisions. Local governments and implementing authorities may not be accountable for ensuring the application of appropriate technologies for infrastructure development that make for safer environments and provide sustainable livelihood resources to the poor. At the same time, the maintenance of small-scale community infrastructure is often challenged unless full community ownership is ensured.

6.2 Partnerships for urban and local governance

Good urban and local governance is critical to the reduction of disaster risk in urban areas. If, as was examined in Chapter 4, urban disaster risk is configured in many developing countries in a context of unequal access to income earning opportunities, public services and basic infrastructure and poor urban and local governance, then two key underpinnings of reduced urban disaster risk would be more equitable access to employment opportunities and the presence of competent and accountable local governance structures to improve the provision of municipal services.

By generating higher incomes from more diversified sources individuals and households have a better chance of reducing risks by gaining access to safer housing in safer locations and safer jobs, accumulating assets and reserves that can be 'bankable' in times of disasters, and protecting assets at risk through insurance [16].

However, higher or more diversified sources of income can only reduce disaster risk when accompanied by a planning and regulatory framework that proactively facilitates access to safe land, housing, infrastructure and services for the urban poor and that provides the secure tenure required to access finance and insurance.

Improvements in the provision of municipal services such as water, electricity, public health, drainage, sanitation and basic housing do not per se reduce disaster risk. Unless information on hazard patterns and trends and the cost of disaster impacts are factored into land-use planning, building and infrastructure provision even the best and most innovative urban programme may fail to reduce disaster risk or even lead to its increase.

However, urban governments that are unwilling or unable to address fundamental issues of access to services and infrastructure for the urban poor are usually unable to address disaster risk. Good urban and local governance therefore is an essential platform for disaster risk reduction. Table 6.1 shows how disaster risk reduction practices can be incorporated into good urban governance practices.

It is estimated that the population of approximately 1 billion people who currently live in urban informal settlements in the developing world is growing by at least 2.5% per year. While not all residents of urban informal settlements are at risk from natural hazards, most risk from natural hazards in cities is concentrated in such areas. It is therefore fundamental that innovative efforts are made to upgrade existing informal settlements and that new growth is planned in a way that accommodates the poor and factors in disaster risk reduction considerations. Well-governed and sustainable cities are likely to have lower levels of disaster risk and be better adapted to climate change.

Table 6.1: Disaster risk reduction practice incorporated in urban governance practice

Good urban governance	Disaster risk reduction
Partnerships between community organizations and local governments to acquire land with secure tenure for low-income households	Hazard mapping used to identify safe sites for housing
Loan schemes for house-building and improvement	Technical assistance to introduce safe building standards as part of loan package
Improvements in sanitation and other infrastructure provision	Improved drainage in flood prone areas and public works to mitigate hazards
Participatory planning involving community organizations and local governments	Disaster preparedness and response plans and early warning systems
Public investments in schools and health facilities in low-income areas	Retrofitting existing facilities and ensuring that all new community infrastructure is built safely on secure sites

6.2.1 Good practice in urban and local governance

The experiences of Curitiba and Porto Alegre in Brazil, and many other cities in Africa, Asia and Latin America, show that if a city is well governed, it can grow successfully without risk prone informal settlements, inadequate vulnerable housing, non-existent services and infrastructure, and poor health, even when a majority of the urban population is poor.

The planning and regulatory frameworks put in place by city and municipal governments and their investments in infrastructure profoundly influence the scope and location of other investments, from large enterprises to small informal entrepreneurs, from large property developers to low-income households seeking land on which to build. In general, cities that have failed to put into place effective planning and regulatory frameworks are those with unrepresentative local governments lacking the resources to invest in essential infrastructure and services and where most local revenues go to recurrent expenditures or debt repayment. In contrast, cities and smaller urban centres that have successfully managed growth often have local governments that are more accountable to the citizens in their jurisdiction, within national government structures that have strengthened and supported local government capacities and infrastructure.

6.2.2 Decentralization, local democracy and civil society

Competent and democratic local governments often arise where decentralization programmes have ensured more power and resources for the local level [17]. Several countries have made constitutional or legal changes that have increased the revenues of city and municipal governments and strengthened local democracies [18], including Brazil, Colombia and India. Brazil has probably gone further than any other nation in developing new national institutions to support more effective urban governance [19]. There are also examples of national governments seeking to develop legal, institutional and financial frameworks to address urban poverty more effectively [20].

Good urban governance is often underpinned by stronger local democracy. The introduction of elected mayors and councillors over the last 10–20 years has helped make many city governments more accountable and responsive to their citizens. However, it also usually reflects a dynamic and proactive civil society and the emergence of innovative partnerships between grassroots organizations, local NGOs and local government [21]. Good urban governance, therefore, is not only the result of elected mayors and councillors or national decentralization processes but also of civil society having avenues to participate in urban governance. This combination of national policies and programmes that encourage decentralization, strengthened local democracy, and an active civil society has held the key to a wide range of innovative partnerships that have favoured the urban poor. Table 6.2 provides a summary of the results of examples of such partnerships from all regions.

Table 6.2: Innovative partnerships for urban governance

Type of partnership	Examples
Participatory planning processes	Porto Alegre, Brazil helped to pioneer participatory budgeting, through which residents in each district of the city had the right to influence public investment priorities – a development facilitated by the strength of grassroots organizations within the city[22]. Participatory budgeting has now come to be implemented in many other cities both within Brazil and in other countries[23], and shows how local governments and businesses can respond to local needs identified in participatory consultations[24].
Planning urban expansion and service provision	Ilo, Peru has around 70,000 inhabitants. Despite the fact that the city's population increased fivefold between 1960 and 2000, there are no informal settlements. This is due to a local government programme, in partnership with low-income households, in which all new settlements have been developed within municipal and housing association programmes through which housing plots are provided with infrastructure and services and land titles.

Table 6.2: Innovative partnerships for urban governance (continued)

Type of partnership	Examples
Planning urban expansion and service provision (continued)	Most of the population now has domestic connections for drinking water and regular solid waste collection. Over 5,000 houses have been improved and there has been a large expansion in public space. Most of this has been financed and implemented through partnerships between the municipal government and community-level management committees.
Relocating and upgrading informal settlements	The Thai Government's Community Organizations Development Institute (CODI) channels government funds in the form of infrastructure subsidies and housing loans direct to community organizations formed by low-income inhabitants in informal settlements. Households in informal settlements can get legal land tenure by purchasing land with a government loan, negotiating a community lease or relocating to other land of the government agency or landowner on whose land they are squatting. CODI also provides loans to community organizations to loan on to their members to help build or improve their homes, and supports city governments to collaborate with urban poor organizations – for instance providing sites for those living in various 'mini' squatter settlements in their jurisdiction to relocate to, with the land provided on a 30-year lease. Overall, CODI has provided loans and grants to community organizations that reached 2.4 million households between 1992 and 2007.
Appropriate land use and building standards	Government-funded serviced-site programmes to official standards were too expensive for low-income groups in Namibia[25]. A new government policy, developed with the Shack Dwellers Federation of Namibia (a federation of savings groups formed mostly by low-income women) shows a willingness to overturn conventional approaches to standards and regulations, for instance in plot sizes and in infrastructure standards, to make their serviced sites more affordable to low-income households. Families are allowed to upgrade services as they can afford to make the investments, extending sewerage and water lines from mains provision into their homes. Groups that belong to the Shack Dwellers Federation have access to their own loan fund from which they can borrow for such service improvements. A similar partnership between government agencies and the Malawi Homeless People's Federation[26] also led to changes in official standards to reduce costs and make better use of land. The Federation is formed by savings groups; most savers are women who currently rent accommodation in existing slums. There are more than 100 savings groups with a membership of more than 30,000. The Federation's negotiation with the Department of Physical Planning in Lilongwe allowed agreement on plots of 150–200 m^2 (well below the official standard) and this meant that land originally allocated for 95 plots could produce 222 plots. This was also helped by reducing road width from the standard 12 m down to 9 m.
Providing basic infrastructure	In Pakistan the Orangi Pilot Project Research and Training Institute (OPP-RTI) supported the inhabitants of *katchi abadis* to plan, implement and finance the provision of basic sanitation – sanitary latrines in their houses, underground sewers in the lanes and neighbourhood collector sewers. The costs are reduced by about a fifth by eliminating contractors and modifying engineering, and can be covered by the inhabitants. OPP-RTI then supports local government to plan and finance the larger 'external' trunk sewers and treatment plants into which the neighbourhood sewers feed. Again, there is a strong focus on keeping down unit costs and building on existing systems (for instance mostly 'boxing' existing natural drains). In around 300 locations in Pakistan, communities have financed, managed and built their own internal sanitation systems. Local governments can also afford to install the external systems as they no longer have to fund the internal components and as OPP-RTI has helped them develop much lower-cost methods for planning and building trunk sewers. OPP-RTI has also helped government agencies convert natural drains into sewers and develop drainage plans for most of Karachi. Thus, community organizations and local NGOs have been able to transform planning and investment in sewers and drains in Karachi in ways that have brought major benefits to large sections of the low-income population. This was also done without a need for large loans from international agencies, which inevitably increase debt burdens.
Incorporating disaster risk reduction into good urban and local governance	In a number of cities in Colombia disaster risk reduction has been incorporated as an integral part of improvements in urban and local governance. In Bogotà, for example, the city government has invested close to US$ 460 million to retrofit and rehabilitate risk prone schools as well as include disaster risk reduction in the educational curriculum. Hospitals, bridges, fire stations and key governmental buildings have also been reinforced. These outcomes were possible through a combination of competent city government, community awareness and participation, and an accurate assessment of disaster risks in the city, the results of which were used in land-use plans, building codes and investment decisions. In Manizales, an innovative cross-subsidized insurance scheme called Predio Seguro, supported by the city government, has enabled poor households to obtain catastrophe insurance cover. The city government, in partnership with women's groups in informal settlements also invests in stabilizing slopes in landslide prone informal settlements [27].

6.3 Innovative financing for disaster risk management

Emerging practices based on microfinance, including microinsurance and catastrophe financing, do not necessarily reduce disaster losses. However, they do increase resilience in both urban and rural areas and therefore can play a key role in avoiding the translation of disaster impacts into poverty outcomes. At the same time, there is evidence that if properly targeted they can be used to provide incentives for risk reduction measures.

Risk financing and other financial tools to manage disaster risk have existed for decades but primarily benefit upper- and middle-income families, large businesses and wealthy governments. Poor households, particularly those working in the informal economy and with irregular cash flows, typically have little access to such tools. Poor households in most developing countries have a limited ability to pay for insurance even when it is available. Most income is used to cover basic needs such as food and housing, and other kinds of insurance, such as health insurance, are usually given a higher priority by households than catastrophe insurance.

As a consequence, more than 40% of direct disaster losses are insured in developed countries, usually through compulsory insurance, whereas it is estimated that less than 10% of these losses are covered by insurance in middle-income countries and less than 5% in low-income countries[28]. The IADB, for example, estimates that only 10% of the population of South and Central America has access to credit and even fewer to insurance and other financial services[29], while insurance penetration, measured as a percentage of GDP, is 1.4% in Latin America, compared to 3% in Europe and 5% in North America.

This lack of access to financial and risk transfer mechanisms compounds the risks faced by the poor and is a significant factor in the translation of disaster loss into increased poverty. As described in Chapter 3, households, communities and countries are left with limited sets of informal coping mechanisms. These often involve increases in high-interest debt, sales of assets, delay of development opportunities or the adoption of low-risk, low-yield livelihood strategies, which generally do not stand up well against series of shocks[30]. While, in the case of large disasters, informal coping may be supported by post-disaster assistance from governments or humanitarian agencies it has been consistently documented over decades that this is often ad hoc, poorly targeted and short-term.

This section will review four kinds of risk financing tools that have strengthened resilience at different levels: microfinance, microinsurance, parametric crop insurance and catastrophe pools.

6.3.1 Microfinance

Due to the efforts of microfinance institutions (MFIs) such as the Grameen Bank, Bangladesh Rural Advancement Committee (BRAC) and now thousands of others in countries of all levels of economic development, microfinance now reaches more than 93 million poor clients[31] and has helped households in risk prone communities around the world to strengthen their livelihoods and increase their resilience. This success has been helped by the development of innovative structures such as self-help groups – small groups of 5–10 members living in the same community agreeing to share liability for individual loans. This reduces the risk to the MFI that loans will not be repaid and reduces the need for collateral.

Microfinance has been used to invest in livelihood activities and to improve or repair houses, actions that can reduce vulnerability and increase disaster resilience. It has also been integrated into post-disaster recovery contexts (see Box 6.7) where MFIs are often already active among affected households. Additionally, many microfinance programmes have specifically targeted women, who are often particularly vulnerable.

While there are immediate needs for funds after a disaster, there are also needs for longer-term credit for economic and livelihood recovery. With their long-term relationship with clients, MFIs can provide ready access to regulated lending, increase resources for recovery and

Box 6.7: Microfinance in disaster recovery, Sri Lanka[32]

By 2005 MFIs in Sri Lanka had more than 15 million deposit accounts (more than one per household) and 2 million outstanding loans in a country with a population of a little over 20 million. The Indian Ocean Tsunami significantly impacted MFIs operating in the affected coastal areas as many lost staff and clients in addition to critical materials such as client records. Many clients had lost livelihood assets and income sources and most transactions involved withdrawals rather than deposits. However, despite the early setbacks, MFIs ultimately proved a valuable resource to bolster resilience and speed the recovery of both existing and new clients. One of the first priorities for MFIs was to understand how their clients had been impacted, looking at whether the borrower or primary income earner had died or was disabled, whether business assets were lost, whether the client's house was damaged, and whether the market for the business was significantly affected. The MFIs then restructured loans on a case-by-case basis for clients, generally only writing off loans when the borrower had been killed or permanently disabled. Since the tsunami a number of MFIs have instituted reforms to offer their clients more protection in future disasters, including revamping group-lending structures to reduce situations where one person's default can pull the entire group into default, and developing new products such as emergency or reconstruction loans to help clients cope.

re-catalyse local economic enterprise. There are many instances, in Bangladesh, El Salvador, India and Nicaragua for example, where MFIs have integrated loans for housing repair or reconstruction into their portfolios.

However, MFIs' effectiveness may be overestimated given a lack of understanding of the potential and limitations of microfinance among some international NGOs and humanitarian agencies that support post-disaster recovery. Efforts to expand MFI programmes too quickly create formidable challenges to operating efficiently and managing risks adequately, particularly as travel and staff compensation costs increase. Additionally, the failure to separate microfinance from relief activities may lead to confusion among clients between assistance provided as loans or grants and may undermine the viability of existing microcredit programmes[33].

There are more fundamental questions regarding the success of microfinance in decreasing poverty, particularly extreme poverty[34]. However, to the extent that MFIs specifically include lending to reduce disaster risk, through home improvement or livelihood strengthening, both before and after disasters, they can increase household resilience and reduce vulnerability to disaster loss, particularly amongst the moderately poor[35].

6.3.2 Microinsurance

Microinsurance has emerged as a potential solution for extending insurance coverage to poor households, providing access to post-disaster finance in a relatively fast, reliable and predictable manner, allowing the poor to protect their assets and mitigate their financial losses in the face of disaster. By providing immediate liquidity, microinsurance is also seen as promoting dignity and self-reliance, which reliance on humanitarian assistance so often undermines.

Microinsurance schemes have existed for a number of years, often building on informal cooperative or mutual models and insuring against funeral expenses, unemployment, accidents and loss of life. Existing schemes have also used a wide variety of distribution channels including community-based mutual savings, MFIs, credit unions, commercial insurance companies and government social protection services.

In recent years, microinsurance schemes have also been developed or extended to cover disaster risks. Many MFIs have begun to offer insurance on microcredit loans so that borrowers (and the MFIs) will not be indebted if their livelihood is damaged by a disaster. There are also examples of bundling with savings programmes, such as the Self Employed Women's Association microinsurance programme in India, which

allows its members to save for insurance through fixed deposits in savings accounts[36].

Governments such as those of the Philippines and South Africa have initiated efforts to change regulations and policies to remove barriers to entry and facilitate broader participation of the private sector in providing microinsurance[37]. However, with the potential for large covariant losses, microinsurance for disaster risk often requires additional partnership with re-insurers to ensure adequate protection. Currently India hosts the greatest number of microinsurance schemes for disaster risk, in large part as a result of the adoption in 2002 of a new regulatory framework that requires insurance companies to increase their coverage in the "rural and social sectors"[38]. Taking a pro-poor stance has helped to shape the market and encourage private sector interest. While the creation of cross-subsidies means that wealthier clients must now cover additional operating costs, it does provide a route through which governments can address market failures to serve the needs of poor clients.

Nevertheless, experience in using microinsurance to protect against disaster risk has been limited and significant questions still remain about its long-term viability and ability to benefit wide segments of the poor. Even the low costs of existing microinsurance programmes can be too high to be affordable to very poor households, who must trade-off the costs of insurance against other needs from scarce incomes. Some organizations like the All India Disaster Mitigation Institute have tried to develop schemes that link microinsurance to other disaster risk reduction measures. However, so far efforts to establish discounts in insurance premiums as incentives for disaster risk reduction have not been viable in ways that preserve the base affordability of the microinsurance.

6.3.3 Weather index crop insurance

While most microinsurance schemes use traditional indemnity insurance, which pays insurance claims in response to specific losses, new index-based schemes, also called parametric insurance, have emerged covering weather risks for crops. Parametric insurance products, which rely on the measurement of an objective and independent proxy, offer new opportunities to transfer the risks associated with crop or livestock loss, caused by droughts, extreme temperatures or extended floods.

Most schemes use rainfall levels (as measured in rain gauges at local meteorological stations) as a physical trigger. Farmers collect an insurance payout if the index is triggered regardless of the actual losses, simplifying administration and reducing the need for costly claims and adjustment procedures. However, for index insurance to be successful the trigger must be transparent, easily understood and well correlated with the losses experienced. If the trigger is not well correlated, even if an individual farmer's losses are substantial, the index may not reach the trigger level and there is no payout.

Weather derivative crop insurance schemes in various forms have now been used in approximately 15 countries, including Ethiopia, India, Malawi, Mexico, Nicaragua, Peru and Ukraine, to protect against both severe rainfall and lack of rainfall, while a livestock scheme has been developed in Mongolia. Generally the contracts are written by insurance companies and sold by rural development banks, farm cooperatives or MFIs.

Index-based insurance can also provide greater incentives for risk reduction than indemnity insurance. Since payments are based on the index measure or trigger and not on actual losses to policyholders, the policyholders have an incentive to minimize their potential losses since they will still collect the payout[39].

While crop insurance continues to spread in many locations around the world, the biggest constraint has been the availability of data from local or regional weather stations. As a result there have been recent efforts to develop new indexing methods that could potentially increase coverage. For example, the World Bank has worked with the Government of Mongolia to develop a scheme to track regional livestock death statistics as an index for insurance against the *dzud* winter freezes[40] and in Thailand it is testing the use of satellite data on flooding to develop an index-based flood insurance that would payout based on the percentage of land inundated and

the duration of the flooding in specific districts[41]. Box 6.8 highlights an innovative programme in Bolivia that uses production on specified reference plots of farmland as the index measure.

Other constraints include contexts where farmers may not have much incentive to participate because they have only limited liability for crop failure[43].

For more case studies on risk financing tools, information is available in Appendix 2.

6.3.4 Catastrophe pools

The traditional model of post-disaster financing, relying on slow and unreliable assistance from the international community, the diversion of budget allocations from development to recovery, or raising new debt in expensive post-disaster capital markets, is increasingly inefficient as disaster occurrence and the magnitude of loss increases[44]. International assistance often offsets less than 10% of countries' disaster losses, reconstruction funding may take up to 12 months or more to mobilize and may not be allocated effectively to address the most affected sectors and households. Resources are often diverted from development sectors to finance reconstruction, negatively impacting on development and poverty reduction. Without access to disaster insurance, homeowners run the risk of losing life-time or inter-generational savings tied up in the value of their homes while governments are typically exposed to tremendous budgetary uncertainty due to unpredictability of disaster relief and recovery expenditures.

New financial instruments, which have showed success in providing resources after disasters both to households in upper- and middle-income countries as well as to governments, include catastrophe pools, catastrophe bonds and lines of contingent credit.

Catastrophe pools provide a mechanism for catalysing the provision of insurance in markets where there have been impediments to private insurers offering disaster coverage, often due to ambiguity about the probabilities of loss, fear of large correlated losses, inadequate premiums and/or lack of ready demand for existing insurance products. Catastrophe pools typically combine a range of governmental, private sector and donor support – often focused on addressing distinct layers of risk – to engage market interest and establish a viable insurance fund. Catastrophe insurance pools provide immediate post-disaster financing proportionate to incurred losses. The pooling can be either among citizens in a particular country or set of countries or among governments to limit their own exposure to their sovereign disaster risk.

Experiences to date include the Turkey Catastrophe Insurance Pool (Box 6.9), the Caribbean Catastrophe Risk Insurance Facility (Box 6.10) and the Mexico Catastrophe Bond, which were stimulated by the experience of large-scale disasters such as the 1999 Marmara earthquake in Turkey or the 2004 hurricane season in the Caribbean. Other mechanisms include the provision of contingent credit lines to provide governments with immediate liquidity in the event of a major disaster. Colombia is the first country to secure such credit from the World Bank for a value of US$ 150 million.

Box 6.8: Fund for the mitigation of agricultural risk (Fondo de Mitigacion del Riesgo Agrario), Bolivia[42]

Fundación PROFIN has developed an innovative index-based insurance scheme that is being piloted in four provinces in the North and Central Altiplano regions of Bolivia. The scheme combines incentives for proactive risk reduction and a flexible, people-centered index mechanism. In this scheme the trigger is based on the "production levels of reference plots of farmland in areas that are geographically similar in terms of temperature, precipitation, humidity and soil type. The reference plots belong to farmers identified as good practitioners by their peers. The yields on these plots serve to indicate whether production levels have been adversely affected by weather, thus triggering an insurance payout, or by other factors within a farmer's control. The reference farmers also serve as technical assistance agents to promote ideas for increasing yields and reducing disaster risks and impacts. The system encourages other farmers to match the reference farmers in implementing mitigation efforts to reduce the effects of drought, excess rains, hailstorms and frost because those farmers run the risk that their own plots will be significantly affected while the reference farmers' plots will be less affected.

Box 6.9: The Turkey Catastrophe Insurance Pool (TCIP)[45]

The TCIP is an insurance pool that seeks to provide affordable insurance to homeowners, especially those in urban residential areas, and to reduce the fiscal exposure of the Turkish Government by accumulating funds for future disasters, sharing portions of risk within the country and transferring other portions of the risk to international reinsurance and capital markets. Proof of participation in the scheme is compulsory for land registry transactions such as when houses are sold. The TCIP started offering policies in September 2000. At that time, the Turkish Government also changed sections of its disaster law to remove the Government's commitment to provide post-disaster reconstruction assistance for housing lost to natural disasters, thus putting much of the responsibility back on homeowners.

The TCIP is managed as a private insurance company under the strategic guidance of the Turkish Treasury. During the first 5 years of the pool's operations, the World Bank also provided a contingent credit layer that would have provided financial resources to the TCIP to meet claims if needed. Marketing and distribution of policies have been facilitated by a state-of-the-art Internet-based information system that has produced significant cost efficiencies in underwriting new policies. The policies are sold by private insurance companies who are paid a standard commission. As of July 2008, TCIP covered 2.8 million households, approximately 21% of the overall target market in Turkey and 31% in the Marmara region surrounding Istanbul. While efforts to keep costs low have made the insurance more affordable, uptake of policies in areas outside of Ankara, Istanbul and the western coast has been hampered by lower awareness of risk and lower levels of household income.

Box 6.10: Addressing public/ sovereign risks – The Caribbean Catastrophe Risk Insurance Facility (CCRIF)[46]

The CCRIF is a regional insurance facility owned and operated by 16 Caribbean governments. The facility insures the governments against the impacts of catastrophic hurricanes and earthquakes and allows them to access liquidity at short notice using parametric triggers. For earthquakes the triggers are based on USGS data on the location, intensity and likelihood of damage to the member countries. For hurricanes the triggers are based on data from the US National Hurricane Center on hurricane paths and wind intensity.

Start-up activities have been supported by the World Bank and the Caribbean Development Bank and the Governments of Canada, France and the UK. By pooling their risk the governments have managed to reduce their individual insurance premium by up to 40%.

To date the CCRIF has made payouts in response to two events – US$ 418,976 to the St Lucian Government and US$ 528,021 to the Dominican Government as a result of the magnitude 7.4 earthquake close to Martinique in November 2007, and US$ 6.3 million to the Government of the Turks and Caicos Islands after Hurricane Ike in September 2008.

From this perspective, catastrophe pools would seem to provide an effective and transparent mechanism for offsetting losses, increasing resilience and for replacing, at least in part, traditional humanitarian and reconstruction assistance (although there is no guarantee that resources provided to governments that have insured their sovereign risk are used any more effectively than traditional recovery and reconstruction financing). They have the additional benefit of increasing awareness of risks, given the need to produce detailed risk estimates of the assets to be insured and given that purchasing insurance per se implies a level of risk awareness and acceptance. In the case of SIDS, where opportunities to reduce asset risks are more limited and where economic resilience is lowest, catastrophe pools may provide a fundamental building block in the disaster risk reduction architecture.

However, experience to date also highlights their limitations. Successful applications to date are in upper–middle-income countries, such as the Caribbean nations, Mexico and Turkey, and it is unclear to what extent the approach can be extended to low-income and least developed countries. Catastrophe re-insurance capacity is certainly available for such countries,

given the relatively low level of asset exposure. However, the requisite start up costs, such as catastrophe risk modelling and data collection, can be expensive relative to potential revenues, while awareness of and capacity to pay for insurance may be low. Even in Turkey insurance penetration tends to be highest in wealthier areas such as Istanbul.

In low-income and least developed countries, and in many low–middle-income countries, support from the public sector and the international community will be required to create the necessary information platforms and domestic and financial infrastructure. These will normally have to be accompanied by a clarification of legal responsibilities for post-disaster assistance. The responsibility of governments to finance post-disaster recovery and reconstruction is often implicit, as the law usually does not clearly define their financial responsibilities. The perception that governments are responsible for covering household disaster losses and that the international community is responsible for covering sovereign disaster losses is a major barrier to a wider application of catastrophe pools to disaster risk financing. At the same time, the provision of direct insurance premium subsidies by the public sector tends to provide the wrong economic incentives, benefiting high-risk policyholders to the detriment of low-risk policyholders[47].

Given the parametric nature of most catastrophe pools, they typically address intensive risk manifestations and do not address the more frequently occurring but low-intensity losses associated with extensive risk. As highlighted in Chapter 3, the housing losses associated with extensive risk may be as high as 40% of total disaster losses in that sector.

To conclude, an effective risk financing strategy should layer catastrophe risk, applying catastrophe pools to transfer the risks associated with extreme events and intensive risk, using other mechanisms such as disaster contingency funds to cover the small, recurrent losses in infrastructure and services associated with extensive risk, and extending microfinance and microinsurance to cover the housing and livelihood losses of poor urban and rural households.

Unfortunately, experience of disaster contingency funds is still mixed and has tended to show that the funds get diverted to other government priorities, in which case the losses associated with extensive risk manifestations are not covered at all and only increase the deficit of infrastructure and services faced by the urban and rural poor.

6.4 The management of ecosystem services

6.4.1 Approaches to ecosystem management

Resilient ecosystems are not only important for reducing disaster risks. They are critical to providing for sustainable livelihoods, in securing a reliable flow of goods and services, and in reducing vulnerability to an increasingly unpredictable climate. Building ecosystem resilience requires actions at different scales, with a wide array of stakeholders, and an understanding that different bodies of knowledge, including scientific, technical and local and traditional, are needed to understand the effects of global environmental change on local ecosystems.

The global decline in many regulating and provisioning ecosystem services contributes to increasing hazard for poor urban and rural households as well as declining livelihood resilience. From this perspective, ecosystem management is an emerging practice that can potentially contribute both to the regulation of weather-related hazards as well as to the strengthening of livelihoods.

A schematic view of the costs and benefits of ecosystem management is given in Figure 6.1.

Figure 6.1: Costs and benefits of applying ecosystem management to disaster risk reduction[48]

Restoration costs (RC)
1st order costs

Costs occurring from maintaining ecosystems, restoring damaged or lost ecosystems, and designing ecosystems in order that they deliver disaster regulating ecosystem services

- Costs for developing ecosystem approaches that often diverge from conventional approaches
- Costs for developing basis, e.g. data necessary for decision-makers to pursue new strategies
- Costs for awareness-, knowledge- and capacity-building among involved stakeholders and civil society to support the ecosystem approach
- Costs for implementing approaches, and for maintaining/monitoring implemented approaches

Benefits or avoided costs (AC)
1st order benefits

Costs that would have occurred from (economic, social and environmental) damage caused by natural disasters that could be reduced or avoided by the use of an ecosystem approach

- Direct benefits resulting from using an ecosystem approach that reduce disaster risk, e.g. avoided loss of land through erosion through establishment of protective coastal vegetation

Opportunity costs (OC)
2nd order costs

Costs resulting from adopting an ecosystem approach – primarily economic benefits foregone due to alternate land use

- Loss of benefits from using the ecosystem that were contrary to management of the ecosystem for disaster risk regulation, e.g. loss of income from logging in watershed areas that are now being reforested for the purpose of regulating flood and sediment flow

Co-benefits (COB)
2nd order benefits

Benefits resulting from adoption of an ecosystem approach

- Indirect benefits that result from using an ecosystem approach, e.g. harvesting of products from trees planted and protected to prevent erosion and desertification

In the case of ecosystem restoration, the avoided costs may significantly exceed the restoration costs. For example, planting and protecting 12,000 ha of mangroves by the IFRC in Viet Nam cost approximately US$ 1 million but reduced the costs of sea dyke maintenance by US$ 7.3 million per year. At the same time, the co-benefits may also greatly exceed the opportunity costs. For example, the Millennium Ecosystem Assessment estimated that the value of healthy coastal mangroves as nurseries, pollution filters and coastal defences is US$ 1,000 to US$ 36,000 for mangrove value versus US$ 200 per hectare for shrimp farming[49]. In Malaysia, the economic value of mangroves as coastal defences has been estimated at US$ 300,000 per kilometre, taking into account the costs of hard engineering work to achieve the same protective effect[50]. In Switzerland, the economic value of forests in preventing avalanches is valued at US$ 100 per hectare per year in open areas but up to US$ 170,000 in areas with high-value assets[51].

At the same time, ecosystems often provide important co-benefits if properly managed. Some of the most fertile agricultural land on the planet depends on regular flooding to recharge the soil with nutrients. Flooding can also recharge aquifers in semi-arid areas or transport vital sediments and nutrients to sustain coastal fisheries in other areas. Periodic fire is vital to

the health of some forest ecosystems. In these cases the co-benefits of protecting the ecosystem usually outweigh the opportunity costs. The best examples of ecosystem management are win–win strategies that simultaneously reduce hazard and increase livelihood viability for poor households, while providing broader global co-benefits in areas such as water and energy supply, air quality and climate regulation.

Managing the provision of ecosystem services is complicated for many reasons. While the benefits may appear obvious they are often shared by many people over the long term. Ensuring that private interests do not degrade these social benefits requires effective and long-term institutional, legal and administrative systems backed up with the resources and political support to be respected. There are many opportunities to engineer ecosystems to provide multiple ecosystem services. However, engineering ecosystems to ensure that they optimally produce services that are produced and consumed by different social groups and economic and political interests at different scales is usually a daunting governance challenge. Nevertheless, there are a number of different practices that applied appropriately or in combination can facilitate ecosystem management in a way that does reduce hazard and strengthen livelihoods.

6.4.2 Environmental governance

The broad area of environmental governance involves creating policy and regulatory frameworks and institutional structures to promote environmental sustainability. Often these frameworks specify levels of environmental protection and call for means to monitor and enforce that protection. One of the best known and most widely applied tools is the use of Environmental Impact Assessments (EIA) in project and investment planning and approval. Disaster risk considerations are now increasingly factored into EIAs. For example, the Caribbean Development Bank has integrated disaster risk into its EIAs and several Caribbean Community and Common Market (CARICOM) member countries, such as Guyana and Trinidad and Tobago, have already formalized these changes in the EIA process.

6.4.3 Integrated planning

Integrated planning, in which both environmental and disaster risk considerations are factored into land-use and development planning, is another mechanism that can facilitate the management of ecosystems. This includes integrated coastal zone management, integrated water resource management, as well as specific initiatives such as the Mangroves for the Future initiative – a multi-country, multi-agency, multi-stakeholder initiative aimed at improving coastal zone management. The success of integrated planning is closely associated with the quality of governance and in most countries success has depended, as in other areas, on innovative partnerships between national agencies, local governments and civil society.

6.4.4 Protected areas

Protected areas legislation, and other methods of natural resource management to conserve and restore ecosystems, is another relevant tool. The promotion of natural floodplains and wetlands as cost effective measures for flood hazard mitigation is becoming increasingly accepted in a number of countries as an alternative to expensive hard-engineering measures such as canalizing rivers and building flood defence walls. Protected forests regulate the water cycle, can mitigate flood and drought hazard and contribute to the sustainability of rural livelihoods both through the provision of forest products as well as eco-tourism (see Box 6.11). Coastal afforestation and the protection and restoration of mangroves can complement sea walls to protect erosion prone coastlines.

6.4.5 Environmental technology

A range of new environmental technologies and innovations is being introduced by the private sector, NGOs and public sector initiatives that offer new soft or eco-engineering approaches to the management of ecosystems and hazards and of energy, as well as to the strengthening of rural and urban livelihoods. Examples include

Box 6.11: Madagascar's watershed protection[52]

Some previously degraded areas have been rescued and economic benefits have been quantified due to the consequent risk reduction. Deforestation in the eastern part of Madagascar had exacerbated flooding from annual monsoon rains. Then, in 1989, the National Environmental Action Plan created the Mantadia National Park including the watershed of the Vohitra River. In terms of reduced crop damage, the estimated 1997 value of the watershed protection was US$ 126,700 – quite substantial considering the local economic situation.

technologies for water harvesting in drought prone areas, for managing temperature extremes in housing, fuel efficient stoves aimed to limit deforestation, decentralized microhydro and solar energy, and countless others. While the potential of technological innovation is enormous, major cultural and economic barriers often exist to their adoption by risk-averse poor rural and urban communities. As a result, while pilot projects abound, cases of mainstreaming and up-scaling are still the exception.

6.4.6 Payment for ecosystem services

Payment for ecosystem services (PES) is an environmental management tool that has been in existence since the 1990s. It involves placing a monetary value upon ecosystem services and then finding both 'buyers' and 'sellers'. The costs and benefits of the different kinds of provisioning, regulatory and cultural ecosystem services are valued and systems are designed so that users pay for the services provided. For example, a protected watershed provides water for domestic consumption and hydro-energy for a nearby city but if the watershed were deforested for logging this would provide benefits for those who sold the wood. If logged the costs in terms of reduced availability and more expensive water and electricity would be paid for by the residents of the city. Using a PES approach, the opportunity costs of protecting the watershed would be paid for by water and electricity consumers (predominantly from peri-urban and urban areas), who receive co-benefits in terms of a secure and cheap supply of water and energy. PES could therefore potentially play a major role in supporting efforts to reduce hazard both in urban and rural areas as well as to increase rural livelihood sustainability (see Box 6.12).

However, the mainstreaming of PES is still in its infancy and many current PES programmes present serious obstacles to the inclusion of poor households[55], given that they were originally designed to meet conservation rather than poverty reduction goals. The policy attention in many countries is indeed now shifting to identifying reforms needed to increase the potential of PES for poverty reduction and even in their current imperfect form, PES programs have managed to deliver some important benefits to low-income households, including the penetration of new markets for sustainable

Box 6.12: PES in Costa Rica[53]

In the Costa Rican programme of PES, forest landowners are paid a flat rate for protecting their forest. These payments are considered a compensation for the environmental services provided. The system acknowledges four types of services: protection of watersheds, biodiversity, carbon mitigation and scenic beauty/tourism. It does not value the actual services provided by a particular forest area, but rather pretends that all forests provide the same average of services and are thus eligible to the same payment. Also, it currently does not differentiate between areas of high vs. low risk of forest degradation or deforestation. The fact that the landowners' demand for PES enrolment currently exceeds by far the availability of financial PES resources indicates that for some landowners the PES payments are much higher than actual conservation opportunity costs. It is likely that efficiency of the PES could be increased if payments were better aligned with opportunity costs and threats and if spatial priorities were established. A less standardized approach, however, would complicate the PES system and increase research and administration costs.

In Central American countries other than Costa Rica, PES mechanisms have been difficult to establish due to enduring institutional deficiencies, lack of legal land tenure and poor governance[54].

timber, organic coffee and other agroforestry products. Like other forms of environmental income, PES may not be sufficient in itself to raise rural households out of poverty, but it can become an important contributor to livelihood security due to the regularity of the payments and the incentive they provide to manage sustainable ecosystems.

6.5 Community- and local-level approaches to disaster risk reduction

The analysis presented in Chapter 3 highlighted that local areas exposed to the same hazard manifest very different patterns of risk. This indicates that while disaster risk is influenced by broader national and global factors such as the quality of governance or climate change, it is shaped at the local level. The way communities, municipal governments, enterprises and other local actors use and transform territory, natural resources, the built environment and other assets has an enormous influence on how hazard, exposure, vulnerability and resilience are configured in each locality and together define the social territory of risk.

Given that risk is configured locally and that disaster impacts are experienced locally, it is unsurprising that in all the different practice areas reviewed in this chapter, emphasis has been placed on the importance of engaging local stakeholders, civil society organizations and municipal governments in disaster risk reduction. This section will examine this engagement with community-based organizations and local government as a practice in its own right, one that cuts across all the other practice areas.

6.5.1 The emergence of community- and local-level approaches

Since the 1980s, there has been a growing interest in the practice of community-based or local-level disaster risk reduction (referred to here as C-DRM and L-DRM[56]). Interest in these approaches initially came from the pioneering work of NGOs in Asia and Latin America, which recognized that national disaster risk reduction policies, strategies and programmes frequently failed to address the risks faced by the urban and rural poor, were uneconomic and often ineffective. Since the 1990s, C-DRM and L-DRM initiatives have been increasingly and enthusiastically promoted by bilateral and multilateral organizations and governments. In 1994, the Yokohama Declaration, from the first World Conference on Disaster Reduction, put an official seal of blessing on these approaches by stressing the importance of focusing disaster risk reduction efforts on poor communities[57].

While in C-DRM the focus is on direct partnership with local community organizations, in L-DRM the focus is on working with and through local governments. As a practice C-DRM has taken root in all developing regions. L-DRM, in contrast, has evolved mainly in Latin America and to some extent in Asia. L-DRM and C-DRM approaches, however, are rarely mutually exclusive. Most L-DRM approaches rest on partnerships between local governments and community and civil society organizations. Similarly, the most successful C-DRM approaches are those that have managed to attract the support of local and national governments. Clearly the definition of what is or isn't local varies from context to context. As a mediator and arbitrator of different social interests and conflicts and as a key actor in environmental, territorial and sector planning and development, local governments can potentially play a huge role in disaster risk reduction. However, the strength or weakness of local governments varies enormously according to a country's territorial and political–administrative structure, the level of decentralization of government responsibilities and the availability of resources.

Most C-DRM and L-DRM initiatives are rarely explicit about how they would contribute to reducing poverty. But a common feature of almost all such initiatives is that they focus on poorer communities. In fact, the focus on addressing disaster risk in poor areas is so implicit that, in most cases, 'vulnerable community' is considered synonymous with rural or urban poverty. In practice, nevertheless, C-DRM and L-DRM initiatives often develop in areas with functioning and active community organizations or local governments, which are not necessarily the most poor or the most vulnerable.

C-DRM and L-DRM consist of applying a community- or local-level approach to a wide range of practices. A wide range of participatory tools and techniques, such as vulnerability and capacity analysis, have been developed and applied in support of C-DRM and L-DRM initiatives[58].

C-DRM and L-DRM approaches have been applied to:

- the mapping and monitoring of hazard levels, using local knowledge to develop early warning systems
- hazard mitigation activities, such as the strengthening or construction of dykes, slope stabilization, the recovery of mangroves and, in urban areas, improvement of drainage
- improved ecosystem management, under local responsibility, including in some cases the use of PES mechanisms
- development of participatory land-use and development plans that incorporate disaster risk considerations
- strengthening of livelihoods, through promotion of employment and measures to increase agricultural productivity, water and food security and marketing initiatives
- application of microfinance and microinsurance to increase social protection and resilience
- strengthening of local governance, including the disaster risk reduction capacities of local governments
- the adoption of gender-sensitive approaches into disaster risk reduction practices.

A great number of community and local development initiatives also address many of the underlying risk factors highlighted in this Report but are not labelled C-DRM and L-DRM.

6.5.2 Why community and local involvement is important

In principle at least, an engagement of civil society and local government in disaster risk reduction would seem essential for a number of reasons[59].

If local stakeholders are not engaged in the design, implementation and management of disaster risk reduction, then the resulting policies, strategies and plans are less likely to respond appropriately to local conditions. For example, cases abound of projects to build hazard resistant but ecologically and culturally inappropriate housing, which ends up not being accepted by the local population[60].

Similarly, if local organizations are not stakeholders in the management of facilities and infrastructure they are less likely to look after them. For example, investment in local infrastructure to reduce hazard, such as storm drainage or slope stabilization, without local involvement and ownership, often results quite quickly in a lack of maintenance and critical disrepair.

The cost of disaster risk reduction can often be dramatically reduced due to the mobilization of local resources, capabilities and knowledge. These assets are often not accessed by national or international organizations because they are either unaware of the potential or because the mechanisms that permit a dialogue with local, particularly poor, communities do not exist.

Local and community engagement contributes to building social capital, raises awareness of disaster risk and strengthens local capacities to address a wider range of development issues.

6.5.3 C-DRM and L-DRM in practice

Documented C-DRM and L-DRM initiatives address both sides of the disaster risk–poverty nexus. There are initiatives that focus on increasing resilience, avoiding the translation of disaster impacts into poverty outcomes; others that seek to reduce the translation of poverty into disaster risk; and yet others that seek to address both.

The vast majority of C-DRM and L-DRM initiatives currently concentrate on risk factors that can easily be addressed at the community- or local-level with small investments, for example, improvements in disaster preparedness and response, rather than those that require addressing more structural issues such as access to land or natural resource management (see Box 6.13).

The Disaster Preparedness European Commission's Humanitarian Aid Office, for example, has promoted a large number of disaster-preparedness projects where preparedness and response planning and early warning systems have often been complemented with local hazard mitigation schemes, for example building and strengthening dykes and stabilizing slopes. Despite a relatively modest investment (approximately € 80 million worldwide over the last decade) these projects have probably contributed significantly to a reduction in mortality and greater livelihood security in the areas where they have been implemented. While it is difficult to prove whether poverty has been reduced, it is reasonable to assume that if they had not been implemented, poverty in the areas concerned might have been worse.

A growing number of C-DRM and L-DRM initiatives, however, address the vulnerability of livelihoods, the decline of ecosystems, the lack of social protection, unsafe housing, the improvement of governance and other underlying risk factors (see Box 6.14). Others aim to factor disaster risk considerations into local land-use and development planning, for example initiatives supported by Swiss Development Cooperation and by the World Bank in Central America, by GTZ in Peru or by local governments in Colombia.

6.5.4 Limitations and potential of C-DRM and L-DRM

Despite its apparent advantages, experience of C-DRM and L-DRM over the last quarter century illustrates that the approach has many limitations in practice.

In principle both C-DRM and L-DRM are described as processes through which disaster risk reduction issues are addressed and local capacities strengthened. In other words, an underlying rationale of both approaches is that there is empowerment of and ownership by local stakeholders, either at the community or municipal level that should lead to a sustainable reduction in disaster risks over time[63].

In practice, however, most initiatives are programmes and projects that are implemented at the community or local levels rather than with community or local ownership. Most initiatives have been promoted by NGOs and other supra-local organizations and have been delivered as relatively short-term projects or programmes, which while they are certainly disaster risk reduction activities, rarely generate the organizational and institutional underpinning that sustainable processes would require. Often, when the project or programme ends the process also ends, indicating that local ownership and involvement may be shallower than it appears. Those cases where sustainable local processes have emerged tend to be where national governments have decentralized both responsibilities and resources to the local level, as done in cities in Colombia such as Manizales or Bogota. For

Box 6.13: Reducing flood risk through a job creation scheme[61]

Heavy rains occur regularly in the West African state of Liberia, yet drainage systems have not been maintained for decades due to factors including lack of funds, years of neglect and misrule, and the civil war. As a result, flooding has triggered recurrent disasters in both rural and urban settings.

Cleaning the drains was not a priority for government officials or citizens. Only after the international NGO Mercy Corps raised the possibility of cash-for-work options did government officials embrace the idea. In September 2006, a one-year project was launched in five counties to clear and rehabilitate drainage systems to significantly increase the flow of rainwater and reduce the risk of localized flooding and related health problems.

The project met the double objective of creating income (it generated more than 17,800 days of employment) and achieving work that benefited the public, including providing clean water through water well rehabilitation and improving market access by clearing roads and constructing small bridges.

Box 6.14: Stabilizing livelihoods through community-based preparedness, India[62]

Exposed to floods, tropical cyclone or drought almost every year, Malda district in the State of West Bengal, in east India is also plagued by low agricultural production and lack of jobs. This situation has exacerbated migration, malnutrition and other related problems that increase vulnerability to disaster. Marginal farmers and landless labourers, who form over 70% of the district's population, are the most affected.

In February 2006, World Vision India, in partnership with the Government of India and UNICEF, initiated a project aimed at strengthening community disaster preparedness and mitigation, while providing wealth creation and income diversification opportunities. Targeting 15,000 vulnerable farmers and marginalized persons, with a special focus on children, the project worked to improve livelihoods as a disaster risk 'safeguard'. Focused support was provided through the following four strategies:

- *Awareness of disaster response and preparedness measures* was significantly enhanced through the distribution of learning materials to elementary school children. Local Relief Action Teams were formed with village volunteers, including women and youth, who are now trained in first aid, rescue and coordination with the local government structures in times of disaster.
- *Livelihoods and infrastructure development* was initiated to address some of the immediate economic and physical barriers to disaster resilience. Vulnerability assessments were conducted and 50 families were assisted with access to income generation activities, including women-headed households. The project also involved the community in the restoration of ponds, installation of tube wells, digging of open wells, construction of roads and the building of two relief centres.
- *Working with children's clubs* to enable community members to access disaster preparedness materials and drill exercises through children. This activity ensures that preparedness reaches all households – including illiterate households that cannot make use of educational materials.
- *Relationships have been established with the local government* through ongoing meetings and communications on the project. This has ensured the cooperation of the local government and provision of ongoing support for community capacity-training sessions.

The project's success is now being replicated in 92 villages – thus integrating poverty reduction and disaster risk reduction in World Vision's programme strategy.

example, in Bangladesh and Cuba success in disaster preparedness and response, leading to a real and drastic reduction in mortality due to tropical cyclones, builds on solid local organization but in both cases it has received sustained support from the national level.

While C-DRM and L-DRM can be applied to all areas of disaster risk reduction, in practice most of the success reported is in the area of improved disaster preparedness and response. In La Masica, Honduras, an effective locally managed early-warning system resulted in no mortalities during Hurricane Mitch, while neighbouring areas where local capacities had not been strengthened suffered hundreds of deaths. It was a similar case when the 2004 Indian Ocean tsunami struck the coast of Tamil Nadu. UNDP's strengthening of local capacities in the village of Samiyar Pettai led to a greatly reduced impact.

In disaster preparedness and response the required investments are relatively small and the benefits immediately visible, at least when the next disaster strikes. At the same time, local preparedness and response capacities can generally be strengthened without addressing underlying risk drivers such as land-tenure and access to resources, which generally lie outside community and local government control. Success in addressing these drivers through community-based and local-level approaches has been far more limited, precisely because so many of the factors that need to be addressed are beyond the capacities of local stakeholders to address.

The most successful programmes – while community- or locally based – have developed broader partnerships with governments and other supra-local stakeholders (see Box 6.15). Many of the underlying risk drivers cannot be addressed by community organizations or local governments on their own. Partnerships with national agencies permit scaling-up of initiatives to go beyond individual communities and localities to address problems that affect wider areas, such as watersheds and coastlines. They enable

the investment of resources that are unavailable locally and increase continuity and sustainability as initiatives move from stand-alone projects and programmes to longer-term processes. The application of social funds to support C-DRM and L-DRM initiatives, for example, offers the potential to scale-up in just this way.

L-DRM has been most successful where decentralization processes have provided local governments with the resources and capacities to fulfil their disaster risk reduction responsibilities, such as in Brazil or Colombia. In such contexts, local governments often become promoters of C-DRM processes. Where local governments are weak and disempowered it is unlikely that L-DRM will take root as the technical capacities, political authority or financial resources required are generally not present.

To conclude, C-DRM and L-DRM are approaches that can and should be applied to ensure the effectiveness and viability of all the other practices reviewed here, from strengthening urban governance and rural livelihoods, through to developing microinsurance and payment systems for ecosystem management. Their full potential is only fulfilled when they grow into partnerships between government and civil society, which are based not only on local participation and ownership but on political and economic support from national institutions, as illustrated by the case of El Salvador (see Box 6.15). Such partnerships are fundamental for advancing the different practices for addressing disaster risk, poverty and climate change that have been presented in this chapter.

Box 6.15: Development promotion from a risk management perspective, El Salvador[64]

The Lower Lempa Valley in El Salvador covers an area of some 880 square kilometres that is recurrently affected by flooding, minor landslides and drought. This area is characterized by poverty levels of over 70%, occupation by resettled ex-combatants from the civil war years, and agricultural production primarily for local consumption and, increasingly, for export.

Seriously affected by flooding related to Hurricane Mitch in 1998, the area has regularly demanded disaster risk reduction attention from the national government. Until 2001, this had mainly consisted of dyke building, river dredging exercises and attempts to introduce an early warning system for flood-related risks. The area had been typified by a division between the west and east banks, where the dominant local organizations professed different, and at times, antagonistic philosophies on development.

A new strategy for development in the area was inspired by a Salvadorian Ministry of Natural Resources and Environment project financed by the IADB. The project was informed by risk management goals and principles, and worked with the two major organizations and other smaller NGOs and municipal governments.

The central notion was that transformation in employment and livelihood options was a crucial component of risk reduction, and thus the plan should emphasize ways that risk reduction and development promotion could be enhanced on a parallel front. Design of the strategy was achieved using participatory diagnostic techniques whereby the population participated actively in the diagnosis and identification of development-based risk reduction instruments and schemes.

The final strategy document called for investment in such diverse aspects as:

- woodland recovery on the river banks as a means for flood control and generation of new employment opportunities
- road construction linking reliable and efficient land to routes out of the zone
- storage facilities for agricultural products so as to be able to avoid forced sale of goods to unscrupulous commercial intermediaries
- provision of potable water supplies in order to combat water-related disease during floods and offer a permanent measure of every-day security to the local population
- early warning systems and continuity of dyke strengthening and river dredging.

This combination of measures attempted to broach the risk reduction theme from the angle of livelihood strengthening and direct risk reduction measures. A very important aspect in the proposed scheme was the creation of a local, representative development support organization that could bring together the opposing factions in the area and negotiate new projects with a shared direction and purpose. The development of a second stage, an early warning system for flood-related risk financed through international funds demonstrates the ongoing effectiveness of this model.

Endnotes

1 Christoplos, et al., 2001
2 De-agrarianization is a long-term process of occupational adjustment, income earning reorientation, social identification and spatial relocation of rural dwellers away from strictly agriculture-based rural livelihoods. Bryceson, 2000.
3 Bryceson, 2000
4 Brown, et al., 2006
5 Winslow, et al., 2004
6 Winslow, et al., 2004
7 Winslow, et al., 2004
8 UNISDR, 2008c
9 IISD et al., 2003
10 RRN, 2006
11 Small tanks are man-made irrigation reservoirs, often built in cascade systems with different ponds being used for different purposes – domestic water supply, rainwater recharge, paddy cultivation, etc.
12 Miamidian, et al., 2005
13 World Bank, 2008b
14 World Bank, 2009
15 de Silva, 2008
16 Hardoy and Pandiella, 2008 note that many middle- and upper-income neighbourhoods also develop in high risk areas near rivers or coasts or on slopes but they have the political influence to ensure public provision of infrastructure to reduce risks and the resources to strengthen their homes and insure their property and possessions.
17 Campbell, 2003
18 Campbell, 2003; Fernandes, 2007; Cabannes, 2004
19 Fernandes, 2007
20 See for instance Edesio, 2007
21 D'Cruz and Satterthwaite, 2005; Mitlin, 2008
22 Abers, 1998; Menegat, 2002
23 Cabannes, 2004
24 Roberts, 2000; Lafferty and Eckerberg, 1998
25 Mitlin and Muller, 2004
26 Drawn from Manda, 2007
27 Omar Dario Cardona (2009) Case study information contributed on behalf of Universidad Nacional de Colombia, for the 2009 Global Assessment Report on Disaster Risk Reduction. ISDR. United Nations. http://www.manizales.unal.edu.co/
28 Cummins and Mahul, 2009
29 Moreno, 2007; O'Donnell, 2009
30 Churchill, 2006; O'Donnell, 2009
31 As of the end of December 2006, from Microcredit Summit Campaign, 2007: http://www.microcreditsummit.org
32 Aheeyar, 2006; Duflos, et al. 2006; Lynch, 2005
33 Warner, 2006 cited in O'Donnell, 2009
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35 Janvry, et al., 2006
36 McCord, et al., 2001
37 Republic of South Africa, 2008
38 Churchill, 2006
39 Arnold, 2008
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41 Lotsch, 2007
42 Fundación PROFIN
43 Gine,and Yang, 2009 (forthcoming)
44 Cummins and Mahul, 2009
45 Gurenko, et al., 2006
46 Caribbean Catastrophe Risk Insurance Facility: www.crif.org
47 Cummins and Mahul, 2009
48 UNEP and Stockholm Resilience Center, 2008
49 Millennium Ecosystem Assessment, 2005
50 ProAct Network, 2008
51 ProAct Network, 2008
52 UNISDR/PEDRR, 2009
53 Centre for Development Research, University of Bonn, 2009: http://www.zef.de/
54 Lavell, 2008
55 UNDP/BDP, 2005
56 We have preferred not to use the more common community-based disaster risk management terminology given that most initiatives take place at the community level but are not necessarily community based.
57 UN, 1994
58 Benson and Twigg, 2007
59 Maskrey, 1989; Wilches-Chaux, 1988; Anderson and Woodrow, 1989
60 This issue has been highlighted consistently since the publication of Davis, 1976.
61 Mercy Corps, 2008
62 UNISDR, 2008c
63 See for example the following definition: "the process of disaster risk management in which communities at risk are actively engaged in the identification, analysis, treatment, monitoring, and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities. This means that people are at the centre of decision making and implementation. The involvement of the most vulnerable is paramount and the support of the least vulnerable necessary. Local and national government are involved and supportive." Abarquez and Murshed, 2004.
64 Lavell, 2008

Chapter 7

Investing today for a safer tomorrow

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The challenge

The evidence presented in this Report shows that, globally, disaster risk is disproportionately concentrated in developing countries. Given similar levels of hazard exposure, developing countries suffer far higher levels of mortality and relative economic loss than developed countries. In general, poorer countries and those with weak governance are more at risk than wealthier, better governed countries. Disaster impacts have more serious outcomes in countries with small and vulnerable economies, including many small island developing states (SIDS) and land-locked developing countries (LLDCs), than in larger countries with more diversified economies. Even assuming constant hazard levels, global disaster risk is growing; economic loss risk is growing faster than mortality risk. In general, economic development increases a country's exposure at the same time as it decreases its vulnerability. However, in low- and middle-income countries with rapidly growing economies, exposure increases at a far faster rate than vulnerability decreases, leading to increased risk overall.

Within many developing countries, disaster risk is also spreading extensively, manifested as a very large number of low-intensity impacts, affecting significant areas of a country's territory. Almost all these impacts are associated with weather-related hazards. Such risk patterns are expanding rapidly, driven by factors such as fast – but poorly planned and managed – urban growth and territorial occupation, which increase both the number of people and assets exposed. Increased hazard exposure is aggravated by environmental mismanagement and the decline in the regulating services provided by ecosystems. Empirical evidence at the local level shows that poorer households and communities suffer disproportionately higher levels of loss and that disaster impacts lead to poverty outcomes. The poor are less able to absorb loss and recover, and are more likely to experience both short- and long-term deteriorations in income, consumption and welfare.

Climate change will magnify these interactions between disaster risk and poverty at all scales. On the one hand it magnifies the severity, frequency, distribution and unpredictability of weather-related and climatic hazards. At the same time, it erodes the resilience of poorer countries and communities through decreased agricultural production, increased water and energy stress, greater prevalence of disease vectors, and other effects. Even small increases in weather-related hazard due to climate change can have a large magnifying effect on risk. Critically, climate change magnifies the unevenness of risk distribution, meaning potentially drastic increases in the disaster impacts and poverty outcomes experienced by poorer, less resilient countries and communities.

7.1 The imperative for urgent action

In principle, international frameworks such as the Hyogo Framework for Action (HFA), the Millennium Development Goals (MDGs) and the United Nations Framework Convention on Climate Change (UNFCCC) recognize the links between disaster risk, poverty and climate change. In practice, however, current progress under these frameworks is not leading to a sustainable reduction in disaster risk.

Under the HFA many low- and middle-income countries have made major strides towards developing national policies, institutional systems and legislation for disaster risk reduction. However, far less progress has been made in reducing disaster risk in the principal development sectors. In many countries, this is a consequence of insufficient development per se. It is impossible to mainstream disaster risk reduction into development that is not there. However, progress is also challenged by weaknesses in risk reduction governance, including difficulties in compiling comprehensive information on disaster risks, insufficient engagement by the development sectors, and major difficulties in ensuring implementation, enforcement and accountability.

Progress in implementing climate change adaptation is slow, and adaptation policy and

institutional frameworks are largely disconnected from those created to reduce disaster risk, at both the national and international levels. Adaptation faces similar challenges to disaster risk reduction, in particular a governance framework that can allow risk in the development sectors to be addressed.

In principle, poverty reduction efforts in both rural and urban areas have considerable potential to address the underlying disaster risk drivers if they are clearly focused. In most countries, however, poverty reduction has only weak functional linkages to policy and institutional frameworks for disaster risk reduction and climate change adaptation. At the same time, the inclusion of disaster risk reduction in instruments such as poverty reduction strategy papers (PRSPs) is often limited to disaster preparedness and response aspects, meaning that their potential to address the underlying risk drivers is often not fully exploited.

The world will experience significant climate change, even if rapid progress is achieved in moving towards a low-carbon economy. Risk prone developing countries will only be able to avoid further increases in disaster impacts and poverty outcomes by taking decisive action to address the underlying drivers that are responsible for the concentration and expansion of risk. A failure to address these drivers will result in dramatic increases in disaster risk and the associated poverty outcomes.

In contrast, if priority is given to addressing these drivers, disaster risk can be reduced and the HFA achieved. Given that disaster impacts and outcomes are so disproportionately concentrated in poorer countries and communities, this is also critical to the achievement of poverty reduction and sustainable development objectives, such as the MDGs, and also offers the best opportunity to adapt to climate change. Rather than a cost, this should be seen as an investment in building a more secure, stable and equitable future.

Box 7.1 outlines the main recommendations for action highlighted in this Report.

Box 7.1: Recommendations for Action

A 20-point plan to reduce risk

Accelerate efforts to avoid dangerous climate change	
1	Agree measures such as an effective multilateral framework to reduce greenhouse gas emissions and policies for sustainable carbon budgeting. These are essential if potentially catastrophic increases in disaster impacts and associated poverty outcomes are to be avoided in disaster prone developing countries.
Increase the economic resilience of small and vulnerable economies	
2	Coordinate policies on trade and productive sector development with policies in climate change adaptation and disaster risk reduction in order to strengthen economic resilience, particularly in the case of SIDS and LLDCs.
3	Promote the development of catastrophe pools between such countries to allow the transfer of sovereign risk at an affordable cost and provide a more reliable mechanism for recovery and reconstruction.
Adopt high-level development policy frameworks to reduce risk	
4	Adopt overarching national development policy frameworks at the highest level, backed by the necessary political authority and resources, focusing on the underlying drivers of disaster risk. These should bring coherence to, align and integrate existing efforts being pursued under the HFA and through poverty reduction and climate change adaptation instruments.

Focus development policy on addressing the underlying risk drivers	
5	Build the capacities of urban and local governments to integrate disaster risk reduction considerations into a broader strategy to ensure the supply of safe land, secure tenure, infrastructure and services, and adequate, disaster resistant housing for the urban poor.
6	Invest in natural resource management, infrastructure development, livelihood generation and social protection to reduce vulnerability and strengthen the resilience of rural livelihoods.
7	Protect and enhance ecosystem services through mechanisms such as protected area legislation, payment for ecosystem services and integrated planning.
8	Shift the emphasis of social protection from an exclusive focus on response to include pre-disaster mechanisms and more effective targeting of the most vulnerable groups.
Adopt an approach supportive of local initiatives	
9	Promote a culture of planning and implementation of disaster risk reduction that builds on government–civil society partnerships and cooperation and is supportive of local initiative, in order to dramatically reduce the costs of risk reduction, ensure local acceptance, and build social capital.
Build on existing systems for public administration to incorporate innovations into the governance of disaster risk reduction	
10	Ensure that responsibility for disaster risk reduction is vested in the highest level of political authority and is explicitly incorporated into national development plans and budgets.
11	Harmonize and where possible integrate the governance arrangements for disaster risk reduction and climate change adaptation.
12	Promote greater synergy in hazard monitoring and risk identification, leading to comprehensive multi-hazard risk assessment, through the functional integration of the scientific and technical bodies responsible for meteorology, geology and geophysics, oceanography and environmental management, etc.
13	Subject all public investment to a cost–benefit analysis to enhance its sustainability and cost-effectiveness, and contribute significantly to the reduction of disaster risk.
14	Encourage national control and audit offices to undertake periodic reviews of the implementation of disaster risk reduction policy in order to achieve improvements in accountability, enforcement and control.
15	Strengthen the linkages between the organizations that generate warnings and those responsible for disaster preparedness and response, and between the national and local levels in order to increase the effectiveness of early warning systems in risk prone communities.
16	Support the development of insurance markets so that a larger proportion of at-risk households can have access to risk transfer mechanisms, complemented by other financial tools such as microfinance and contingency financing.
Invest to reduce risk	
17	Increase the resources available for climate change adaptation in risk prone developing countries, in order to complement resources pledged to achieve the MDGs and allow such countries to address the underlying drivers of risk.
18	Use increased public spending in the context of economic stimulus packages, to invest in risk-reducing infrastructure and other measures that address the underlying risk drivers.
19	Ensure that additional investments are made to factor disaster risk reduction considerations into all new development.
20	Strengthen the capacities of disaster prone countries to develop the policy and governance frameworks necessary to organize and manage all the above.

7.2 Global action to reduce risk

7.2.1 Climate change mitigation

The evidence of increasing disaster risk presented in this Report underlines the critical importance of avoiding dangerous climate change. Greater urgency is needed in efforts to reduce GHG emissions and energy consumption if a potentially catastrophic increase in disaster risk – the impacts of which will be largely concentrated in developing countries – is to be avoided.

Mitigation must be a priority for high-income nations because they are responsible for most GHG emissions to date. For most low-income nations, there is not much scope for mitigation because current levels of GHG emissions are so low. In many low-income countries, carbon dioxide emissions per capita are less than 1/200th that of the United States of America and Canada. In 2004, annual per capita carbon dioxide emissions were around 20 tonnes in the United States of America and Canada, between six and ten tonnes in most European nations, and less than 0.25 tonnes for many nations in sub-Saharan Africa and Asia[1]. These nations' per capita figures are also far below the targets for the world average sought for 2030 or 2050 to slow and then stop the increase in carbon dioxide concentrations in the atmosphere.

However, achieving the necessary reductions in global emissions will also require 'low-carbon' development paths for all growing economies (including the successful low- and middle-income nations).

7.2.2 Trade policy and productive development

The threat posed by disaster risk is highest in the case of SIDs, LLDCs and countries with small and vulnerable economies. Many of these countries are also highly susceptible to climate change. As climate change worsens, hazard levels and economic vulnerability will rise. Given the reliance of many vulnerable countries on a single economic sector, risk may reach unsustainable levels, in some extreme cases threatening their social and economic viability as nations.

A key recommendation is to start coordinating policies on trade and productive sector development with those on climate change adaptation and strategies for disaster risk reduction. Strategies are needed to develop capacities and reduce dependence on a single economic sector. The resilience of these countries will increase if they can diversify their economies and improve their participation in world trade.

7.3 Policy frameworks for risk reducing development

7.3.1 Addressing the underlying risk drivers is possible

It is possible to address the underlying drivers of disaster risk. In all regions, innovative approaches are already being applied at the local level and in different sectors, which show that it is possible to address these underlying risk drivers. These include mechanisms for providing land, infrastructure and housing for the urban poor; strengthening the resilience of rural livelihoods; enhancing valuable regulatory and provisioning ecosystem services; using microfinance, microinsurance and index-based insurance to strengthen resilience. The most successful of these experiences have emerged in the context of innovative partnerships between national and local governments and civil society that increase the effectiveness and sustainability of investments, reduce costs, and build valuable social capital.

These experiences demonstrate that the underlying risk drivers can be addressed, and that the tools, methods and approaches necessary to do so already exist. However, they must still be integrated into the policy mainstream. Most countries still lack a determined and focused

high-level development policy framework that addresses these drivers and is supportive of such innovative approaches. Without such central support, ongoing efforts in disaster risk reduction and climate change adaptation cannot gain traction.

The adoption of such an overarching policy framework would allow the different plans, programmes and projects in poverty reduction, climate change adaptation and disaster risk reduction – as well as in sustainable development in general – to become better aligned in order to address the underlying drivers of disaster risk. These plans and programmes include PRSPs, National Adaptation Programmes of Action (NAPAs), United Nations Development Assistance Frameworks (UNDAFs) and nationally specific programming instruments. To be relevant and successful such a policy framework must be at the centre of the political agenda, backed by dedicated resources in the national budget, and should have leadership at the highest levels of government.

7.3.2 Seizing the opportunity to reduce risk

The principal focus of risk-reducing development should be to avoid the rise of new disaster risk. While it is difficult to reduce existing major concentrations of accumulated risk, the avoidance of new risk will stabilize and eventually reduce the overall stock of disaster risk.

From this perspective, the reduction of extensive risk is particularly important, given that it represents the initial stages of disaster risk accumulation. Extensive risk can normally be addressed with relatively small investments: for example, minor investments in storm drainage in informal settlements can greatly reduce flood risk. It is better to address extensive risk now, than to deal with major concentrations of intensive risk in the future.

However, even intensive disaster risk can be addressed over time. All buildings and infrastructure, for instance, are periodically renewed, repaired, replaced or upgraded, all of which provide opportunities to avoid new disaster risk. Each of these moments of change is a point of bifurcation: if the opportunity is seized, new risk will not arise, but if it is missed, new risk begins to accumulate.

Risk is periodically liberated in disaster events, reducing the stock of accumulated risk. The recovery and reconstruction period, after a disaster, therefore, is a particularly powerful moment of opportunity to stop new risk from arising. But it can only be seized if a clear policy framework for risk reducing development exists.

A second aim should be to avoid the translation of disaster impacts from existing risks into poverty outcomes. Even if countries are successful in avoiding the creation of new risk, existing concentrations of unrealized risk may be so vast that further and increased disaster loss can be expected in the short- and medium-term. Ensuring that these impacts do not feed back into increased poverty is critical to defusing the disaster risk–poverty nexus.

7.3.3 Urban and local governance

Every year the population of urban, informal settlements increases by approximately 25 million people globally. If the expansion of unregulated, informal settlements continues to be the principal mechanism for absorbing urban growth, there will be a commensurate increase in both extensive and intensive disaster risk, as well as urban poverty. Both will be accentuated through climate change.

Improving urban and local governance should therefore be a key policy priority in most developing countries. As was highlighted in Chapter 6, good urban and local governance is usually built on a partnership between competent and accountable local government and an active civil society that can articulate needs and priorities, as well as the decentralization of authority and resources from a supportive central government. Improvements in urban and local governance can integrate disaster risk reduction considerations into a broader strategy that ensures the supply of safe land, secure tenure, infrastructure and services, and adequate, disaster resistant housing for the poor. Chapter 6 provided a non-exhaustive list of good practices, which have already been applied by cities around the world, and which show that it is possible to absorb urban growth in a way that does not increase risk.

7.3.4 Strengthening rural livelihoods

As highlighted in Chapters 3 and 4, disaster impacts translate into particularly challenging poverty outcomes for the rural poor. Despite urbanization, disaster risk in poor rural areas will continue to be a major challenge and one that will be accentuated by climate change, since rural livelihoods still depend heavily on weather-sensitive activities.

In those countries with large, poor rural populations, it will be essential to focus policy on strengthening rural livelihoods. As outlined in Chapter 6, a range of innovative approaches exist in areas including natural resource management, infrastructure development, livelihood generation and others. While strengthening rural livelihoods per se decreases vulnerability and increases resilience, it is essential that disaster risk reduction considerations are factored into the process, for example, to ensure that new schools in rural areas are built to hazard resistant standards.

7.3.5 Enhancing ecosystem services

Any further decline in the regulatory services provided by ecosystems will increase weather-related hazard. A decline in provisioning services will further increase the vulnerability of rural livelihoods, as well as the availability of water and energy in urban centres. Protecting and enhancing such ecosystem services is therefore another key policy priority.

It is cheaper and easier to manage and protect ecosystems than to restore damage. Chapter 6 highlighted a number of mechanisms that are already available and that could be mainstreamed including payments for ecosystem services and integrated planning.

7.3.6 Targeted social protection for the poorest and most vulnerable

At present most countries rely on ex post mechanisms such as emergency assistance, cash transfers and food aid to assist those affected by disasters. Such mechanisms are short-term and often fail to target the most vulnerable groups, which according to the context may include female-headed households, the elderly and children. They also fail to address the longer-term increases in poverty and inequality caused by disaster loss, and negative effects on health, human development and productivity.

Another key policy recommendation, therefore, is to shift the emphasis of social protection from ex post to include ex ante mechanisms, and to more effectively target the most vulnerable groups. This Report has not reviewed social protection practice and therefore does not provide detailed policy guidance. Improved social protection should be a key priority not only in those areas subject to concentrations of intensive risk, but in all communities affected by ongoing manifestations of extensive risk.

7.4 An approach based on partnership

Risk reducing development should be supportive of – and build upon – ongoing local and sectoral initiatives. It should explicitly adopt an approach built on partnerships between national and local government, civil society and the private sector.

This Report has stressed the limitations of conventional approaches to planning and regulating development in low- and middle-income countries where a considerable proportion of both economic and urban development occurs outside the formal sector. While further improvements in building codes, land-use planning and environmental regulations can contribute to risk reduction in high- and upper-middle income countries, they produce diminishing returns in poorer countries and may even be counter-productive. This might occur, for example, if high building standards are used to exclude poor families from the formal housing market.

If a policy framework for risk-reducing development is to be actionable, a different culture of implementation will be required, one that builds on government–civil society partnerships and cooperation. As highlighted in Chapter 6, such partnerships can dramatically reduce the costs of risk reduction, ensure local acceptance, and help to build social capital, which reduces long-term vulnerability.

The importance of this approach cannot be overstressed. For example, investments in urban drainage to reduce extensive risk in informal settlements will be ineffective if the drains are not maintained, are obstructed with garbage, or are encroached upon by buildings. If the drainage is planned and built in partnership with local government and the affected communities, there is a far better chance of it being maintained and protected in the long-term.

This approach, however, needs a change in culture in public administration in many countries and therefore a corresponding investment in capacity development with support from the international community. Bilateral and multilateral donors have traditionally preferred large, top-down projects as an easy mechanism for disbursing and managing resources. They also, therefore, have a responsibility for supporting a more process-based approach built on local partnerships. There is now enough experience of working through consortiums of NGOs and mechanisms such as social funds to manage the interface between donors, governments and local communities.

7.5 Effective risk reduction governance

In addition to a policy framework that prioritizes risk-reducing development, a set of governance arrangements is needed for disaster risk reduction, poverty reduction and climate change adaptation, which is capable of ensuring that risk considerations are factored into all development investments. Improvements to risk reduction governance are critical, in order to provide a vehicle for policy and a systematic approach to planning, financing and monitoring investment in all sectors.

In particular, the existing institutional and governance arrangements for disaster risk reduction and climate change adaptation need to be harmonized, building on existing systems of public administration. Each country has a different political and legal system and arrangements for public administration: there is no one-size-fits-all framework for risk reduction governance. The development of a single governance framework for risk reduction would seem to offer opportunities for more effective policy implementation and for avoiding duplication and lack of coordination. The harmonization of international frameworks and requirements for planning and reporting would be supportive of better integration at the country level.

The institutional and administrative responsibility for risk reduction has to be vested at the highest possible level in government, in order to have the necessary political authority and resources to influence development policy. If risk reduction can be included explicitly in national development plans and budgets, all parts of government are then able to programme risk reduction actions and investments.

Fortunately, the review of HFA progress highlighted that many countries are already putting into place innovative mechanisms for risk reduction governance, on which an improved governance framework can be built.

7.5.1 Hazard monitoring and risk information

Responsibilities for both hazard monitoring and risk information management are currently highly dispersed amongst a large number of governmental technical institutions, universities, and international technical cooperation projects. As a result, little progress is being made in comprehensive multi-hazard risk assessments

and hazard monitoring is often ad hoc and discontinuous.

It is recommended, therefore, that in the context of a country's planning system, greater synergy is sought in hazard monitoring and risk identification. This might be achieved by the functional integration or merging into a single institution of the large number of scientific and technical bodies responsible for meteorology, geology and geophysics, oceanography, and environmental management.

Such functional integration or institutional merging would improve the availability of accurate and up-to-date disaster risk information in appropriate scales and formats to support decision-making. This would facilitate, for example, the analysis of costs and benefits of incorporating disaster risk reduction into public investment, including ecosystem protection and renovation; the identification of priorities for investments in corrective disaster risk reduction; the assessment of probabilistic risk levels for the calculation of insurance premiums; the provision of hazard maps for use by local and city governments in land-use and territorial planning and regulation; the formulation of building codes; the dissemination of risk information for the private sector and civil society; and the establishment of norms and standards for risk reduction, such as the new ISO 3100 Standard currently under discussion.

Enhanced hazard monitoring would support improved early warning related to the major risks faced by a country, including cyclones, floods, volcanic eruptions and risks associated with climate variability such as El Niño Southern Oscillation (ENSO) cycles.

7.5.2 Incorporating cost–benefit analysis into public investment

Some countries have incorporated governance innovations in their public investment systems, such as the analysis of the costs and benefits of disaster risk reduction, illustrated by Table 5.5.

On the basis of accurate and up-to-date information on hazards, vulnerabilities and risks, an effective public investment system, normally located in either the planning or the finance ministry, could ensure that all new public investment is subject to a cost–benefit analysis to determine whether the additional costs of incorporating disaster risk reduction measures are justified by the level of risk. This would enhance the sustainability and cost-effectiveness of public investment, whether in sectoral or local development, new development or in rehabilitation of existing infrastructure and services. Such action would contribute significantly to the reduction of future disaster risks.

Normally the finance or planning ministry would also manage national budget resources for investments in reducing and correcting existing risks or those that are likely to increase due to climate change. These resources would be used for hazard mitigation; retrofitting of highly vulnerable key facilities and infrastructure (for example, schools, hospitals, water, sanitation and energy networks); for the development of early warning systems; for the restoration of ecosystems; and for other corrective disaster risk reduction investments.

If disaster risk reduction is incorporated into public investment systems, the finance or planning ministry would then also be best placed to negotiate the transfer of residual sovereign risk through participation in catastrophe pools, the issue of catastrophe bonds or other instruments, and to ensure that adequate resources exist for investment in recovery and reconstruction after disasters, through the management of contingency funds.

7.5.3 Ensuring implementation

A further governance innovation implemented in some countries is the inclusion of disaster risk reduction on the national audit or controller's office agenda of periodic audits of public sector performance. This in turn depends on risk reduction becoming a central component of national policy and being included in national development plans and budgets.

This can ensure that risk reduction policies and norms are implemented and enforced at all levels and sectors of government. Without improvements in implementation, enforcement and control, there is a real danger that other advances in policy and governance lead to

achievements on paper but have little effect on the underlying risk factors.

Audits can lead to administrative or other sanctions for non-compliance. However, they can also be used to highlight deficiencies and areas where improvements can be made and should become a key element in governance frameworks for risk reduction.

7.5.4 Improvements in early warning systems

The review of early warning systems (see Box 5.2) highlighted nine areas in which improvements are required to ensure that those at risk have access to timely and understandable early warning information, know their risks, and are prepared to take appropriate risk-reducing action. In particular, linkages need to be enhanced between the systems that provide early warnings of impending hazard events and the organizations responsible for disaster preparedness and response; local and community capacities for preparedness and response also need to be strengthened. Experience has shown that even when national and regional early warning fails, those areas with strong local capacities experience drastically reduced mortality rates even in cases of catastrophic events.

7.5.5 Risk transfer and financial mechanisms

There are still major barriers to the penetration of catastrophe insurance in lower-middle and low-income countries. These barriers include the lack of accurate and systematic risk assessments and the necessary financial infrastructure.

Support for the development of insurance markets in lower-income countries is another governance innovation that addresses these barriers, allowing a larger proportion of at-risk households to have access to risk transfer mechanisms. The development of insurance markets should be complemented by measures such as microfinance and contingency funding mechanisms to address different layers of risk in each country.

A greater penetration of risk transfer mechanisms in lower-income countries will also provide a quicker, more predictable and transparent mechanism for financing recovery and reconstruction, enabling a rapid recovery of livelihoods and lost assets.

7.6 Investing today for a safer tomorrow

In general terms, the cost implications of the recommendations presented above have three principal components:

1. **Investment in risk-reducing development:** the cost of providing the infrastructure and services needed to address the underlying risk factors. For example, this might include improvements to storm and surface drainage in urban areas; retrofitting existing buildings and infrastructure to reduce their vulnerability; improving water and sanitation, health and education; or providing infrastructure in rural areas.
2. **Incorporating risk reduction considerations:** the additional costs of factoring risk reduction considerations into all the above investment.
3. **Risk reduction governance framework:** the costs of building the governance frameworks and capacity at both the national and local levels to organize the tasks listed in points 1 and 2 above, and ensuring they are implemented.

Progress in the first two components depends on the presence of an adequate governance framework. At the same time, a governance framework without investment in the first two components is analogous to a country that has developed a comprehensive building code, but where 90% of the housing of the poor is built in the informal sector without reference to the code. In other words, investment in all three areas is mutually supportive.

7.6.1 Investment in risk-reducing development

Calculations of the costs of risk-reducing development investment must include both the cost of addressing existing development deficits, such as upgrading existing informal settlements or restoring damaged ecosystems, and that of ensuring that new development contributes to risk reduction – for example, ensuring that the urban poor have access to safe land, infrastructure and services.

It is difficult or impossible to provide accurate global estimates of the cost of reducing the development deficit in rural and urban areas. However, as Box 7.2 shows, the estimates developed by the Millennium Project serve to give an idea of the magnitude.

These different estimates indicate that several hundred billion dollars of investment a year are required to address the underlying risk factors in rural and urban areas. As Chapter 6 indicated, these costs can be greatly reduced through innovative government–civil society partnerships. However, even assuming that governments up-scale and mainstream such participatory approaches, there is no getting round the fact that addressing the underlying risk factors requires major and sustained investment, of which the international community will have to pay a significant portion. Reducing disaster risk and adapting to climate change in developing countries is not a free ride for the international community.

Paradoxically the current global economic crisis may offer an opportunity to promote such investment. Many countries are increasing public investment in areas such as infrastructure and employment creation as part of economic stimulus packages. To the extent that this investment could be targeted at risk-reducing

Box 7.2: The cost of meeting the MDGs

Detailed estimates of the cost of meeting the MDGs in Bangladesh, Cambodia, Ghana, Tanzania and Uganda suggest a total of around US$ 1,000 per person[2]. Of this, about half is for infrastructure. The only housing-related component is around US$ 30 per person allocated to slum upgrading[3]. The difference between the total investment needed to meet the MDGs and current domestic resource mobilization from households and governments is estimated to be approximately US$ 600 per person for these five countries. If this average were applied only to the LDCs, this would still imply a need for external investment of US$ 480 billion over ten years. The MDG finance gap for all low- and middle-income countries was estimated at US$ 73 billion in 2006, rising to US$ 135 billion in 2015. This costing exercise highlights the high monetary cost of addressing the development deficit that underpins disaster risk reduction in poor countries.

The estimated cost of remedying existing deficiencies in the provision of water, sanitation and drainage in urban areas provides another relevant example. If we assume that there are 30 million urban dwellings lacking provision for water and sanitation in Africa and Latin America, and 150 million lacking such provision in Asia[4]; and that the average cost per household of providing water, sanitation and drainage is US$ 200–400[5], with another US$ 200–400 needed for the trunk infrastructure this requires (including water abstraction and treatment), then US$ 42–84 billion would be needed. The proportion of this that could be funded by local and national governments would differ greatly between regions and countries. At the same time, this only considers the water and sanitation infrastructure needed in urban areas and does not consider the investment needed for the 55% of the population who live in rural areas.

The cost of upgrading informal settlements has been estimated at an average of US$ 665 per person[6]. This implies that the cost of upgrading the 800 million to one billion people living in informal settlements would be US$ 532–665 billion[7]. If 30% of these investments could be recovered through small loans and 10% was contributed by residents themselves, this would still imply the need for some US$ 300–400 billion.

The cost of providing good quality alternatives to the growth of informal settlements for an estimated 457 million people between 2005 and 2020, through assisted owner-driven housing, would require a per capita investment of US$ 400. This implies a total requirement of US$ 182 billion, of which 60%, or US$ 110 billion, would have to come from subsidies. The other 40% could be funded through savings and contributions from participant households and cost-recovery from small loans.

development (for example, improving drainage in flood prone areas) it could be used as a risk reducing tool.

7.6.2 Incorporating risk reduction

Risk reduction (whether conceptualized as disaster risk reduction or adaptation to climate change) is usually viewed as an additional development cost. In fact, one of the principal arguments that has been used to justify the lack of progress in disaster risk reduction, is that developing countries have other priorities, such as reducing poverty, and cannot afford the additional costs.

This Report puts forward a contrasting view. As Table 5.5 illustrated, investment in disaster risk reduction generally represents a large saving in terms of avoided losses and reconstruction costs. It is thus a way of lowering the costs of poverty reduction and of addressing the underlying risk factors. This means that the real cost of development investments is actually lower if disaster risk reduction is included.

Mechanisms such as catastrophe pools and bonds may provide a means to transfer residual risks, where it is not cost-effective to reduce them. Given that insurance markets in most lower-middle and low-income countries are highly undeveloped, this policy recommendation requires public sector support to ensure that risk assessments are available for the estimation of hazard and risk levels, and to assist with the start-up costs associated with opening an insurance market. These costs need to be included in budgets for improving governance arrangements for disaster risk reduction.

7.6.3 Risk reduction governance framework

It is likewise difficult to estimate the investments required to enhance national policy and governance frameworks, because needs and capacities vary from one country to another.

Many of these investments require an element of international technical cooperation, even in countries where most of the key resources and capacities are available nationally. In any case, the key resource in this case is political will more than international finance. When the necessary political will is present, even small investments can produce huge benefits. Without political will even large investments in capacity building may have little tangible effect.

In conclusion, the key requirements are to help countries strengthen governance arrangements and improve management of investments for addressing the underlying risk drivers, and to ensure disaster risk reduction is incorporated into those investments. Without strengthening these arrangements and capacities, even large investments in development may have little tangible effect or be counter-productive. If the governance arrangements and capacities for risk reduction can be strengthened, small investments can produce huge benefits. Investing today to strengthen capacities is essential if future generations are to enjoy a safer tomorrow.

Endnotes

1 World Bank, World Development Indicators On-line: http://go.worldbank.org/U0FSM7AQ40, accessed 1 November 2008

2 Sachs and UN Millennium Project, 2005. The original listed figures for individual years for 2006, 2010 and 2015. To get the figures above, an average was taken of these three annual figures and multiplied by 10.

3 An inadequate figure. Personal communication from David Satterthwaite, IIED, London. Received 10.01.2009

4 Hardoy, et al., 2001

5 It is impossible to estimate the real costs, in part because they will vary so much from place to place – and indeed within each place – depending on who designs and implements it. A 'high-income' nation solution with a 24-hour service of piped water supplies to drinkable standards and a flush toilet is generally much more expensive than this; some innovative programmes that have provided good quality water and sanitation are less than this.

6 UN Millennium Project, 2005. This estimate includes funding for land purchase and transfer, housing improvement, network and bulk infrastructure, schools and health clinics, community facilities, planning and oversight, and community capacity building.

7 This is in line with other estimates – for instance, by the Cities Alliance, that US$ 50 billion was needed to upgrade housing for 100 million slum dwellers; and the estimate of US$ 74 billion for this by UN-HABITAT; see Flood, 2004.

Acronyms

ASEAN	Association of Southeast Asian Nations
AU	African Union
BCPR	Bureau for Crisis Prevention and Recovery
BRAC	Bangladesh Rural Advancement Committee
CAPRADE	Comité Andino para la Prevención y Atención de Desastres
CDERA	Caribbean Disaster Emergency Response Agency
CDM	Clean Development Mechanism
C-DRM	Community Based Disaster Risk Management
CENTRO	Centro de Estudios Sociales y Ambientales
CEPREDENAC	Central American Coordinating Center for Disaster Prevention
CIDAP	Centro de Informacion Documentacion y Asesoria Popular
CODI	Community Organizations Development Institute, Thailand
CV	coefficient of variation
DFID	UK's Department for International Development
DRM	Disaster Risk Management
ECCAS	Economic Community of Central African States
ECLAC	Economic Commission for Latin America and the Caribbean
ECO	Economic Cooperation Organization
ECOWAS	Economic Community of West African States
EIA	Environmental Impact Assessments
EMDAT	OFDA/CRED International Disaster Database
EMI	Earthquake and Megacities Initiative
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
FLACSO	Latin America Social Science Faculty
GDP	gross domestic product
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	greenhouse gas
GIS	geographical information systems
GRADE	Grupo de Anàlisis para del Desarrollo
GRID	Global Resource Information Database
GRIP	Global Risk Identification Programme
GRUMP	Global Rural-Urban Mapping Project
GSHAP	Global Seismic Hazard Assessment Programme
GTZ	Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)
HFA	Hyogo Framework for Action 2005–2015
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
HSIF	Honduras Social Investment Fund
IADB	Inter-American Development Bank
IASC	Inter Agency Standing Committee
IDS	Institute of Development Studies
IFRC	International Federation of Red Cross and Red Crescent Societies
IIED	International Institute for Environment and Development
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IRP	International Recovery Platform
ISDR	International Strategy for Disaster Reduction
ISO	International Organization for Standardization
KDP	Kecamatan Development Program
LDCF	Least Developed Countries Fund

L-DRM	Local Level Disaster Risk Management
LLDC	Land-locked Developing Country
MDG	Millennium Development Goal
MFI	microfinance institution
MMI	Modified Mercalli Intensity
NAPA	National Adaptation Programme of Action
NCF	net capital formation
NGO	non-governmental organization
NHC	National Hurricane Center
NOAA	United States National Oceanic and Atmospheric Administration
NREGP	National Rural Employment Guarantee Programme
OECD	Organization for Economic Cooperation and Development
OPP-RTI	Orangi Pilot Project: Research and Training Institute, Pakistan
OSSO	Observatorio Sismologico del Sur-Occidente
PES	Payments for Ecosystem Services
PREDECAN	Apoyo a la Prevención de Desastres en la Comunidad Andina
PRSP	Poverty Reduction Strategy Paper
SAARC	South Asian Association for Regional Cooperation
SADC	Southern African Development Community
SCCF	Special Climate Change Fund
SIDS	Small Island Developing States
SIISE	Sistema Integrado de Indicadores Sociales del Ecuador
SOPAC	Pacific Islands Applied Geoscience Commission
SPI	Standardized Precipitation Index
SST	sea surface temperature
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNAM	Universidad Nacional Autónoma de México
UNCT	United Nations Country Team
UNDAF	United Nations Development Assistance Frameworks
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Centre for Human Settlements
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNITAR	United Nations Institute for Training and Research
UN OCHA	United Nations Office for the Coordination of Humanitarian Affairs
UN-OHRLLS	United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States
UNOOSA	United Nations Office for Outer Space Affairs
UNOSAT	United Nations Operational Satellite Applications Programme
USGS	United States Geological Survey
VTA	Village Tract Assessment
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

Summary table on mortality risk

ISO3 code	Territory name	Multiple Mortality Risk class	Multiple Mortality Risk class (absolute)	Multiple Mortality Risk class (relative)	Cyclones Mortality Risk class	Cyclones Mortality Risk class (absolute)	Cyclones Mortality Risk class (relative)	Earthquakes Mortality Risk class	Earthquakes Mortality Risk class (absolute)	Earthquakes Mortality Risk class (relative)	Floods Mortality Risk class	Floods Mortality Risk class (absolute)	Floods Mortality Risk class (relative)	Landslides Mortality Risk class	Landslides Mortality Risk class (absolute)	Landslides Mortality Risk class (relative)
ABW	Aruba	0	0	0	0	0	0									
AFG	Afghanistan	8	8	7				8	8	7	6	6	5	4	4	3
AGO	Angola	4	4	4				0	0	0	4	4	4	4	4	3
AIA	Anguilla	3	1	5	3	1	5	0	0	0						
ALB	Albania	7	6	7				7	6	7	4	3	4	5	4	5
AND	Andorra															
ANT	Netherlands Antilles	4	2	6	4	2	6	0	0	0						
ARE	United Arab Emirates	0	0	0							0	0	0	0	0	0
ARG	Argentina	5	5	4				4	5	3	5	5	4	3	4	2
ARM	Armenia	7	6	7				7	6	7	5	4	5	4	3	4
ASM	American Samoa	2	0	3	2	0	3									
ATG	Antigua and Barbuda	4	2	6	4	2	6	3	1	4						
AUS	Australia	4	4	4	4	4	3	3	3	2	3	3	2	3	3	2
AUT	Austria	4	4	4				1	1	1	3	3	3	3	3	3
AZE	Azerbaijan	5	4	5				2	2	2	4	4	4	4	3	4
AZO	Azores Islands															
BDI	Burundi	5	4	5				1	1	0	4	3	4	4	4	4
BEL	Belgium	3	3	3				0	0	0	3	3	3			
BEN	Benin	4	4	4							4	4	4	4	4	4
BFA	Burkina Faso	4	4	4							4	4	4	2	2	1
BGD	Bangladesh	9	10	7	9	10	7	2	3	1	7	8	5	4	5	2
BGR	Bulgaria	4	3	4				1	1	0	3	3	3	3	2	3
BHR	Bahrain	0	0	0							0	0	0			
BHS	Bahamas	4	2	5	4	2	5									
BIH	Bosnia and Herzegovina	5	4	5				2	2	2	4	4	4	4	4	4
BLR	Belarus	4	4	4							4	4	4			
BLZ	Belize	5	3	6	4	2	5	0	0	0	4	2	5	4	2	6
BMU	Bermuda	3	1	5	3	1	5									
BOL	Bolivia	5	5	5				4	4	4	4	4	4	4	4	4
BRA	Brazil	5	6	3	1	2	0	0	0	0	4	5	3	4	5	2
BRB	Barbados	3	1	4	3	1	4									
BRN	Brunei Darussalam	4	2	5							0	0	0	4	2	5
BTN	Bhutan	6	4	7				3	2	4	5	4	6	5	4	6
BVT	Bouvet Island															
BWA	Botswana	4	3	4							4	3	4			
CAF	Central African Republic	5	4	5				0	0	0	5	4	5	4	3	4
CAN	Canada	4	4	3				1	1	0	2	2	1	3	3	2
CCK	Cocos (Keeling) Islands	0	0	0	0	0	0									
CHE	Switzerland	4	4	4				0	0	0	3	3	3	4	3	4
CHL	Chile	6	6	5				5	5	5	4	4	3	4	4	4

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CHN	China	9	10	7	4	6	2	9	10	7	6	8	4	4	6	2
CIV	Côte d'Ivoire	5	5	4							5	5	4	4	4	3
CMR	Cameroon	5	5	5				0	0	0	4	4	4	5	5	4
COD	Democratic Republic of the Congo	7	8	6				7	8	6	5	6	4	0	0	0
COG	Congo	5	4	5				0	0	0	4	4	4	4	3	4
COK	Cook Islands	2	0	4	2	0	4									
COL	Colombia	9	9	8	0	0	0	9	9	8	5	5	4	5	5	4
COM	Comoros	7	5	8	0	0	0							7	5	8
CPT	Clipperton Island															
CPV	Cape Verde	5	3	6										5	3	6
CRI	Costa Rica	7	6	7	2	1	2	7	6	7	3	2	3	5	4	5
CUB	Cuba	5	5	5	4	4	4	1	1	0	4	4	4	4	4	3
CXR	Christmas Island															
CYM	Cayman Islands	3	1	5	3	1	5	0	0	0						
CYP	Cyprus	3	2	4				2	1	3	0	0	0	3	2	4
CZE	Czech Republic	4	4	4				0	0	0	3	3	3	3	3	3
DEU	Germany	4	4	3				1	1	0	3	4	2	2	3	1
DJI	Djibouti	5	4	6				5	4	6	2	1	3			
DMA	Dominica	6	4	8	3	1	5	0	0	0				6	4	8
DNK	Denmark	0	0	0							0	0	0			
DOM	Dominican Republic	6	6	6	6	6	6	5	5	5	4	4	4	4	4	4
DZA	Algeria	7	8	6				7	8	6	5	5	4	4	4	3
ECU	Ecuador	7	7	7				7	7	7	4	4	4	5	5	4
EGY	Egypt	5	6	4				3	4	2	5	6	4			
ERI	Eritrea	4	4	4				0	0	0	4	3	4	4	3	4
ESH	Western Sahara															
ESP	Spain	4	4	3				1	1	0	3	4	2	3	3	2
EST	Estonia	0	0	0							0	0	0			
ETH	Ethiopia	6	6	5				4	5	3	4	5	3	5	6	4
FIN	Finland															
FJI	Fiji	6	5	7	5	4	6	1	1	1				5	4	6
FLK	Falkland Islands (Malvinas)															
FRA	France	4	4	3				0	0	0	4	4	3	3	3	2
FRO	Faroe Islands	3	1	4	3	1	4							0	0	0
FSM	Micronesia (Federated States of)	4	2	6	4	2	6	1	0	1						
GAB	Gabon	4	3	5				0	0	0	4	3	5	3	2	4
GBR	UK of Great Britain and Northern Ireland	3	4	2				0	0	0	3	3	2	2	3	1
GEO	Georgia	5	5	5				3	3	3	5	4	5	5	4	5
GGY	Guernsey															
GHA	Ghana	4	4	3							4	4	3	3	3	2

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GIB	Gibraltar															
GIN	Guinea	5	5	5				3	3	3	4	4	4	4	4	4
GLP	Guadeloupe	3	2	4	3	2	4	2	1	2				0	0	0
GMB	Gambia	4	3	5							4	3	4	3	2	4
GNB	Guinea-Bissau	4	3	5				0	0	0	4	3	4	3	2	4
GNQ	Equatorial Guinea	5	3	6				0	0	0	0	0	0	5	3	6
GRC	Greece	5	5	5				5	5	5	2	2	2	4	4	3
GRD	Grenada	0	0	0	0	0	0							0	0	0
GRL	Greenland	0	0	0				0	0	0						
GTM	Guatemala	8	8	8	2	2	2	8	8	8	4	4	3	6	6	5
GUF	French Guiana	4	2	5							4	2	5	0	0	0
GUM	Guam	4	2	5	3	1	5	3	1	4				0	0	0
GUY	Guyana	4	3	5							4	3	5	3	2	4
HKG	Hong Kong	4	4	4	0	0	0							4	4	4
HMD	Heard Island and McDonald Islands															
HND	Honduras	6	5	6	3	3	3	5	5	5	4	4	4	5	4	5
HRV	Croatia	5	4	5				3	2	3	4	3	4	4	3	4
HTI	Haiti	6	6	6	6	6	6	1	1	1	4	4	4	5	5	5
HUN	Hungary	3	3	3				0	0	0	3	3	3	1	1	1
IDN	Indonesia	9	10	7	0	0	0	9	10	7	5	6	3	5	6	3
IMN	Isle of Man	0	0	0	0	0	0									
IND	India	9	10	7	6	8	4	9	10	7	8	10	5	4	6	2
IOT	British Indian Ocean Territory															
IRL	Ireland	4	3	4							3	2	3	3	2	3
IRN	Iran (Islamic Republic of)	8	8	7				8	8	7	5	6	4	3	4	2
IRQ	Iraq	5	5	4				1	1	0	5	5	4	3	3	2
ISL	Iceland	4	2	5				0	0	0				4	2	5
ISR	Israel	3	3	3				0	0	0	3	3	3	3	2	3
ITA	Italy	5	5	4				5	5	4	3	4	2	4	4	3
JAM	Jamaica	5	4	5	4	3	4	2	1	2				5	4	5
JEY	Jersey															
JOR	Jordan	3	3	3				2	2	2	3	3	3			
JPN	Japan	7	8	5	5	6	3	6	7	5	4	5	2	4	5	2
JTN	Johnston Atoll															
KAZ	Kazakhstan	5	5	4				1	1	0	5	5	4	1	1	1
KEN	Kenya	5	5	4				0	0	0	4	4	3	5	5	4
KGZ	Kyrgyzstan	6	6	6				6	6	6	4	4	4	3	3	3
KHM	Cambodia	6	6	6	0	0	0				6	6	6	4	4	4
KIR	Kiribati															
KNA	Saint Kitts and Nevis	5	2	7	5	2	7	2	1	3						
KOR	Republic of Korea	5	5	4	3	4	2	0	0	0	4	5	3	4	4	3
KWT	Kuwait	2	1	2				0	0	0	2	1	2			

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LAO	Lao People's Democratic Republic	6	6	6	4	4	4	3	2	3	6	5	6	5	4	5
LBN	Lebanon	5	4	5				1	1	1	3	3	3	5	4	5
LBR	Liberia	5	4	5							4	3	4	4	3	4
LBY	Libyan Arab Jamahiriya	3	3	3				0	0	0	3	3	3			
LCA	Saint Lucia	5	3	7	0	0	0							5	3	7
LIE	Liechtenstein	4	1	6							0	0	0	4	1	6
LKA	Sri Lanka	5	5	4	3	3	2				4	4	4	4	4	3
LSO	Lesotho	4	3	5							4	3	4	4	3	4
LTU	Lithuania	4	3	4							4	3	4			
LUX	Luxembourg	3	1	4							3	1	4			
LVA	Latvia	0	0	0							0	0	0			
MAC	Macau	0	0	0	0	0	0									
MAR	Morocco	5	5	4	2	2	1	5	5	4	0	0	0	0	0	0
MCO	Monaco	4	1	6							0	0	0	4	1	6
MDA	Moldova (Republic of)	4	4	4				1	1	1	4	4	4	2	2	2
MDG	Madagascar	6	6	6	6	6	6	1	1	0	4	4	4	5	5	4
MDR	Madeira Islands															
MDV	Maldives															
MEX	Mexico	6	7	5	4	5	3	5	6	4	4	5	3	4	5	3
MHL	Marshall Islands	3	1	5	3	1	5									
MID	Midway Island															
MKD	The Former Yugoslav Republic of Macedonia	4	3	5				1	1	1	4	3	4	4	3	4
MLI	Mali	4	4	4							4	4	4	2	2	2
MLT	Malta	3	2	4										3	2	4
MMR	Myanmar	9	9	8	6	6	5	9	9	8	6	6	5	5	6	4
MNE	Montenegro	5	4	6				2	1	2	4	2	5	5	4	6
MNG	Mongolia	4	3	4				1	1	0	4	3	4	0	0	0
MNP	Northern Mariana Islands	4	2	6	4	1	6	3	1	4						
MOZ	Mozambique	6	6	5	5	5	5	3	3	2	4	4	4	4	4	3
MRT	Mauritania	4	3	4							4	3	4			
MSR	Montserrat	4	1	7	0	0	0	4	1	7						
MTQ	Martinique	2	1	3	2	1	3	0	0	0				0	0	0
MUS	Mauritius	5	4	6	4	3	5							5	4	6
MWI	Malawi	5	5	5				3	3	3	4	4	3	4	4	4
MYS	Malaysia	5	5	4				1	1	0	4	4	4	4	4	3
MYT	Mayotte	0	0	0	0	0	0									
NAM	Namibia	4	3	5				0	0	0	4	3	4	3	2	4
NCL	New Caledonia	5	3	6	5	3	6	0	0	0				4	2	6
NER	Niger	4	4	4							4	4	4	3	3	2
NFK	Norfolk Island	0	0	0												
NGA	Nigeria	5	6	4				0	0	0	5	6	3	4	5	3
NIC	Nicaragua	6	5	6	4	3	4	4	4	4	4	3	4	5	4	5

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NIU	Niue	0	0	0	0	0	0									
NLD	Netherlands	3	3	3				0	0	0	3	3	3			
NOR	Norway	3	2	3	0	0	0							3	2	3
NPL	Nepal	6	6	6				6	6	5	5	5	4	6	6	5
NRU	Nauru															
NZL	New Zealand	5	4	5	3	2	3	1	1	1	3	3	3	4	3	4
OMN	Oman	2	1	3							0	0	0	2	1	3
PAK	Pakistan	8	9	7	3	4	1	8	9	6	5	6	4	4	5	3
PAN	Panama	5	4	5				4	3	4	3	2	3	5	4	5
PCN	Pitcairn															
PER	Peru	8	8	7				8	8	7	4	4	3	5	5	4
PHL	Philippines	8	8	7	6	7	5	7	8	6	4	5	3	5	6	4
PLW	Palau	4	1	6	4	1	6									
PNG	Papua New Guinea	6	6	6	0	0	0	5	5	5	4	3	4	6	5	6
POL	Poland	4	4	3				0	0	0	4	4	3	2	2	1
PRI	Puerto Rico	4	4	4	3	3	3	0	0	0	2	1	2	4	3	4
PRK	Democratic People's Republic of Korea	6	6	5	3	3	3	0	0	0	6	6	5	5	5	4
PRT	Portugal	4	4	4				1	1	0	2	2	2	3	3	3
PRY	Paraguay	5	4	5				0	0	0	4	4	4	4	4	4
PSE	West Bank and Gaza	2	2	2				2	2	2	0	0	0			
PYF	French Polynesia	2	1	3	2	1	3									
QAT	Qatar	0	0	0							0	0	0			
REU	Réunion	0	0	0	0	0	0							0	0	0
ROU	Romania	8	8	7				8	8	7	0	0	0	3	3	2
RUS	Russian Federation	5	6	4				3	4	2	5	6	3	2	3	1
RWA	Rwanda	5	5	5				5	5	5	4	4	4	4	4	4
SAU	Saudi Arabia	3	3	2				2	2	2	3	3	2			
SDN	Sudan	6	6	5				6	6	5	6	6	5	3	3	2
SEN	Senegal	4	4	4				0	0	0	4	4	4			
SGP	Singapore															
SGS	South Georgia and the South Sandwich Islands															
SHN	Saint Helena															
SJM	Svalbard and Jan Mayen Islands															
SLB	Solomon islands	6	5	7	4	2	5	6	4	7				6	4	7
SLE	Sierra Leone	6	5	6							4	4	4	5	5	5
SLV	El Salvador	7	7	7				7	7	7	3	3	3	5	5	5
SMR	San Marino	4	1	6										4	1	6
SOM	Somalia	5	5	5				1	1	0	5	5	5			
SPM	Saint Pierre et Miquelon	0	0	0	0	0	0									
SRB	Serbia	5	5	5				5	5	5	4	4	4	3	3	3
STP	Sao Tome and Principe	6	4	7										6	4	7

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SUR	Suriname	4	2	5							4	2	5			
SVK	Slovakia	4	3	4							4	3	4	2	2	2
SVN	Slovenia	4	3	5				2	1	2	3	2	4	4	3	4
SWE	Sweden	2	2	2				0	0	0	2	2	2			
SWZ	Swaziland	4	3	5				0	0	0	4	3	5	2	1	3
SYC	Seychelles	0	0	0	0	0	0									
SYR	Syrian Arab Republic	5	5	5				0	0	0	5	5	4	4	4	3
TCA	Turks and Caicos islands	0	0	0	0	0	0									
TCD	Chad	5	5	5							5	5	5	3	3	3
TGO	Togo	5	4	5							4	4	4	4	3	4
THA	Thailand	5	6	4	1	2	0	1	1	0	5	6	4	4	4	3
TJK	Tajikistan	6	6	6				6	5	6	5	4	5	4	3	4
TKL	Tokelau	0	0	0	0	0	0									
TKM	Turkmenistan	5	5	5				1	1	1	5	4	5	0	0	0
TLS	Timor-Leste	6	5	7				5	4	6	4	3	4	5	4	6
TON	Tonga	4	2	6	4	2	6	3	1	4						
TTO	Trinidad and Tobago	4	3	5	0	0	0	3	2	3				4	3	5
TUN	Tunisia	4	4	4				0	0	0	4	4	4	3	3	3
TUR	Turkey	6	7	5				6	7	5	4	5	3	4	4	3
TUV	Tuvalu	0	0	0	0	0	0									
TWN	Taiwan	7	7	7	2	2	2	7	7	6	3	3	2	4	4	4
TZA	United Republic of Tanzania	5	6	4				5	5	4	4	4	3	5	5	4
UGA	Uganda	6	6	5				6	6	5	4	4	3	4	4	3
UKR	Ukraine	4	5	3				1	1	0	4	5	3	2	3	1
UMI	Baker Island															
URY	Uruguay	4	3	4							4	3	4	3	2	3
USA	United States of America	6	7	4	3	4	1	6	7	4	3	4	1	3	4	1
UZB	Uzbekistan	8	8	7				8	8	7	5	5	4	2	2	1
VAT	Holy See															
VCT	Saint Vincent and the Grenadines	4	2	6	4	2	6									
VEN	Venezuela (the Bolivarian Republic of)	6	6	5	1	1	0	5	5	4	4	4	4	4	4	3
VGB	British Virgin Islands	3	1	4	3	1	4	0	0	0						
VIR	United States Virgin Islands	3	1	5	3	1	5	0	0	0						
VNM	Viet Nam	6	7	5	4	5	3	3	3	2	6	7	5	4	5	3
VUT	Vanuatu	7	5	8	6	4	7	5	3	7				5	3	6
WLF	Wallis and Futuna	0	0	0	0	0	0	0	0	0						
WSM	Samoa	5	3	6	5	3	6	0	0	0						
YEM	Yemen	4	4	4				3	3	2	1	1	0	4	4	3
ZAF	South Africa	4	4	3				1	2	0	3	4	2	3	3	2
ZMB	Zambia	4	4	4				1	1	0	4	4	4	3	3	3
ZWE	Zimbabwe	5	5	5	5	5	5	1	1	0	4	4	4	2	2	2

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