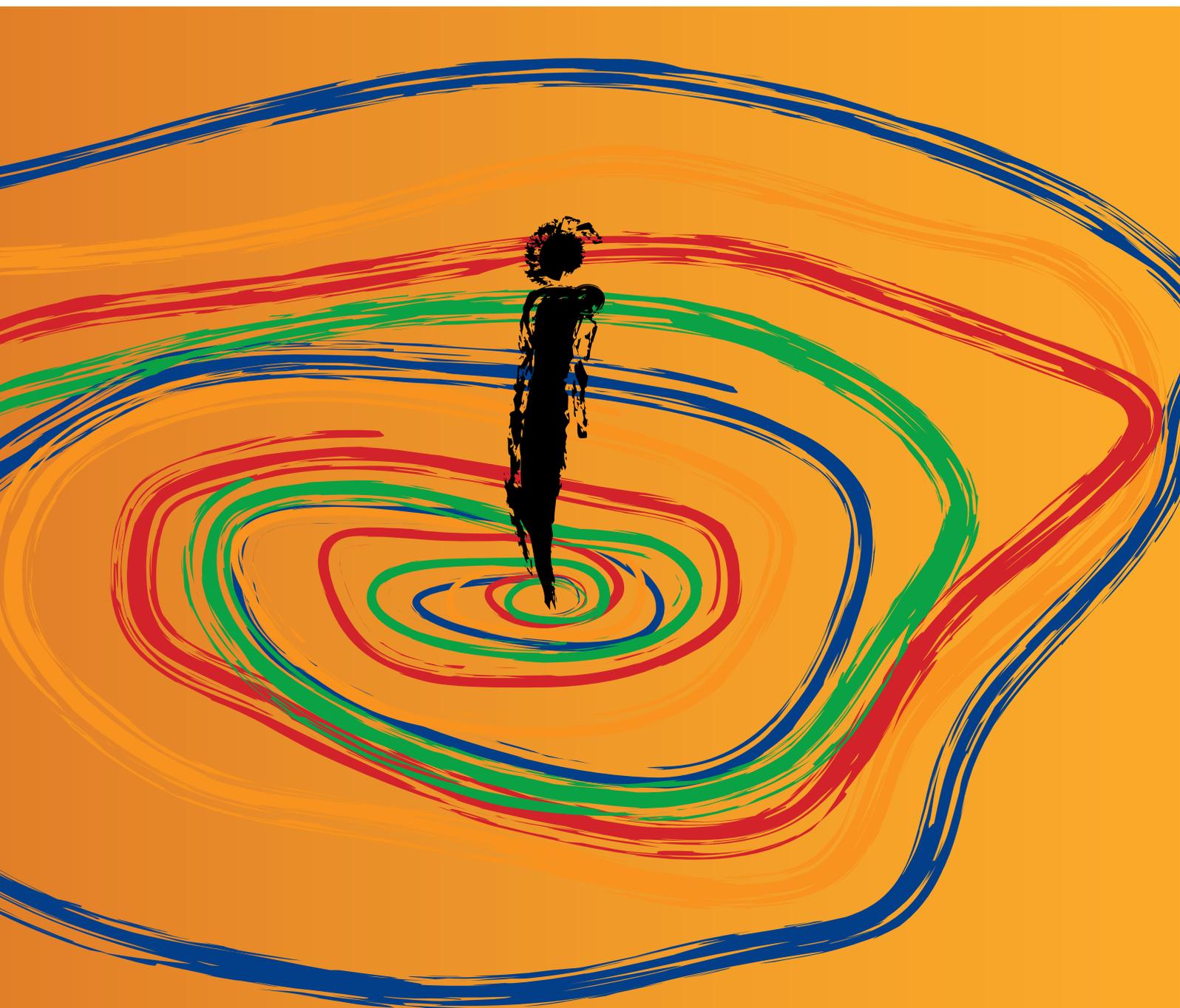


Summary and Recommendations:  
2009 Global Assessment Report on Disaster Risk Reduction

# Risk and poverty in a changing climate

*Invest today for a safer tomorrow*



United Nations



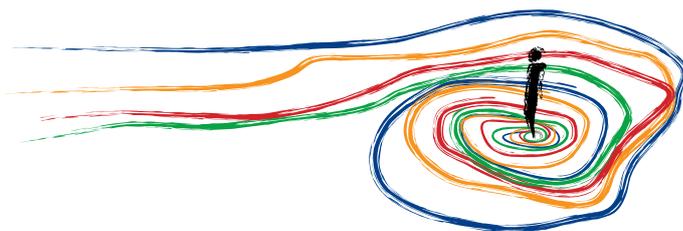
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The Kingdom of Bahrain, the Global Facility for Disaster Reduction and Recovery (GFDRR), UNDP, UNEP, the Government of Norway, the Government of Switzerland, the ProVention Consortium and the Gesellschaft für Technische Zusammenarbeit (GTZ) contributed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

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## Introduction

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 epidemics seriously challenge progress towards improving social welfare and economic growth in many developing countries.

In 2008, the deaths of approximately 140,000 people in the Myanmar cyclone and the collapse of more than five million buildings and damage to 21 million more in the China earthquake, were stark reminders that disaster risks associated with tropical cyclones, floods, earthquakes, droughts and other natural hazards are a key part of this interlocked set of threats.

The *Global Assessment Report on Disaster Risk Reduction* focuses attention on that challenge. It identifies disaster risk, analyses its causes, shows that these causes can be addressed and recommends the means to do so. The over-riding message of the Report is that reducing disaster risk can also help in reducing poverty, safeguarding development and adapting to climate change, with beneficial effects on broader global security, stability and sustainability. Given the urgency posed by climate change, the Report forcefully argues the case for taking action now.

The Report 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 168 UN member states at the World Conference on Disaster Reduction in Kobe, Japan in 2005, urges all countries to make major efforts to reduce their disaster risk by 2015.

The Report was coordinated by the United Nations International Strategy for Disaster Reduction (UNISDR) Secretariat, in collaboration with the United Nations Development Programme (UNDP), the World Bank, the United Nations Environment Programme (UNEP), the World Meteorological Organization (WMO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the ProVention Consortium, the Norwegian Geotechnical Institute and a wide range of other ISDR partners. The Kingdom of Bahrain, the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), UNDP, UNEP, the Government of Norway, the Government of Switzerland, the ProVention Consortium and the German Technical Cooperation (GTZ) contributed financial resources that enabled the successful development of the Report.

## Key findings and recommendations

- **Global disaster risk is highly concentrated in poorer countries with weaker governance. Particularly in low and low-middle income countries with rapid economic growth, the exposure of people and assets to natural hazards is growing at a faster rate than risk-reducing capacities are being strengthened, leading to increasing disaster risk.**
- **Countries with small and vulnerable economies, such as many small-island developing states (SIDS) and land-locked developing countries (LLDCs), have the highest economic vulnerability to natural hazards. Many also have extreme trade limitations.**
- **Most disaster mortality and asset destruction is intensively concentrated in very small areas exposed to infrequent but extreme hazards. However, low-intensity damage to housing, local infrastructure, crops and livestock, which interrupts and erodes livelihoods, is extensively spread within many countries and occurs very frequently. Such damage represents a significant and largely unaccounted for facet of disaster impacts.**

- Poorer communities suffer a disproportionate share of disaster loss. Poor households are usually less resilient to loss and are rarely covered by insurance or social protection. Disaster impacts lead to income and consumption shortfalls and negatively affect welfare and human development, often over the long term.
- Weather-related disaster risk is expanding rapidly both in terms of the territories affected, the losses reported and the frequency of events. This expansive tendency cannot be explained by improved disaster reporting alone. In countries with weaker risk-reducing capacities, underlying risk drivers such as poor urban governance, vulnerable rural livelihoods and ecosystem decline underpin this rapid expansion of weather-related disaster risk.
- Climate change is already changing the geographic distribution, frequency and intensity of weather-related hazards and threatens to undermine the resilience of poorer countries and their citizens to absorb loss and recover from disaster impacts. This combination of increasing hazard and decreasing resilience makes climate change a global driver of disaster risk. Climate change will magnify the uneven distribution of risk skewing disaster impacts even further towards poor communities in developing countries.
- Progress towards reducing disaster risk is still mixed. In general terms, countries are making significant progress in strengthening capacities, institutional systems and legislation to address deficiencies in disaster preparedness and response. Good progress is also being made in other areas, such as the enhancement of early warning. In contrast, countries report little progress in mainstreaming disaster risk reduction considerations into social, economic, urban, environmental and infrastructural planning and development.
- 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.
- The policy and institutional frameworks for climate change adaptation and poverty reduction are only weakly connected to those for disaster risk reduction, at both the national and international levels. 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.
- Documented experience in upgrading squatter settlements, providing access to land and infrastructure for the urban poor, strengthening rural livelihoods, protecting ecosystems, and using microfinance, microinsurance and index-based insurance to strengthen resilience shows that it is possible to address the underlying drivers of disaster risk. However, in most countries these experiences are not integrated into the policy mainstream.
- A failure to address the underlying risk drivers will result in dramatic increases in disaster risk and associated poverty outcomes. In contrast, if addressing these drivers is given priority, risk can be reduced, human development protected and adaptation to climate change facilitated. Rather than a cost, this should be seen as an investment in building a more secure, stable, sustainable and equitable future. Given the urgency posed by climate change, decisive action needs to be taken now.

## 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.

<b>12</b>	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.
<b>13</b>	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.
<b>14</b>	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.
<b>15</b>	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.
<b>16</b>	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.
<b>Invest to reduce risk</b>	
<b>17</b>	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.
<b>18</b>	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.
<b>19</b>	Ensure that additional investments are made to factor disaster risk reduction considerations into all new development.
<b>20</b>	Strengthen the capacities of disaster prone countries to develop the policy and governance frameworks necessary to organize and manage all the above.

## Global disaster risk: the challenge

### Risk is intensively concentrated

The risk of both mortality and economic loss in disasters is highly concentrated in a very small portion of the Earth's surface. Countries with large populations exposed to severe natural hazards account for a very large proportion of global disaster risk. For example, 75% of global flood mortality risk is concentrated in only three countries: Bangladesh, China and India.

Similarly mortality and economic loss are concentrated in a very small number of disasters. Between 1975 and 2008, EMDAT<sup>1</sup> recorded 8,866 disasters killing 2,283,767 people. Of these 23 mega-disasters killed 1,786,084 people, meaning that 0.26% of the events accounted for 78.2% of the mortality<sup>2</sup>. In the same period

internationally recorded economic losses were US\$ 1,527.6 billion. Just 25 mega-disasters, representing 0.28% of the events, accounted for 40% of the loss.

However, small island developing states (SIDS) and other small countries have far higher levels of relative risk with respect to the size of their populations and economies. For example, in the case of tropical cyclones, Vanuatu has the highest mortality risk per million inhabitants in the world, with St. Kitts and Nevis in third place.

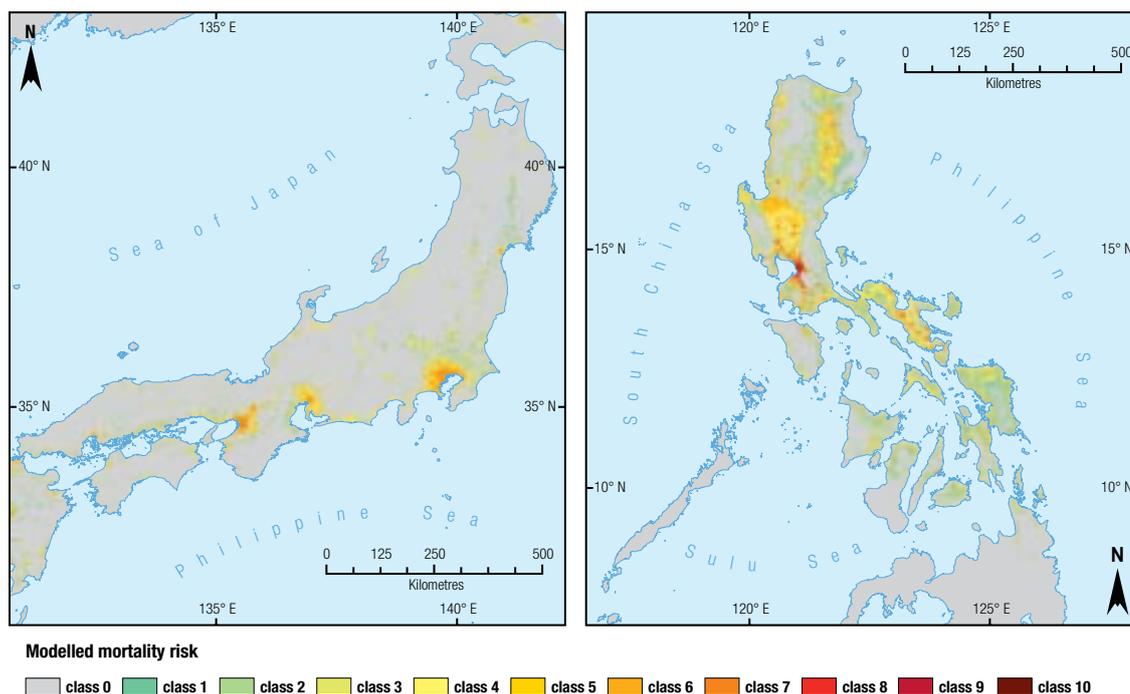
### Risk is unevenly distributed

Disaster risk is not evenly distributed. Developing countries concentrate a hugely disproportionate share of the risk. For example, both Japan and



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

Note:  
See note to figure on p.7 for explanation of risk classes.



### Risk is increasing

While wealthier countries are usually less risk prone than poorer countries, economic development must be accompanied by the strengthening of governance capacities if disaster risk is to be reduced. Rapid economic and urban development can lead to a growing concentration of people and economic assets in hazard prone cities, fertile river valleys and coastal areas. Disaster risk increases if the exposure of people and assets to natural hazards increases faster than countries can strengthen their risk-reducing capacities by putting policy, institutions, legislation, planning and regulatory frameworks in place.

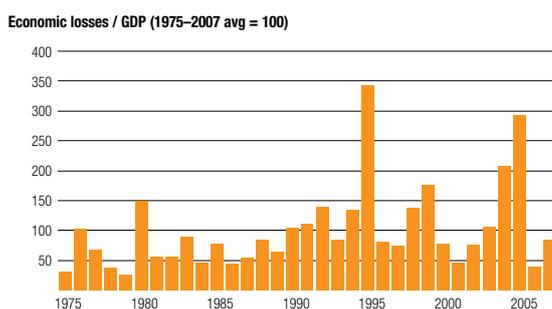
In absolute terms, and assuming constant hazard levels, global disaster risk increased between 1990 and 2007. In the case of floods, mortality risk increased by 13% from 1990 to 2007. Over the same period flood economic loss risk increased by 35%. These increases in disaster risk are primarily driven by the growing exposure of people and economic assets. The number of people exposed to floods increased by 28% over the same period, while exposed GDP

increased by 98%. Most flood risk is concentrated in Asian countries, such as China and India. While global GDP increased by 64%, China and India increased their GDP by 420% and 185% respectively. Over the same period, vulnerability declined; in the case of flood mortality risk by 11%, and flood economic loss risk by 32%. But this reduction in vulnerability was insufficient to compensate for the increase in exposure.

This suggests that disaster risk is increasing fastest in low- and lower-middle income countries with rapidly growing economies. These countries have rapidly increasing exposure but relatively weak institutions. While they are making improvements in risk-reducing capacities these have yet to catch up with rising exposure. In contrast, most high income countries experience more moderate increases in exposure and have already reduced a significant part of their vulnerability.

Relative to the size of the global population and GDP, risk may actually be falling. For example, when recorded economic losses are adjusted for inflation and expressed as a proportion of global GDP they are fairly stable.

**Inflation adjusted economic losses as a share of global GDP**



**Small and vulnerable economies are least resilient**

Countries with small and vulnerable economies, such as many SIDS and land-locked developing countries (LLDCs), have seen their economic development set back decades by disaster impacts. The countries with the highest ratio of economic losses in disasters, with respect to their capital stock are all SIDS and LLDCs, such as Samoa and St. Lucia. 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

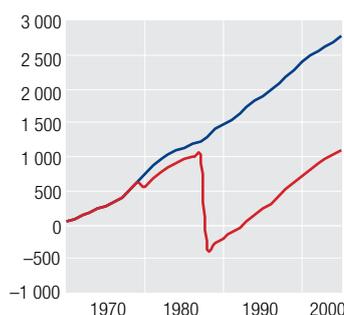
of America is imperceptible, even though that country has experienced huge economic losses, for example the US\$ 125 billion associated with Hurricane Katrina in 2005. Similarly, there is no marked effect in large low-income countries such as India or middle-income countries such as Colombia. The implications are that disasters do not have a significant impact on capital accumulation in countries with large economies, but a devastating impact on those with small economies.

The countries with the highest economic vulnerability are those with the highest ratio of economic losses to capital stock and the lowest economic resilience to shocks, indicated by very low national savings. Many of these countries also have extreme limitations to their ability to benefit from international trade, characterized by a very low participation in world export markets (less than 0.1%) and low export diversification. SIDS and LLDCs together constitute 60% of the countries with high, and 67% with very high, economic vulnerability to disasters, as measured by the above variables, and comprise about two thirds of all countries affected by extreme trade limitations in the same groups.

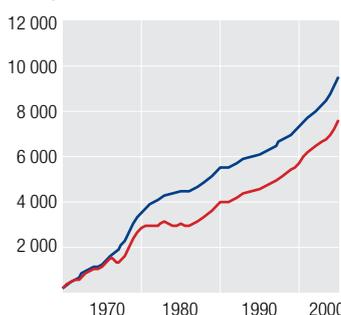
**Impact of economic losses**

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

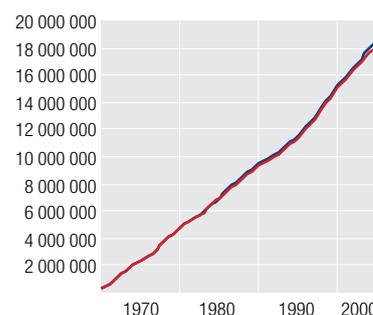
**St. Lucia**



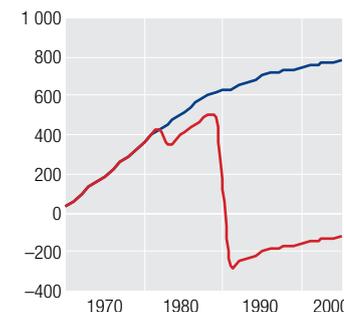
**Madagascar**



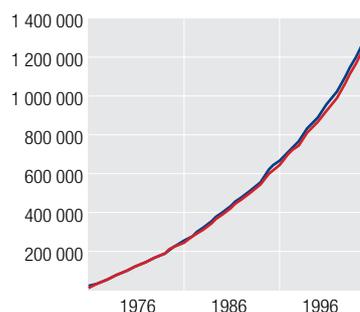
**United States of America**



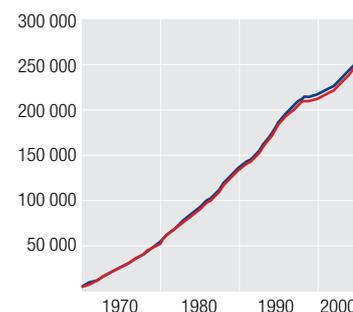
**Samoa**



**India**



**Colombia**



## Disaster risk and poverty trends at the local level

### Mortality and direct economic loss are intensively concentrated

Viewed locally, most mortality and direct economic loss are similarly highly concentrated in very small areas and in relatively infrequent events. Disaster loss reports at the local government level compiled for a sample of 12 Asian and Latin American countries for the period 1970 to 2007<sup>3</sup> show that 84% of the mortality and 75% of the destroyed housing were concentrated in only 0.7% of the reports. These are the disasters that make news headlines and capture the attention of the international community.

### Damage is extensively spread

However, there are other risk patterns at the local level that are essentially invisible when viewed from a global perspective. Low-intensity damage to housing, local infrastructure, crops and livestock, which interrupt and erode livelihoods is extensively spread within countries and occurs very frequently.

In the 12 countries sampled there were 126,620 reports of disaster damage at the municipal level since 1970, implying an average of 9 disasters per day. More than 82% of the municipalities reported losses at least once over this period. Almost half reported losses six times or more, and over 10% reported losses more than 50 times.

Housing damage is extensively spread over these reports. In the case of Tamil Nadu, India, there were more than 900,000 damaged houses between 1976 and 2007. More than 60% of the housing damage, representing 550,000 houses, was spread amongst 12,000 low-intensity loss reports. Damage to 40 or 50 houses in a localized storm or flood does not attract international media attention. But over time such losses add up to a considerable accumulation of loss and an erosion of local development.

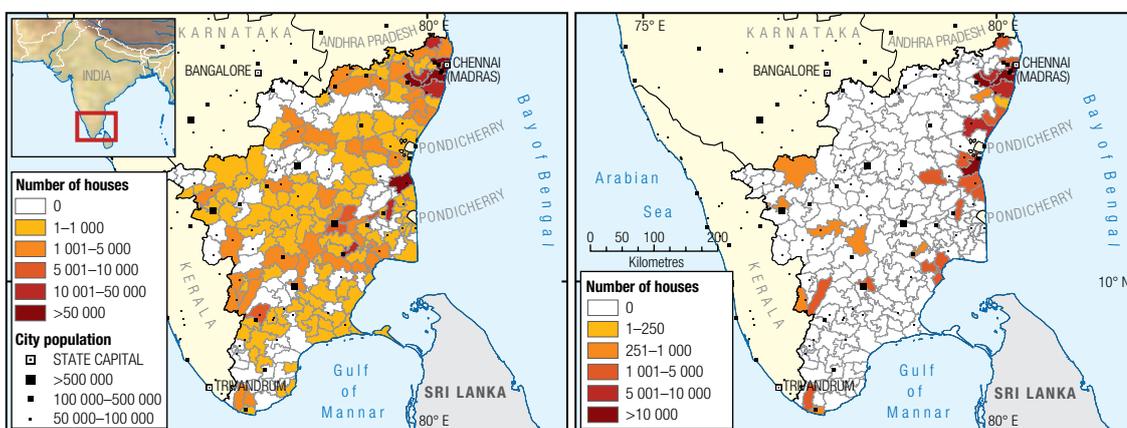
Such losses, therefore, represent a significant and largely unreported facet of disaster impacts. Across the 12 countries, 34% of the economic cost of disasters in the housing sector was associated with such low-intensity loss reports, as well as 57% of the damage to schools, 65% of the damage to hospitals and 89% of the damage to roads.

### Poor communities face the highest risk

Within developing countries, poorer communities are also more at risk than wealthier communities. Furthermore, poor households are often less resilient as they are unable to access or mobilize the assets necessary to buffer disaster losses and are rarely covered by insurance or social protection measures.

In Mexico, it was found that between 1980 and 2006, disaster loss affected only 8%

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



of the housing stock in municipalities with low or very low levels of marginality. In contrast, in municipalities with high or very high levels of marginality that proportion was far higher: in 20% of these municipalities more than 50% of the housing stock had been damaged or destroyed. These findings were mirrored by other countries. In Sri Lanka more houses are damaged by floods in areas with people living below the poverty line. In Tamil Nadu, disaster mortality is higher in areas with vulnerable housing, while housing damage in tropical cyclones is greater in areas with the lowest literacy.

Poor households are likely to experience income or consumption shortfalls after disaster impacts. In El Salvador, for example, the average income per capita in poor rural households affected by the 2001 earthquakes was reduced by approximately one third.

Welfare is also negatively affected at the local and regional levels. In Mexico, for example, municipalities that experienced disaster losses between 2000 and 2005 experienced a 3.5% growth in the number of households without enough income to buy a basic food basket. In Iran, the provinces that experienced the largest number of deaths and destroyed houses in earthquakes also experienced the greatest drop in household expenditure.

The poorest households also tend to lose a higher proportion of their assets and income. In Peru, for example, in 2006, rural households that had experienced disasters between 2000 and 2005 had a reduced per capita consumption. However, consumption dropped by 3.85% in the poorest quarter of households, as opposed to 1.2% in the wealthiest quarter.

Disaster impacts produce other poverty outcomes as well. The empirical evidence shows that school enrolment tends to fall and children may grow at a slower rate due to nutritional shortfalls following disasters. For example, children that were in the womb to 36 months of age and living in villages affected by the 1984 drought and famine in Ethiopia were almost 3cm shorter ten years after the disaster than their non-affected counterparts<sup>4</sup>. In countries where women have a low social and economic status they may be particularly affected.

These outcomes may be short-term, if targeted and appropriate assistance is provided to poor families, but in its absence, poverty outcomes may be long-term and recovery slow or difficult. In Ethiopia, poor rural households most affected by the droughts and famines of the mid-1980s were still experiencing 4–16 % lower growth in household income in the mid-1990s, a period of substantial recovery of food consumption and nutrition. Rural households affected by repeated disasters often never recover fully before being hit by another shock.

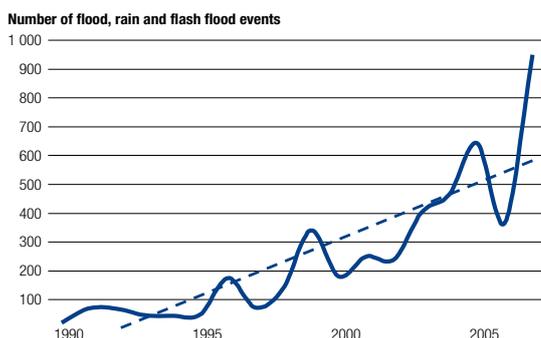
### **The rapid expansion of weather-related disaster risk**

The number of local-level disaster loss reports in the 12 countries sampled has more than doubled since 1980, and housing damage has quintupled. While the sample is not globally representative, there is no reason to believe that these countries are exceptions to a global trend. 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 highly localized weather-related events. This indicates that more hazard events are occurring and that, at the same time, there is increasing exposure to those events.

Weather-related disaster risk is also affecting an ever-growing area and some regions are being affected more often. The number of local government areas reporting losses one to nine times a year has doubled since 1980. The number of municipalities reporting losses between 10 and 49 times has quintupled. Importantly, the number of loss reports associated with flooding and heavy rains is increasing faster than all other hazard types. In Costa Rica, for example, these have at least quintupled since 1990.

It is likely that improved disaster reporting at least partly explains this increase. Since the introduction of the Internet in the early 1990s, many more disasters are being reported, particularly from remoter, rural areas. However, improved reporting is insufficient to explain the geographic expansion of risk. In addition flood related hazard is also increasing in major cities, where disaster losses have always been historically reported.

### Extensive flood and rain loss reports in Costa Rica (1990–2007)



Case study evidence from Africa, Asia and Latin America documented in the Report shows that the expansion of weather-related disaster risk closely mirrors development-related processes such as the growth of cities and the expansion of the agricultural frontier into previously sparsely populated areas. These processes simultaneously increase the number of people exposed to hazards and also generate new hazard patterns. In countries with weaker risk-reducing capacities, it is underlying risk drivers such as poor urban governance, vulnerable rural livelihoods and ecosystem decline that underpin the expansion of risk.

## The underlying risk drivers

### Poor urban governance

By 2008, over half the world's population was living in urban areas and by 2010 it is projected that 73% of the world's urban population and most of its largest cities will be in developing countries.

Many city governments have been incapable of ensuring that there is safe land for housing, adequate infrastructure and services, and a planning and regulatory framework to manage the associated environmental and other risks. This has led to urban growth in developing countries being absorbed through the creation of informal settlements. Approximately one billion people worldwide live in these settlements and numbers are growing by approximately 25 million per year.

Poor people in informal urban settlements typically have higher levels of everyday risk, even without considering the impact of natural hazards. For example, cities in high-income countries typically have under-five mortality rates of less than 10 per 1,000 live births. In contrast many cities in developing countries have far higher rates. In Nairobi, for example, under-five mortality rates were 61.5 per 1,000 live births for the city as a whole in 2002, but approximately 150 per 1,000 in informal settlements.

Evidence from cities in Africa, Asia and Latin America, shows that the expansion of informal settlements is closely associated with the

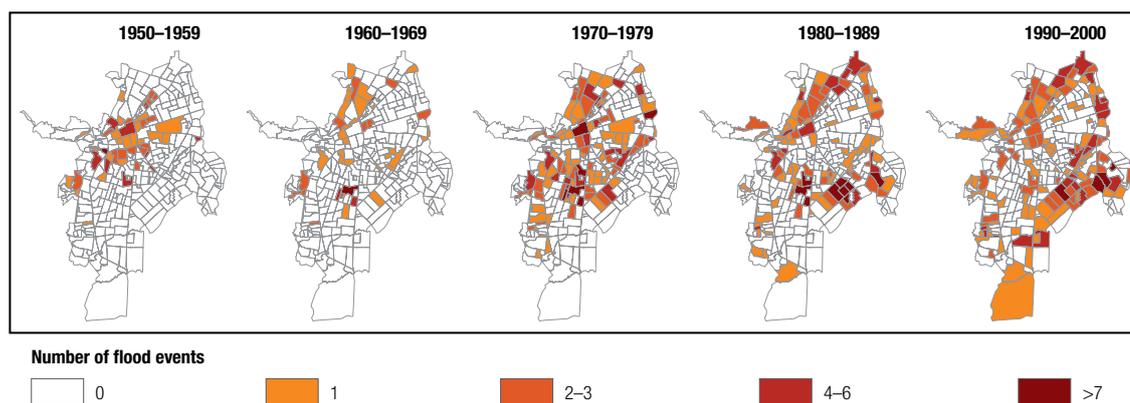
rapid increase in weather-related disaster reports in urban areas. Flood loss reports in the city of Cali, Colombia are shown in the map for each decade since the 1950s. The centrifugal expansion of reported floods has mirrored the expansion of informal settlements in the city.

Urbanization per se tends to increase the intensity of run-off during storms and heavy rains. Instead of being absorbed into the ground, greater volumes of rainwater are channelled into drains, culverts and streams. Informal settlements typically occupy land deemed unsuitable for residential or commercial use, located in low lying flood prone areas, on landslide prone hillsides or in ravines, exposing people to hazard. Houses are built and modified without reference to hazard resistant building standards. In many cities there has been an underinvestment in building drains and in maintaining those that exist, particularly in informal settlements. Many floods are caused as much by deficient or non-existent drainage as by the intensity of rainfall.

### Vulnerable rural livelihoods

Livelihood vulnerability is an underlying driver of disaster risk and poverty in many areas. Approximately 75% of the people living below the international poverty line (US\$ 1.25 per day) live and work in rural areas<sup>5</sup>: 268 million in sub-Saharan Africa; 223 million in East Asia

**Extensive flood reports in Cali, Colombia (1950–2000)**



and the Pacific and 394 million in South Asia. Even in countries experiencing rapid economic development, such as China, there are 175 million rural dwellers below this poverty line. Disaster losses affect huge numbers in poor rural areas. In sub-Saharan Africa, during the 2001–2003 drought, an estimated 206 million people, or 32% of the region's population, were undernourished, a number only slightly less than the total 268 million rural poor<sup>6</sup>.

Many rural livelihoods still depend heavily on agriculture and other natural resource sectors. Rural farm-based livelihoods are generally characterized by low input and low output agriculture due to constrained access to productive assets such as land, labour, fertilizers, irrigation facilities, infrastructure and financial services. For example, average maize yields in Malawi are only one tenth of yields in the United States of America<sup>7</sup>. Opportunities for processing and adding value to agricultural production are also often limited due to asset constraints, trade barriers and lack of access to markets.

Historical patterns of land distribution and tenure tend to discriminate against the poor, who may only have access to marginal and unproductive land including areas prone to flooding, erratic or minimum rainfall, or with poor soil. Poor households usually do not have access to improved seeds, irrigation technology and other inputs that can reduce the vulnerability of crops to drought. They are dependent on rain-fed agriculture, which is far more sensitive to small seasonal fluctuations in rainfall, temperature and other weather variables than

irrigated agriculture. Household dependence on a single main harvest for most annual requirements of food and income further increases vulnerability. Livelihoods in rural areas are also limited by a lack of economic diversification, thin markets, weak and costly mechanisms of exchange and trade barriers.

Poor and indebted households thus have little or no surplus capacity to absorb crop or livestock income losses and to recover. 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. Resilience is further undermined by the impacts of other hazards such as conflict and HIV/AIDS.

The high structural vulnerability of housing, schools, infrastructure and other assets in poor rural areas exposed to floods, tropical cyclones and earthquakes also leads to major mortality in disasters. Rural housing is usually built with local materials and labour and without hazard resistant building techniques. The collapse of heavy earth walls led to the destruction of 329,579 houses in the 2005 Kashmir earthquake. The lack of protection offered by wattle and daub, and thatch houses in Myanmar contributed to the deaths of 140,000 people in the 2008 cyclone. The isolation of many poor rural areas, combined with under-investment by government in infrastructure and in disaster preparedness and response capacities, further increases asset and mortality risk.

### Declining ecosystems

People receive substantial benefits or services from ecosystems. These include provisioning services which provide energy, water, food and fibre for both urban and rural households, as well as regulating services, such as the mitigation of floods and storm surges. 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 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 regulation.

The Millennium Assessment found that the supply of approximately 60% of the ecosystem services evaluated (15 of 24) were in decline (see table)<sup>8</sup>. At the same time, consumption of more than 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 provisioning services, these modifications have led to the decline of regulating ecosystem services, including those responsible for mitigating hazards, such as fires and floods.

An increase in landslide hazard on slopes deforested for agricultural use and in storm surges in areas where mangroves have been destroyed to create shrimp ponds are 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.

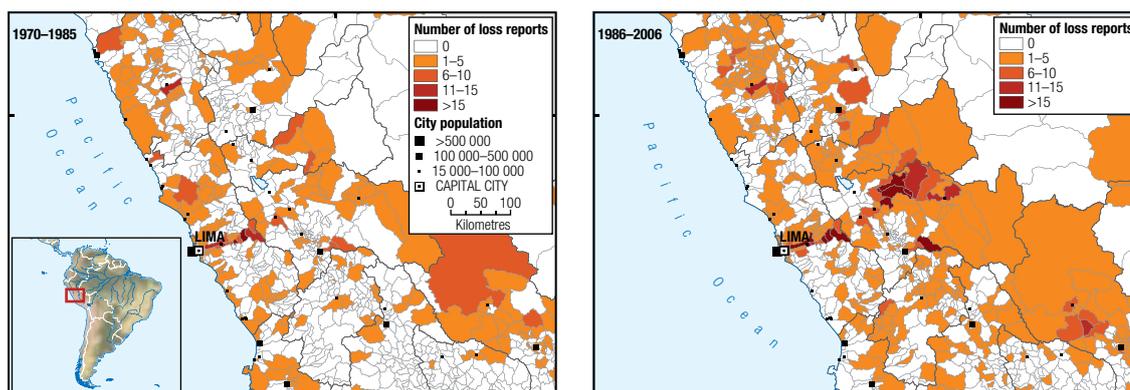
Changes in the supply of ecosystem services may also increase livelihood vulnerability, particularly when livelihoods depend on common pool resources. For example, the destruction of mangroves for shrimp cultivation not only reduces protection against coastal erosion and storm surges but also negatively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

In Peru, the opening of new roads down the eastern slopes of the Andes and into the central jungle in order to extend the agricultural frontier has led to a notable increase in the number of reported landslide disasters in that region since the 1980s, easily visible in dark brown on the map. Deforestation may increase the supply of provisioning services such as crops and livestock but reduces the supply of regulating services such as erosion control and landslide regulation.

Use and supply of assessed ecosystem services	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

### Redistribution of extensive risk in central Peru between 1970–1985 and 1985–2006



## Global climate change

### Changes in means and extremes lead to increasing hazard and declining resilience

Climate change is probably the greatest global outcome of environmental inequity. It is driven by greenhouse gas emissions that have brought benefits to affluent societies and individuals, yet most of the burdens fall on developing countries and their poorest citizens.

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report has emphasized that if the planet's surface temperature increases by 2°C above pre-industrial levels, the catastrophic collapse of ecosystems becomes possible with unforeseen, non-linear impacts on poverty and disaster risk<sup>9</sup>.

The IPCC has also confirmed that the geographic distribution, frequency and intensity of weather-related hazards are already being altered significantly by climate change<sup>10</sup>. Changes are already occurring in the amount, intensity, frequency and type of precipitation. This is associated with an increase in the area affected by drought, in the numbers of heavy daily precipitation events that lead to flooding, and in the intensity and duration of certain kinds of tropical storms.

At the same time, changes in the climate means threaten to undermine the resilience of poorer countries and their citizens to absorb loss and recover from disaster impacts, through, for

example, decreases in agricultural productivity, water and energy stress, and increasing disease vectors. This combination of increasing hazard and decreasing resilience makes climate change a global driver of disaster risk that will increase the impact of disasters on the poor.

There is already evidence that some kinds of weather-related hazard are increasing. The table shows that the average annual number of cyclones has been fairly stable, (between 54.9 and 58.1 per year) since 1976, regardless of sea surface temperature (SST). However, in warmer years there are more Category 3 and 4 (i.e. more intense) cyclones and fewer in Categories 1 and 2. In particular, compared to the period between 1976 and 1984, when there were no data on SST, there are now significantly more category 4 and 5 cyclones. This is in line with the findings of the IPCC Fourth Assessment Report and recent research that has estimated that a 1°C increase in SST would lead to a 31% increase in the global frequency of Category 4 and 5 cyclones per year.

### Climate change magnifies the uneven distribution of disaster risk

By increasing hazard at the same time as it erodes resilience, climate change has a magnifying effect on disaster risk. In particular, climate change will magnify the uneven distribution of risk, skewing disaster impacts even further towards poor communities in developing countries.

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	Number	Number	Number	Number
					events	events	events	events	events
					Cat. 1	Cat. 2	Cat. 3	Cat. 4	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).

For example, it is estimated that 1.9% of the GDP of Madagascar is annually at risk from Category 3 cyclones compared to 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.

As highlighted above, 97% of the documented local-level loss reports are weather-related. This means that a very significant part of emerging disaster risk in developing countries is highly sensitive to any increase in hazard intensity and frequency due to climate change. It is likely that climate change is already contributing to the rapid increase in the number of weather-related loss reports since 1980, although at present it is not possible to calculate by how much.

Rural livelihoods, which are dependent on agriculture and other natural resources and vulnerable to slight variations in weather, are particularly sensitive to climate change. Changes

in climate means may lead to greater water stress and lower agricultural productivity; increases in the frequency and intensity of hazards may lead to greater losses; and resilience may be further sapped by more widespread disease vectors.

Many urban areas will also experience stress through water and energy shortages, heat and cold waves and more prevalent disease vectors. Climate change will further increase flood hazard, with particular implications for informal settlements. Many cities are also at risk from sea level rise. 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<sup>11</sup>. There are clear risks associated with increased flooding and storm surges, exacerbated by sea level rise, in cities such as Dhaka, Mumbai and Shanghai, large parts of which are only 1–5 metres above sea level.

## Progress in addressing disaster risk

### The Hyogo Framework for Action

In 2005, 168 countries adopted the Hyogo Framework of Action (HFA), a comprehensive set of five priorities that aim to achieve a substantial reduction in disaster losses, in terms of lives and social, economic and environmental assets of communities and countries by 2015.

A recent review by 62 countries<sup>12</sup> indicates that progress towards this objective is still mixed. In general terms, countries are making significant progress in strengthening capacities, institutional systems and legislation to address deficiencies in disaster preparedness and response. Good progress is also being made in other areas, such

as the enhancement of early warning. As a result, some lower-income countries, such as Bangladesh and Cuba, have already made dramatic strides in reducing mortality risk in the face of hazards such as tropical cyclones and floods, which are sensitive to improvements in early warning, preparedness and response. For example, despite being hit by five successive hurricanes in 2008, only 7 deaths were reported in Cuba.

In contrast, countries report little progress in mainstreaming disaster risk reduction considerations into social, economic, urban, environmental and infrastructural planning and development. Early warning and preparedness can help to evacuate people in the case of a cyclone. But housing, schools and infrastructure cannot be evacuated and, if not structurally resistant, they are damaged or destroyed.

Across all five HFA Priorities for Action, high-income countries outperform low- and middle-income countries. In these high-income countries, the adoption of hazard resistant building standards, planning and environmental regulations as well as a web of institutions and systems that protect citizens when disasters occur, have enabled a substantial reduction in vulnerability. In the case of the least-developed countries, some lack the basic technical, human, institutional and financial capacities to address even the most basic aspects of disaster risk reduction.

Between these two poles, many middle- and low-income countries have made major strides towards developing national policies, institutional systems and legislation for disaster

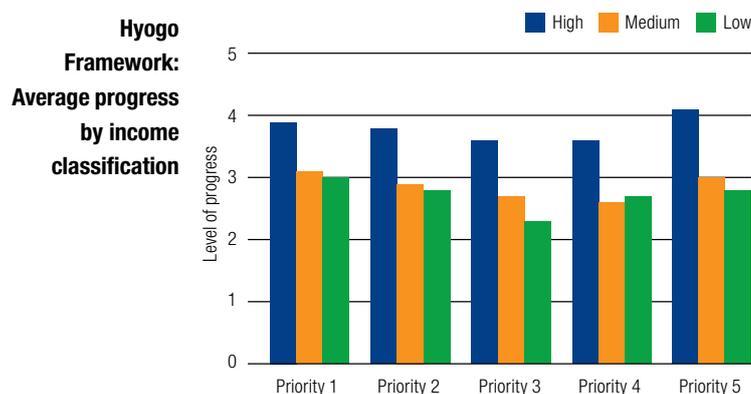
risk reduction. Unfortunately this has not been translated into reductions in disaster risk in the principal development sectors. It would appear that countries have difficulty addressing underlying risk drivers such as poor urban and local governance, vulnerable rural livelihoods and ecosystem decline in a way that leads to a reduction in the risk of damage 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. Mainstreaming is challenged by a range of factors that include difficulties in compiling comprehensive information on disaster risks, weak engagement by the development sectors and major difficulties in ensuring implementation, enforcement and accountability.

### Climate change adaptation

Many countries are also developing plans and strategies to adapt to climate change, for example through National Adaptation Programmes of Action (NAPAs). In principle, given that increased risk from weather-related hazards is a manifestation of climate change, adaptation could and should reinforce disaster risk reduction efforts. The Report has not comprehensively reviewed progress in adaptation. However, there is evidence to show that progress in implementation is still 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.

### Poverty reduction

Large numbers of Poverty Reduction Strategy Papers (PRSPs) explicitly recognize the poverty outcomes associated with disaster impacts and some include sections on disaster risk reduction. In principle, poverty reduction efforts in both rural and urban areas have a



considerable potential to address the underlying risk drivers if they are clearly focused. In most countries, however, poverty reduction has only weak functional connections to the policy and institutional frameworks for disaster risk reduction. Unless disaster risk considerations are factored into poverty-reducing development, the

result may be increased risk, as the collapse of schools in earthquakes so poignantly illustrates. At the same time, the inclusion of disaster risk reduction in PRSPs is often limited to disaster preparedness and response aspects. Therefore, the potential of PRSPs to address the underlying risk drivers is still not fully exploited.

## Conclusions

### The imperative for urgent action

Current progress under the HFA and in related areas of poverty reduction and climate change adaptation is not leading to a reduction in disaster risk. The Report highlights that risk is continuing to increase, even assuming constant hazard levels, and that any further increase will disproportionately affect poor communities in developing countries. Climate change magnifies the uneven distribution of risk, increasing both disaster risk and poverty outcomes in these communities. Unless this trend is reversed it will be impossible to achieve the HFA and progress towards the Millennium Development Goals (MDGs) will be compromised.

The evidence provided in the Report underlines the urgency of avoiding dangerous climate change. Greater urgency in efforts to reduce global greenhouse gas emissions and reduce energy consumption are required if a potentially catastrophic increase in disaster risk is to be avoided, the impacts of which will be largely concentrated in developing countries.

Action in other policy areas is also required. The countries with the highest relative risk and the lowest resilience to disaster impacts are those with small and vulnerable economies, such as many SIDS and LLDCs. The low resilience of these countries is associated with extreme limitations in their ability to participate in global trade. Efforts are therefore required to coordinate policies on trade and productive sector development in these countries.

Unfortunately, the world is committed to significant climate change, even if rapid progress

is achieved towards a low-carbon economy. Therefore, disaster prone 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. The Report highlights the need to strengthen capacities to address three key drivers: poor urban governance, vulnerable rural livelihoods and ecosystem decline. Weak social protection is a fourth driver, which, while not examined in depth in the Report, is also important.

A failure to address these drivers will result in dramatic increases in disaster risk and associated poverty outcomes. In contrast, if addressing these drivers is given priority, risk can be reduced, human development protected and adaptation to climate change facilitated. Rather than a cost, this should be seen as an investment in building a more secure, stable, sustainable and equitable future. Given the urgency posed by climate change, decisive action needs to be taken now.

### A policy framework for risk-reducing development

It is possible to address the underlying drivers of disaster risk. In all regions of the world, documented experience in upgrading squatter settlements, providing access to land and infrastructure for the urban poor, strengthening rural livelihoods, protecting ecosystems, and using microfinance, microinsurance and index-based insurance to strengthen resilience show that it can be done. The most successful of

these experiences have emerged in the context of innovative partnerships between national and local governments and civil society and are leading to a sustainable reduction in risks.

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 need to strengthen capacities to develop and implement such a policy framework is particularly urgent in those low- and middle-income countries where hazard exposure is growing most rapidly, where risks are concentrated, and where the magnifying effects of climate change will be most felt. Risk-reducing development is essential if disaster risk reduction is to be mainstreamed into development and if development is to be adapted to climate change.

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, NAPAs, United Nations Development Assistance Frameworks 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.

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. Such partnerships can dramatically reduce the costs of risk reduction, ensure local acceptance, and help to build social capital, which reduces long-term vulnerability.

### **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 that 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. 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, many countries are already putting into place innovative mechanisms that enable this mainstreaming and harmonization to occur. These include factoring disaster risk reduction into national development plans and budgets; development of new institutional structures for hazard monitoring and risk assessment that integrate existing scientific and technical institutions; the inclusion of cost–benefit analysis into public investment systems; the involvement of the national audit or controller’s office in supporting implementation, enforcement and accountability in all sectors and at all levels of government; improvements in early warning systems; and the application of innovative mechanisms for risk transfer.

## Disaster risk reduction is an investment not a cost

To seriously address the underlying risk factors on the scale necessary requires major investment. It is difficult to provide an accurate global estimate of this cost but the calculations developed by the Millennium Project serve to give an idea of the magnitude. These costs can be significantly reduced through adopting participatory approaches, but it is clear that several hundred billion dollars are required. This figure is coherent with estimates regarding the cost of climate change adaptation. An increase in the resources available for climate change adaptation will be required, as well as those pledged for the MDGs. In the context of the global economic crisis, investments in infrastructure and employment creation can provide opportunities to address the underlying risk drivers, for example through investments to improve drainage in flood prone areas.

Disaster risk reduction is usually conceptualized as an additional cost. In fact one of the principal arguments used to justify a lack of progress in disaster risk reduction is that developing countries have other priorities, such as reducing poverty, and cannot afford the additional costs of disaster risk reduction. The Report puts forward a contrasting view. Investment in disaster risk reduction generally represents a large saving in terms of avoided losses and reconstruction costs and 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 addressing the underlying risk drivers is actually lower if disaster risk reduction is included.

In conclusion, the key requirements are to help countries strengthen governance arrangements and improve management of investments for addressing the underlying risk factors, 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 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 The Office for US Foreign Disaster Assistance/Centre for Research on the Epidemiology of Disasters (OFDA/CRED) International Disaster Database: <http://www.emdat.net>
- 2 EMDAT does not register reports of small-scale disasters below its threshold of 10 deaths, 100 people affected or a call for international assistance.
- 3 Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Iran, India (States of Orissa and Tamil Nadu), Mexico, Nepal, Peru, Sri Lanka and Venezuela.
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- 11 Satterthwaite, D., Huq, S., Pelling, M., Reid, H. and Lankao, P. R. (2007) *Adapting to Climate Change in Urban Areas. The Possibilities and Constraints in Low- and Middle-Income Nations*. Human Settlements Discussion Paper Series. Theme: Climate Change and Cities No.1. London. IIED (International Institute for Environment and Development).
- 12 The number of countries that had prepared interim HFA progress reports by the end of February, 2009.



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