

## Chapter III

# Forces of nature? the climatic threat to economic security

### Introduction

The capricious force of nature can have a devastating impact on the livelihoods of households and communities across the world. For some, particularly those living on small islands and in poor agricultural economies, such disasters often pose the single greatest threat to their security and welfare. Moreover, these are the communities most at risk with respect to the rising incidence of disasters, which are striking more than four times as frequently today as in the 1970s, and costing, on average, almost seven times as much.

Although hurricanes, tsunamis, earthquakes and floods are natural events, the disasters they trigger are not. In the case of developing countries, particularly the least developed, the adverse effects from natural hazards occur within a context of structural vulnerabilities associated with high rates of poverty, high levels of indebtedness, inadequate public infrastructure, lack of economic diversification, and the like. On some accounts, these factors make it difficult for the State in developing countries to respond effectively to the risks associated with natural hazards. Instead, much attention has been given in recent years to strategies for pooling and transferring disaster risk and smoothing household incomes through market-based financial instruments. New insurance products, and other hedging instruments, have been developed to meet some of the needs of developing regions, with strong backing from the donor community and international financial institutions.

The present chapter will examine the strengths and weaknesses of such responses. It will suggest that, though such instruments can play a role in managing disasters, it would be wrong to view them as a panacea, particularly in poorer developing countries. Indeed, as discussed in chapter II, addressing economic insecurity by extending the influence of financial markets has intrinsic flaws. What is needed instead is a more integrated approach to disaster management in the context of wider socio-economic vulnerabilities. Achieving this requires more emphasis on (ex ante) investments to better prepare for hazards and to reduce those vulnerabilities that can turn hazards into disasters, along with more effective (ex post) coping strategies.

When countries are unable to guarantee economic security through their own resources, part of the burden falls on humanitarian relief and development assistance, which, apart from ethical motivations and geopolitical considerations, can be in the donor community's self-interest if they help break the vicious circle that keeps these countries locked in a hazard-vulnerable and aid-dependent growth trap. To date, the emphasis has been on emergency relief. Making progress requires that the international community give much greater attention to large-scale investment in disaster prevention and mitigation and adopt a more consistently multilateral approach to financing such investments, including through reforms to the aid architecture.

In developing countries, death rates from disasters are 20 times higher than in developed countries

### Identifying and measuring “natural” disasters

Natural hazards are predominantly either geologic events (earthquakes, volcanoes) or hydro-meteorological ones (floods, droughts, windstorms, tsunamis) (see box III.1). Both

## Box III.1

**Definitions of disasters, terminology and data sources**

Following the criteria of the International Strategy for Disaster Reduction (UNISDR), disasters are events where (a) at least 10 people are reported as having been killed, (b) at least 100 people are affected, (c) a state of emergency is declared or (d) a request for international assistance is made by the national Government.

The most frequently used source of disaster-related data is the Emergency Disasters Data Base (EM-DAT), provided by the Centre for Research on the Epidemiology of Disasters (CRED) at the Université Catholique de Louvain in Brussels. These data are compiled from a number of sources, including United Nations organizations, non-governmental organizations, insurance companies, research institutes and the press; nevertheless, there are large data gaps resulting from the lack of concerted efforts to systematically collect disaster-related data.

For instance, for more than 63 per cent of registered disasters, a figure is not reported for the damages caused. Hence, reported figures do not provide a comprehensive picture of the impact of disasters. Moreover, owing to different sources and methodologies for assessing damages, cost estimates must be used with caution. In particular, while reasonable estimations of direct costs are often available soon after a disaster, indirect costs tend to be more difficult to assess and are consequently often underreported.

Political interests with respect to mobilizing more foreign aid, and inadequate information systems, might also prompt overestimations of the actual costs of the damages. In general, methodologies used for assessing costs can have policy implications in terms of whether to focus on repair and rehabilitation or on preventive and reconstructive investment for development (Vos, 1999; and Vos, Velasco and de Labastida, 1999). The cost estimates referred to by the literature and quoted in this chapter refer mostly to the alleged damages relating to repair and rehabilitation.

Natural hazards are differentiated into hazards of hydro-meteorological origin, such as windstorms, wave surges, drought, floods and extreme temperatures, and those of geologic origin, such as earthquakes, volcanic eruptions and landslides. Although natural hazards also comprise wild fires, insect infestations, extreme temperatures and epidemics, these are not considered in this chapter primarily owing to the unreliability and patchiness of data.

There are in principle seven distinguishing characteristics of natural hazards, regardless of their origin, (Albala-Bertrand, 1993): (a) *magnitude*, (b) *frequency*, (c) *duration*, (d) *areal extent*, (e) *spatial dispersion pattern*, (f) *speed of onset* and (g) *regularity*. Different hazards have different implications in terms of direct damages and indirect losses.

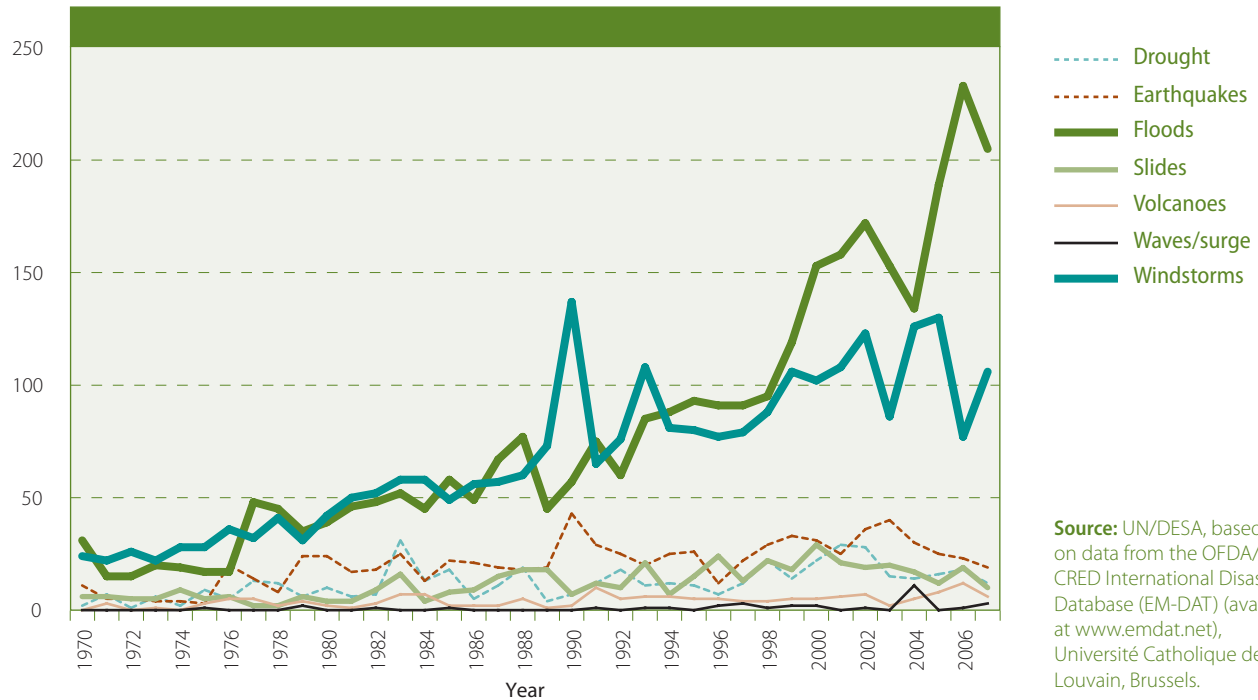
Geologic disasters such as earthquakes are infrequent events which often cause significant damage to assets (or *stock variables*), with fewer indirect damages, particularly in economies based on agriculture, and are associated with a more rapid recovery. Poor housing structures and conditions in poor urban neighbourhoods often entail a high human cost in terms of displaced, homeless and injured populations.

Climatic disasters, such as severe windstorms, flooding and drought, occur more frequently, have a wider impact, with particularly devastating consequences for the rural economy, usually have a greater effect in terms of indirect losses (or *flow variables*), and make for a longer recovery time. Droughts are more likely to affect rain-fed agricultural economies: a severe reduction of rainfall impacting output and income can generate food insecurity and increased health risks. In a pastoral economy, stressed selling of livestock at low prices will probably increase both income and food insecurities.

Floods can be equally devastating for rural and urban economies. Loss of harvests, able-working lives, and homelessness and displacement might signify reduction of household income and loss of jobs and livelihoods. Income insecurity can be the outcome of the loss of boats by fishing communities while informal workers and day labourers may see their opportunities become reduced or vanish as commerce and transportation are disrupted.

types can have potentially devastating consequences for the communities they strike. However, hydro-meteorological events pose a greater threat of becoming large-scale (catastrophic) disasters and also account for much of the rising trend of reported disasters in recent decades (see figure III.1). The remainder of this chapter concentrates primarily on such events.

Figure III.1  
Frequency of disasters, 1970-2006



Source: UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

On average, according to official figures, 78 disasters per year had occurred during the 1970s. That figure rose to 351 per year during 2000-2006. By contrast, the average number of people killed in any single disaster has been on a long-term declining trend, leaving the total number of deaths each year from disasters fairly constant. However, the increased frequency has contributed to a large increase in the number of persons affected by disasters and in the estimated costs of damages (see figure III.2): damages have averaged \$83 billion per year since 2000 compared with an average of \$12 billion per year in the 1970s.<sup>1</sup> As disasters have become less life-threatening, they have become more threatening to the well-being of the communities that are hit.

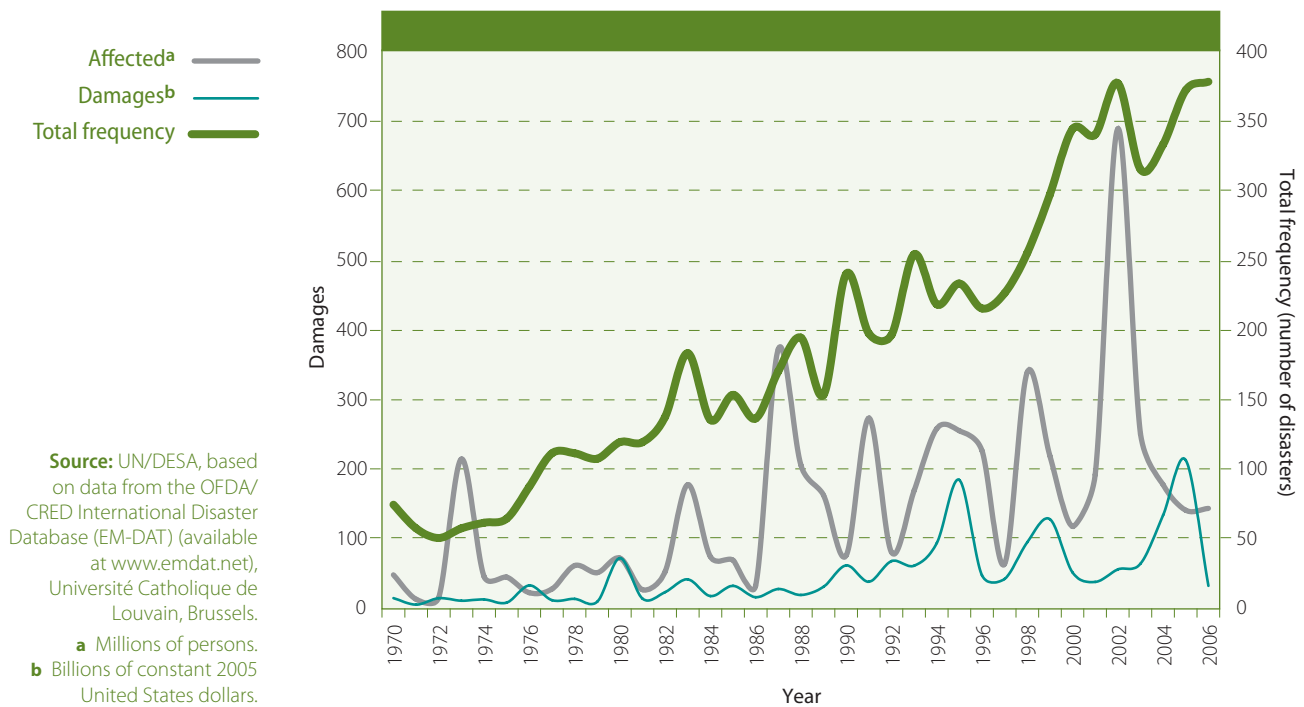
Despite the fact that the threat from natural hazards is a shared one, the human cost measured in terms of both the number of persons affected and the losses of human lives is significantly higher in developing countries, albeit with regional variations (see tables III.1, III.2 and III.3). The large number of persons killed per event in Africa in the 1970s and 1980s was primarily due to the devastating effects of drought: in Ethiopia, more than 100,000 people perished in 1978 and at least 300,000 perished during the drought of 1983-1984.<sup>2</sup> In the Sudan and Mozambique, the drought of 1985 caused the

As disasters have become less life-threatening, they have become more threatening to the well-being of the communities that are hit

<sup>1</sup> Figures adjusted to constant 2005 United States dollars.

<sup>2</sup> Food relief has greatly improved over recent years, contributing significantly to the fall in the number of deaths resulting from disasters. Food insecurity, however, remains a concern in many regions.

Figure III.2  
Magnitudes of disasters, 1970-2006



death of 150,000 people and 100,000 people, respectively. The high figure for Asia in the 1970s reflects the impact of the cyclones that hit Bangladesh in 1970, killing more than 300,000 people, and the earthquake in China, which killed more than 240,000 people in 1976. In fact, in the period 1970-2006, 95 per cent of all deaths resulting from disasters occurred in low-income and lower middle income countries, compared with just 1.5 per cent in high-income countries (see figure III.3). Controlling for population size, it appears that people in low-income countries are 20 times more likely to die from natural hazards than those in high-income countries.

Similarly, while more than 60 per cent of the total damages resulting from disasters occurred in high-income countries (see figure III.4), the estimated cost of disasters as a share of GDP was greatest in smaller economies (see table III.4). In the case

Table III.1

**Average number of affected people per disaster, by country group according to level of development, 1970-2006**

Thousands				
	1970-1979	1980-1989	1990-1999	2000-2006
High-income: non-OECD	108	126	314	68
High-income: OECD	3 994	6 628	28 117	9 276
Upper middle income	25 297	52 906	23 914	26 143
Lower middle income	55 535	291 601	1 364 179	916 552
Low-income	450 054	884 370	535 887	753 023
Unclassified	102	49	91	6

**Source:** UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

Table III.2  
Average number of persons killed per disaster, by region, 1970-2006

Thousands				
	1970-1979	1980-1989	1990-1999	2000-2006
Africa	1 344	3 008	37	28
Asia	2 098	147	352	387
Europe	67	41	15	4
Latin America and the Caribbean	728	161	144	32
Northern America	57	20	9	18
Oceania	10	6	27	2
Overall average	1 324	521	202	186

Source: UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

Table III.3  
Selected disaster statistics for various regions, 1970-2006

	Number of disasters	Killed (thousands)	Affected (millions)	Killed per 100 000	Affected per 100 000
Africa	951	702	316	78	35 168
Asia	2 984	1 561	4 888	41	127 331
Europe	844	16	31	2	4 263
Latin America and the Caribbean	1 308	244	165	44	29 790
Northern America	601	11	13	3	3 911
Oceania	380	4	15	13	44 553
Total	7 068	2 538	5 428	40	85 052

Source: UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

of Grenada and the Cayman Islands, for example, damages amounted to several times their GDP. In contrast, Hurricane Katrina and the Kobe earthquake caused damages of less than 2 per cent of the GDP of the United States of America and Japan, respectively.<sup>3</sup> In fact, no upper middle income country has been ranked in the top 100 for most costly disasters relative to GDP;<sup>4</sup> over half of the 20 most costly disasters occurred in predominantly agrarian economies, while 4 hit least developed countries, and 3 occurred among the heavily indebted poor countries (HIPC).<sup>5</sup>

<sup>3</sup> The damages caused amounted to approximately 1.3 per cent of GDP for Hurricane Katrina and 1.9 per cent of GDP for the Kobe earthquake.

<sup>4</sup> Having suffered damages amounting to approximately 4.3 per cent of GDP owing to an earthquake on 23 November 1980, Italy ranked as the first high-income OECD country in one hundred twenty-eighth place.

<sup>5</sup> The least developed countries were Vanuatu, Maldives and Samoa (which was ranked twice among the top 20), while the heavily indebted poor countries were Nicaragua, Tonga and Guyana.

Figure III.3  
Distribution of total deaths resulting from disasters,  
by country group according to level of development, 1970-2006

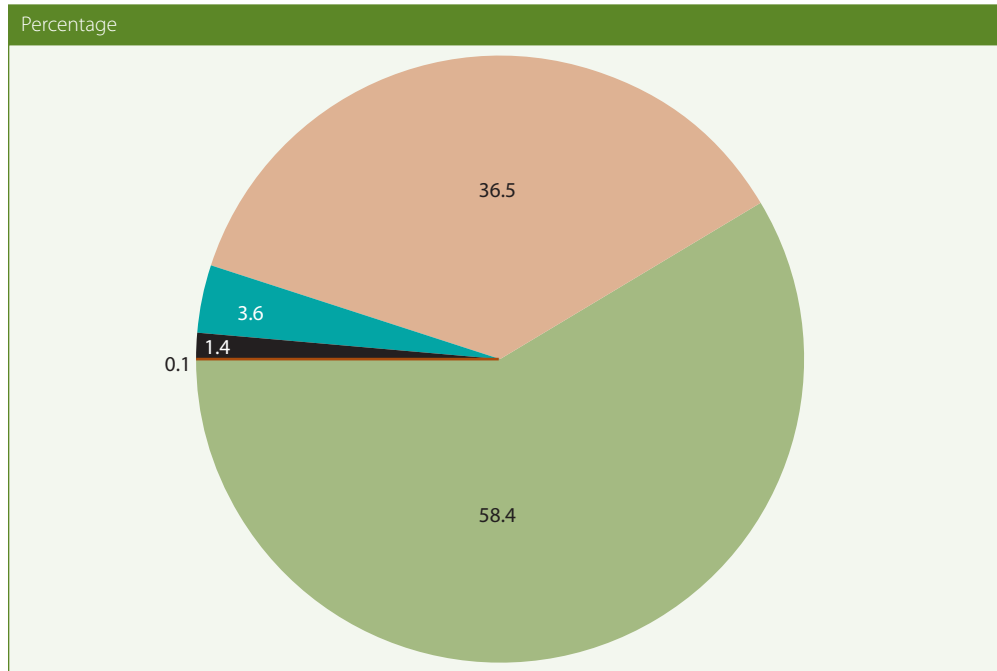
High-income:  
non-OECD

High-income:  
OECD

Upper middle  
income

Lower middle  
income

Low-income



Source: UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

Figure III.4  
Distribution of damages resulting from disasters,  
by country group according to level of development, 1970-2006

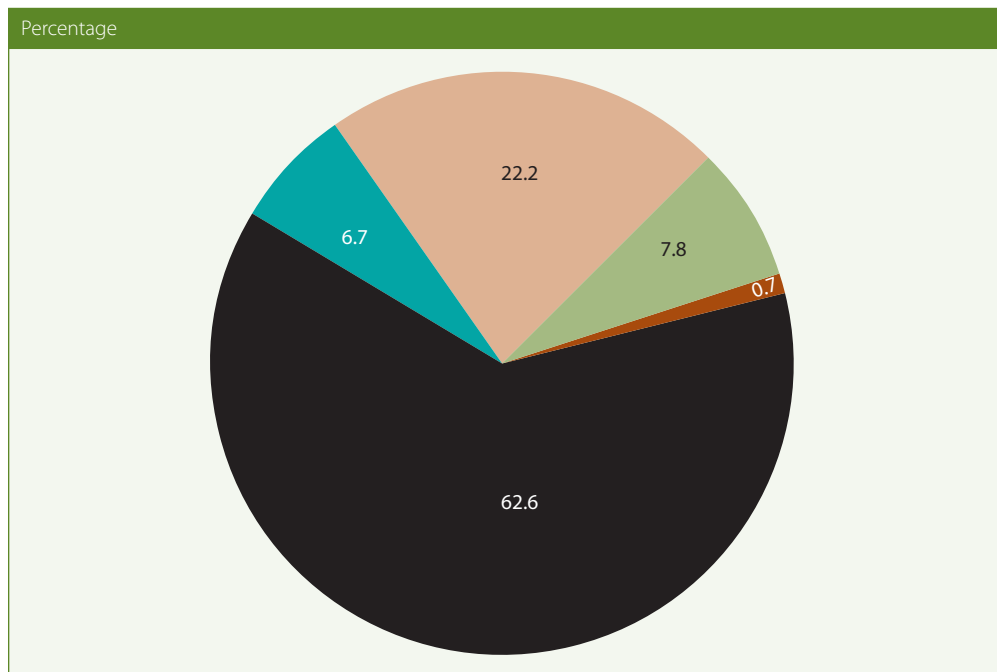
High-income:  
non-OECD

High-income:  
OECD

Upper middle  
income

Lower middle  
income

Low-income



Source: UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

**Table III.4**  
**Top 20 disasters in terms of costs and fatalities (absolute and relative), 1970-2006**

Country or area, year	Damage <sup>a</sup>	Country, year	Damage <sup>b</sup>	Country, year	Total deaths	Country, year	Deaths <sup>c</sup>
Democratic People's Republic of Korea, 1995 <sup>d</sup>	309	United States of America, 2005 <sup>e</sup>	158.2	Bangladesh, 1970 <sup>e</sup>	300 317	Mozambique, 1985 <sup>g</sup>	0.76
Cayman Islands <sup>e</sup>	224	Japan, 1995 <sup>f</sup>	78.1	Ethiopia, 1985 <sup>g</sup>	300 000	Ethiopia, 1984 <sup>g</sup>	0.71
Grenada, 2004 <sup>e</sup>	203	United States of America, 2004 <sup>e</sup>	55.9	China, 1976 <sup>f</sup>	242 000	Sudan, 1985 <sup>g</sup>	0.64
Saint Lucia, 1980 <sup>e</sup>	183	Italy, 1998 <sup>f</sup>	50.4	Indonesia, 2004 <sup>e</sup>	165 708	Peru, 1970 <sup>f</sup>	0.51
Vanuatu, 1985 <sup>e</sup>	146	United States of America, 1992 <sup>e</sup>	45.0	Sudan, 1985 <sup>g</sup>	150 000	Bangladesh, 1970 <sup>e</sup>	0.46
Samoa, 1991 <sup>e</sup>	139	Turkey, 1999 <sup>f</sup>	38.1	Bangladesh, 1991 <sup>e</sup>	138 987	Nicaragua, 1972 <sup>f</sup>	0.42
Dominica, 1979 <sup>e</sup>	101	United States of America, 1994 <sup>f</sup>	37.5	Ethiopia, 1978 <sup>g</sup>	100 000	Somalia, 1976 <sup>g</sup>	0.42
Samoa, 1990 <sup>e</sup>	99	Democratic People's Republic of Korea, 1994 <sup>d</sup>	36.6	Mozambique, 1985 <sup>g</sup>	100 000	Guatemala, 1976 <sup>f</sup>	0.36
Nicaragua, 1972 <sup>f</sup>	96	China, 1998 <sup>d</sup>	36.0	Pakistan, 2005 <sup>f</sup>	73 338	Ethiopia, 1978 <sup>g</sup>	0.28
Dominica, 1995 <sup>e</sup>	89	Japan, 2004 <sup>f</sup>	27.1	Peru, 1970 <sup>f</sup>	66 823	Honduras, 1974 <sup>e</sup>	0.27
Antigua and Barbuda, 1995 <sup>e</sup>	81	United States of America, 1995 <sup>e</sup>	25.3	Iran (Islamic Republic of), 1990 <sup>f</sup>	40 021	Honduras, 1998 <sup>e</sup>	0.24
Honduras, 1998 <sup>e</sup>	73	China, 1996 <sup>d</sup>	21.6	Sri Lanka, 2004 <sup>h</sup>	35 399	Sri Lanka, 2004 <sup>h</sup>	0.18
Maldives, 2004 <sup>e</sup>	62	China, 1994 <sup>g</sup>	19.1	Venezuela (Bolivarian Republic of), 1999 <sup>d</sup>	30 005	Venezuela (Bolivarian Republic of), 1999 <sup>d</sup>	0.13
Saint Kitts and Nevis, 1998 <sup>e</sup>	61	China, 2003 <sup>d</sup>	17.1	Bangladesh, 1974 <sup>d</sup>	28 700	Bangladesh, 1991 <sup>e</sup>	0.13
Guyana, 2005 <sup>d</sup>	59	Italy, 1976 <sup>f</sup>	16.7	Iran (Islamic Republic of), 2003 <sup>f</sup>	26 797	Honduras, 1973 <sup>j</sup>	0.10
Democratic People's Republic of Korea, 2000 <sup>e</sup>	57	United States of America, 2003 <sup>e</sup>	16.0	Iran (Islamic Republic of), 1978 <sup>f</sup>	25 045	Solomon Islands, 1975 <sup>h</sup>	0.10
Afghanistan, 1998 <sup>f</sup>	54	United States of America, 1999 <sup>e</sup>	16.0	Guatemala, 1976 <sup>f</sup>	23 000	Swaziland, 1983 <sup>g</sup>	0.08
Honduras, 1974 <sup>e</sup>	52	Germany, 2002 <sup>d</sup>	15.7	Colombia, 1985 <sup>i</sup>	21 800	Indonesia, 2004 <sup>h</sup>	0.08
Tonga, 2001 <sup>e</sup>	39	United States of America, 1993 <sup>d</sup>	15.7	India, 2001 <sup>f</sup>	20 005	Iran (Islamic Republic of), 1990 <sup>f</sup>	0.07
Zimbabwe, 1984 <sup>g</sup>	39	France, 1999 <sup>e</sup>	15.6	China, 1974 <sup>f</sup>	20 000	Nicaragua, 1998 <sup>e</sup>	0.07

**Source:** UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

**a** Percentage of GDP.

**b** Billions of constant 2005 United States dollars.

**c** Percentage of population.

**d** Floods.

**e** Wind.

**f** Earthquakes.

**g** Droughts.

**h** Waves.

**i** Volcanoes.

**j** Slides.

## Disaster dynamics: risks, vulnerabilities and vicious circles

### The development dimension

Natural hazards generally are difficult to predict and almost impossible to control. This makes them risky events, but just how risky depends, in part, on the frequency, strength and predictability of the particular hazard involved. For instance, droughts, windstorms and floods may occur relatively frequently, build over time and are relatively easy to track. In contrast, earthquakes and volcanic eruptions occur less frequently, hit instantaneously and are much more difficult to predict. However, both types are potentially catastrophic and, unlike other risks, such as illness, accidents and crime, can hit a large number of households simultaneously and cause disruptions across large swathes of economic activity. This combination of “catastrophic” and “covariant” risk is particularly difficult to assess and even more difficult to price, even in countries with sophisticated financial markets.

The threat to economic security from such events depends less, however, on the particular hazardous event itself and much more on the ability of households, communities and Governments to prepare for such events, to mitigate their impact and to deal with their aftermath. Higher levels of per capita income are strongly correlated with a lesser threat to economic security from disasters, particularly in terms of loss of life. Poorer countries and communities, by contrast, face these events with a series of economic deficits closely associated with low income per capita, including low levels of savings and other asset holdings, shortage of secure and decent employment, lack of access to credit, poor infrastructure, including schools and hospitals, etc., which limit their capacity to prepare for, respond to and recover from disasters.

Reduced vulnerability to natural hazards in wealthier countries also reflects changes in economic structure as those countries diversify into a wider range of productive activities, beginning with a shift away from agriculture, which is particularly vulnerable to a range of hydro-meteorological hazards. It is also a reflection of the depth and breadth of institutions. According to some assessments, this is a matter mainly of the presence of institutions of political voice, but others claim it is more one of strong property rights, lower levels of corruption and deeper financial markets.<sup>6</sup> No matter the precise nature of institutional strength, the general appreciation is that, with a better-functioning institutional environment, countries will be more resilient in respect of coping with disasters. Poor information, inadequate access to finance and poor social networks will affect resilience adversely, reducing the quality and effectiveness of societies’ response capacities and exacerbating the impact of the hazard (United Nations Human Settlements Programme (UN-Habitat), 2007). What matters with regard to all of these factors is the State’s capacity, both administrative and financial, to prepare for disasters and organize recovery.

The threat to economic security and well-being associated with natural hazards in developing countries reflects a broad range of structural vulnerabilities. These expose poorer countries and communities not just to potentially catastrophic large-scale disasters but also to frequent smaller-scale disasters which occur seasonally or annually, such as regular flooding in Bangladesh or windstorms in the Caribbean and Pacific region. In-

The impact of hazards are exacerbated by poor response capabilities

<sup>6</sup> Amartya Sen has argued that a key factor in averting famines following a natural catastrophe is the ability of the affected population to give “voice” to its predicament and to maintain pressure on Governments to respond rapidly and effectively to social and economic distress (Sen and Drèze, 2006). Drawing on the example of India, he identified this factor with the presence of democratic government. Others, however, have argued that it may not be sufficient to avert disaster.

deed, smaller disasters often prove to be the more difficult to manage, placing a permanent constraint on resource mobilization in many developing countries and short-circuiting the possibility of their making full recoveries (Oxfam International, 2007a).

The relationship between development and vulnerability to natural hazards is not straightforward. Evidence suggests that some countries may face increased vulnerability as they move up the development ladder: the strengthening of economy-wide linkages between sectors (such as the agriculture sector and the agricultural-processing industry) that takes place at early stages of development may in fact increase susceptibility to natural hazards, as has been reported in some African countries (World Bank, 2001, chap. 9). Similarly, demographic transitions, which accompany rising income levels, can add new vulnerabilities, as can the transition from a rural to an urban economy, as land use, in both rural and urban areas, comes under increasing strains, with environmental degradation adding a further dimension to an already vulnerable and insecure situation. The livelihoods of an estimated 80 per cent of the poor in Latin America, 60 per cent in Asia and 50 per cent in Africa are dependent on low-quality land vulnerable to natural hazards (Hardoy, Mitlin and Satterthwaite, 2001).

Geographical factors add another dimension of vulnerability. Country size, location and remoteness can matter greatly, with 8 of the 10 relatively most costly disasters having been registered in small island developing States, a group of highly vulnerable but not necessarily low-income countries (Heger, Julca and Paddison, 2008). Indeed, as Rasmussen (2004, p. 7) notes, relative to land area, countries in the Eastern Caribbean Currency Union are among the most disaster-prone countries in the world (see box III.2).

The vulnerability of poorer countries to disasters is reflected in the difficulty experienced by those countries in mobilizing the resources needed to reduce their exposure to hazards, to build up their resilience and to make a rapid recovery after disasters strike. This is a development challenge which can be properly met only through large-scale investments and strategic policies that strengthen economic and social capacities at the local and national levels and that can draw on as wide a range of coping and recovery options as possible when disaster strikes.

The vulnerability of poorer countries to disasters is heightened by difficulties in mobilizing domestic resources

### The impact of disasters on economic insecurity

Disasters heighten economic insecurity through three principal channels: the immediate (and more lasting) damage to the stock of productive assets (crops ready for harvest, live-stock, irrigation works, plants and machinery, etc.), public infrastructure (roads, bridges, etc.), residential property and human capital (through loss of lives, injuries, interrupted schooling, etc.); the loss of income flows associated with the interruption in normal economic activity and transactions (including the displacement of populations); and the threat to growth prospects from increased economic volatility and heightened uncertainty. In fact, even the threat of disasters can impact upon economic security: for instance, rural banks may deny farmers access to financial services owing to high (perceived) disaster risk.

Capital assets, both physical and human, can be seriously damaged during a disaster, with long-term implications for employment creation and productivity performance. Damage to the capital stock varies significantly across hazards, and can be particularly severe with geologic shocks. The immediate burden is felt at the level of the household, firm and farm; however, the resulting impact as regards economic insecurity very much depends on the effectiveness of the mitigation and recovery strategies at the

## Box III.2

### Small isn't always beautiful: small island developing States and the disaster threat

The unique characteristics of many small island developing States and their special challenges have been recognized in the international development agenda.

Despite their economic and social diversity, many of them still share common characteristics such as a narrow resource base, geographical remoteness and lack of competitive economic activities and economies of scale, which have partly translated into high transportation and communication costs, contributing further to their marginalization in the global economy. Owing to these structural features, the majority of small island developing States are highly vulnerable to natural hazards (Rasmussen, 2004).

On one measure, devised by the Commonwealth Secretariat and the World Bank (combining economic diversification, export dependence and the portion of the population affected by disasters), 26 of the 28 most vulnerable countries are small States (18 of them islands). In fact, damages resulting from disasters exceeding 50 per cent of GDP in individual countries are common: 12 of the 20 most costly disasters (relative to GDP) have occurred in small island developing States. While larger or more complex economies, for example, those with highly competitive industrial and service sectors, can spread the burden of adjusting to disasters over time as well as over space, the ability to "bounce back" is more limited for smaller countries. Thus, some part of the structural vulnerability of small island developing States is beyond the control of stakeholders, and cannot be easily reduced by policies or actions (Guillaumont, 2007).

The issue of climate change is particularly relevant for small island developing States. For one, the increasing incidence of disasters (from 64 during the 1970s to 166 for the seven-year period covering 2000-2006) and their intensity are set to continue. The occurrence of tropical typhoons and cyclones may increase by as much as 50–60 per cent (NASA Goddard Institute for Space Studies, 2001) and their intensity may increase by 10–20 per cent. In the short term, rising sea levels will contribute to greater storm damage. In the long term, they may lead to the submersion of large proportions of many small island developing States.

The greatest challenge of climate change, however, may lie in the implications for water supply, particularly for islands in the Pacific. Increasing storm surges, rising sea levels and global warming will significantly impact upon the availability of potable water owing to saltwater intrusion into freshwater supplies. Already less than half of the population in Kiribati has access to safe water; for the rural population in Papua New Guinea, the proportion is less than 10 per cent (Hoegh-Guldberg and others, 2000). Thus, water scarcity may make many small island developing States uninhabitable long before they are covered as a result of the rising sea level.

household, community and State levels in keeping costs to a minimum and in bringing about a rapid return to pre-disaster levels of activity.

At the macroeconomic level, disasters typically result in an immediate drop in output and employment. Increased imports of intermediate goods and raw materials are likely once the process of repair and reconstruction is under way, contributing to a worsening of the trade balance which is likely to be exaggerated by decreased exports, particularly when one or two commodities account for a large share of foreign-exchange earnings, and when the sector(s) concerned are significantly affected by the disaster. For instance, much of export production was lost as approximately 50 per cent of planted banana trees were swept away in Honduras by Hurricane Mitch in 1998; in 2004, Hurricane Ivan devastated Grenada's nutmeg crop, representing one of the economy's principle export sectors; in Sri Lanka, it was the fishing sector, one of the country's primary sources of income, that was hardest hit by the 2004 tsunami.

In the context of widespread poverty and in the absence of economic diversification, intense floods and windstorms not only destroy harvests and the livelihoods of farmers but also may severely erode the financial capacity of Governments to respond effectively. Not only will the public sector experience damage to its assets, but revenue will also be squeezed, even as that sector faces a growing expenditure bill from the damages incurred. Public reconstruction may be accelerated by borrowing abroad; but the resulting rising stock of debt may, over the longer run, adversely affect the country's credit rating and the future cost of borrowing. This, along with the increase in macroeconomic volatility, is likely to adversely affect overall investment levels at a time when resources need to be channelled towards repairing the damaged capital stock.

A number of studies have found that vulnerability to disasters, especially in terms of the proportion of the population affected, is closely associated with high volatility of income, consumption and fiscal balances, a large agricultural sector, a low investment-to-GDP ratio and an open current account.<sup>7</sup> Moreover, a squeeze on public finances can trigger inflationary pressures, and pose problems for the management of the public debt. Where large inflows of assistance occur in response to the disaster, these can also introduce sources of macroeconomic volatility, particularly where the flows are unpredictable (United Nations, 2005a).

In countries where existing structural vulnerabilities are significant, existing economic insecurity associated with fragile food, health and employment conditions will not only be compounded by disasters, but also slow the recovery process. Families will quickly exhaust coping mechanisms, such as savings, credits, sale of assets and migration, etc., and be forced into more risk-bearing survival strategies—for example, child labour and high-cost loans—which further perpetuate vulnerability. This will adversely impact on private investment.

While vulnerability to climatic shocks and other natural hazards suggests a poor growth environment, the available econometric evidence is inconclusive. Several studies focusing on the Caribbean region found that, although growth slows in the year of disaster, it tends to rebound in subsequent years mainly owing to post-disaster reconstruction activity which can spill over to other sectors. For instance, following a growth rate of over 7 per cent in 2003, GDP contracted by 7.4 per cent in 2004 in Grenada following Hurricane Ivan in 2004, but it subsequently expanded by 13.2 per cent in 2005 owing to reconstruction (United Nations, Economic Commission for Latin America and the Caribbean, 2007a). Thus, an overall positive, though not always significant, correlation between disasters and GDP growth may be found in this region. In contrast, other studies have reported a more strongly negative impact of disasters on *long-term* growth; no significant impact at all (Caselli and Malhotra, 2004); or an impact that in fact depends on the type of disaster.<sup>8</sup>

<sup>7</sup> See Auffret (2003) and Gassebner, Keck and Teh (2006). A high degree of openness can work through volatility of terms of trade and tends to be associated with a more specialized trade pattern, as is found in smaller economies.

<sup>8</sup> Differentiating more generally among disasters, climatic disasters were found to be positively associated with growth, whereas with geologic disasters, the association was negative (Toya and Skidmore, 2007). Climatic disasters might be assumed to shift relative returns in favour of human capital, which some suggest is a more important source of long-term growth, whereas the bias following geologic disasters is towards more physical capital, explaining their differing growth effects. However, Benson (1994) argues precisely the opposite, namely, that geologic disasters require larger reconstruction programmes, which may spur growth for greater periods. Arguably, neither argument offers a fully convincing analysis of accumulation dynamics where rents are the motivating force. Another problem is that such exercises often simply pick up the influence of unobserved variables unrelated to the disaster-growth nexus itself, a problem that is more likely to arise when stock and flow variables are mixed together, as is often the case.

Poverty and lack of diversification can weaken Governments' capacity to respond to disasters

## A vicious circle of vulnerability and insecurity

Any pronounced and lasting impact of disasters on economic insecurity therefore appears to arise from the presence of feedback mechanisms that work to deepen structural vulnerabilities and expose populations to the threat of future disasters. This in turn heightens the risks from future shocks, with adverse consequences for investment planning and further threats to economic security. From a policy perspective, identifying such mechanisms would appear to be key to finding more effective responses to disaster planning and mitigation.

The poorest households and communities suffer the most from disasters, as they are already deprived of the basic ingredients of a more secure livelihood

Poverty is one such feedback mechanism. Rising levels of poverty have been reported after disasters and while comprehensive studies are missing, the impact can be significant. As already suggested, the poorest households and communities suffer the most from disasters, as they are already deprived of the basic ingredients of a more secure livelihood. However, the impact of disasters may push previously secure groups into the ranks of the vulnerable, if the available coping strategies collapse under large-scale or repeated shocks; according to World Bank estimates, anywhere between one fifth and two thirds of people in developing countries are vulnerable to falling into extreme poverty. Liquidating productive assets, defaulting on loans, withdrawing children from school to work on farms or tend livestock, severely reducing nutrient intake and over-exploiting natural resources, can, in these circumstances, become unavoidable but self-defeating strategies. One recent study of south India, for example, found that all segments of the population, landed and landless, upper and lower castes, were vulnerable to poverty after crop shocks (Gaiha and Imai, 2004). Moreover, disasters can compound other problems which add to the threat of heightened poverty. For example, the disaster resulting from the El Niño phenomenon in Ecuador in 1997-1998 provoked a downturn, especially in agriculture, which was further compounded by the fall of oil prices and an extremely fragile banking sector, leading to a full-blown economic crisis in 1999 (Parandekar, Vos and Winkler, 2002).

The resilience of social networks, which may be of an informal nature, can be another critical factor in dampening or perpetuating the costs of adjustment following a disaster. For instance, although the majority of flood-prone communities in the Malamulele district in South Africa share characteristics of insecure livelihoods, including food insecurity which often goes hand in hand with non-access to land, and a limited access to formal non-farm employment, the Menele community was found to have fared better than the Mavambe community because of employment opportunities linked to a rural elite with access to cropland, livestock and farm equipment (Kandelhela and May, 2006). Such networks may also involve more formal public service providers.

Lack of well-built health infrastructure and facilities such as hospitals and emergency attention centres located near vulnerable populations, as well as insufficient medical doctors, equipment and supplies, often contributes to the vulnerability of exposed populations, particularly as disasters often reduce infrastructural capacities while increasing the demand for them. In this respect, the resilience of social networks is closely linked to wider levels of inequality.

Immediately after disasters, young and older persons count among the most fatalities and injuries, with survivors dependent on family and public resources for immediate resettlement and relief

At least one study reports a strong relation between a country's level of inequality and the scale of the impact from disasters (Roberts and Parks, 2007). This can often assume a regional dimension and will likely include horizontal inequalities, such as those associated with gender and ethnic discrimination. For instance, following a disaster, pressures for women's additional work rises as the amount of unpaid work and family care likely increases, while their coping and resilience mechanisms are typically weak or further eroded by unequal public relief distribution practices (Ngo, 2001; Bunyavanich and others, 2003). Similarly, young and older persons are physiologically and socially more vulner-

able to disasters, given their lower coping capacities. Immediately after disasters, young and older persons therefore count among the most fatalities and injuries, with survivors dependent on family and public resources for immediate resettlement and relief.<sup>9</sup>

Constraints on the supply of food could be another factor reinforcing vulnerability to the impact of natural hazards.<sup>10</sup> Food insecurity can be the result of geographical pressures, as is the case in small island economies, or economic pressures, linked to deforestation, overgrazing and inadequate management practices, particularly as agricultural activities crowd into increasingly fragile areas. In the immediate aftermath of a disaster, food insecurity is often significantly heightened, leading to distress sales of productive assets or the resort of using children as a source of family income so as to maintain nutritional levels. Such coping responses can reinforce poverty traps at the household level, thereby perpetuating vulnerability to future disasters. Responding to food insecurity by increasing imports of foodstuffs, however, can potentially enhance structural import dependence if it destabilizes domestic and local markets and erodes the production capacity of the local agriculture sector.<sup>11</sup>

While vicious circles of this kind are a persistent feature of the development landscape, there are reasons to believe that they have intensified in recent years. In particular, climate change and shifting patterns of development have contributed to a growing link between disasters and heightened economic insecurity.

Although the socio-economic impact of climate change is the subject of ongoing research, there is broad agreement that, with rising temperatures and ocean levels, longer and more severe dry periods will be experienced in some already drought-prone areas and more intense rainfall can be expected in some already flood-prone and coastal areas (United Nations Development Programme, 2007, pp. 90-107). Much of the likely cost of these changes will be borne by some of the world's poorest countries and communities. However, even the chairman of Lloyd's of London has identified climate change as its number one issue, and Europe's largest insurer, Allianz, has stated that "climate change stands to increase insured losses from extreme events in an average year by 37 per cent within just a decade while losses in a bad year could top 1 trillion" (quoted in Mills, 2007).

The increased concentration of human settlements in vulnerable urban areas has been another factor heightening the disaster-insecurity nexus. Urbanization has been growing at a tremendous pace in the developing world in recent years (United Nations Human Settlements Programme (UN-Habitat), 2007); yet it is not urbanization per se, but rather the nature of the process, that determines whether vulnerability increases or not. Particularly in developing countries, urbanization is often characterized by an increase in unstable and precarious living environments, for example, slums and shanty towns. These settlements are frequently located in high-risk areas, for example, on steep slopes which are prone to landslides, or on flood plains or in ravines, contributing to the vulnerability to hazards such as flooding and landslides. Moreover, the lack of enforcement of building regulations in the construction of such settlements exacerbates their vulnerability.

<sup>9</sup> See United Nations Human Settlements Programme (UN-Habitat) (2007, p. 181).

<sup>10</sup> More often than not, natural hazards often expose multiple vulnerabilities. In August 1999, after a major earthquake had struck the north-western part of Turkey, a survey of 230 households from the four communities worst affected revealed that the greatest immediate need for most families was shelter requirements (37 per cent), followed by food (23 per cent) and hygiene requirements (19 per cent). Ten days after the earthquake, basic environmental health needs of food, shelter and hygiene still predominated in this displaced population (Daley, Karpati and Sheik, 2001).

<sup>11</sup> This includes vulnerability to price increases. Following an increase by 10 per cent in 2006, the food import bill of developing countries was estimated to have increased by 25 per cent in 2007 owing to higher food prices (Food and Agriculture Organization, 2006); see also box II.1.

Responding to food insecurity with imports can potentially enhance structural import dependence

Climate change could increase insurance losses in a bad year to over \$1 trillion

However, as the report of UN-Habitat has made abundantly clear, this pattern of growing urban vulnerability owes a good deal to the failed development policies of the past three decades and, in particular, to those that have orchestrated a “retreat of the state”. The report states (pp. 189-190):

“Urban risk accumulation was accelerated by the debt crisis and subsequent structural adjustment programmes of the 1980s and 1990s that forced Governments throughout Latin America, Asia and Africa to slash subsidies on food, electricity and transportation and to retrench public-sector workers ... Neo-liberal policies ... have scaled down State responsibilities for risk reduction and response and place greater emphasis on the role of private citizens and companies”.

One clear aspect of this shifting emphasis has been fiscal retrenchment and the accompanying decline in public investment across much of the developing world over the past two and half decades (United Nations Conference on Trade and Development, 2003, chap. IV). In some cases, this has been directly responsible for the stalled diversification of production and income sources, which remains a key component of building protection against disaster shocks. It has also led to the erosion of infrastructure for transportation, communications, energy supplies, and social services, which adds to the vulnerability of many communities. Also investments aimed at disaster preparedness and adaptation, such as in flood defences and early warning systems, have been cut back in such contexts.

## Strategies to increase resilience and diminish disaster impact

Coping mechanisms include market and non-market strategies

The discussion in previous sections suggests that there is, in many developing countries, a growing threat to economic insecurity from a rising incidence of disasters. To manage these shocks, households, farms, businesses and Governments rely on both market and non-market strategies to cope with the consequences when they do hit and to aid reconstruction in their aftermath. Table III.5 illustrates observed practices on pre- and post-disaster risk financing arrangements.

Coping measures such as improved insurance and relief constitute ex post responses that leave the underlying and fundamental causes of disasters untouched. To be of lasting effect, these measures need to be part of a broader rethinking of development strategies in vulnerable countries, focused on preparedness and preventive actions. Such actions require ex ante approaches to disaster management that can more effectively reduce and mitigate the risks associated with hazard shocks, as well as strengthen resilience directed against these shocks’ becoming disasters, along with a better linking from ex post coping strategies to medium-term recovery.

## Disaster risk reduction

The highest priority in managing disasters must be to reduce, through increased investment in preparation and adaptation measures, the risk of natural hazards’ turning into disasters

The highest priority in managing disasters must be to reduce, through increased investment in preparation and adaptation measures, the risk of natural hazards’ turning into disasters. This is a multidimensional challenge. Mitigation measures comprise, inter alia, appropriate land-use planning, improved infrastructure design, and more integrated water management systems. They should also involve stronger regulation with respect to, for example, building codes. In many cases, new institutional arrangements will be needed that

Table III.5  
Examples of pre- and post-disaster risk financing arrangements

	<i>Security for loss of assets (households/businesses, non-farm)</i>	<i>Food security for crops/livestock loss (farms)</i>	<i>Security for relief and reconstruction (Governments)</i>
<b>Post-disaster (ex post)</b>			
	Emergency loans; moneylenders; public assistance	Sale of productive assets, food aid	Diversions; loans from World Bank and other international financial institutions
<b>Pre-disaster (ex ante)</b>			
Non-market	Kinship arrangements	Voluntary mutual arrangements	International aid
Inter-temporal	Microsavings	Food storage	Catastrophe reserve funds, regional pools, contingent credit
Market-based risk transfer	Property and life insurance	Crop and livestock insurance (also index-based)	Insurance or catastrophe bonds (also index-based)

Source: Linnerooth-Bayer and Mechler (2007).

can better respond to emergencies through more effective monitoring and warning systems, and better-trained and equipped personnel. Measures will also likely involve more far-sighted environmental planning for adaptation to expected climate change.

Disaster risk planning and matching targeted expenditures constitute other critical elements of disaster mitigation. The first steps in a risk reduction plan involve identification of vulnerabilities and risks and their ranking or prioritization. Box III.3 gives two examples of community-based preparedness and risk assessment plans, the first based on activities undertaken to better withstand floods in West Bengal, India, and the second on actions taken to reduce risk of droughts in rural communities of southern Ethiopia and northern Kenya.

Unfortunately, disaster risk reduction has been a priority neither in many vulnerable countries nor among donors. Approximately only 2 per cent of disaster management funds are spent by bilateral and multilateral donors on proactive disaster risk reduction; the remaining 98 per cent are spent for relief and reconstruction (Mechler, 2005). Such skewed expenditure stands in stark contrast to potential benefits of disaster risk reduction. For instance, a retrospective analysis of 4,000 mitigation projects in the United States of America reported an average benefit-cost ratio of 1 to 4 (Multihazard Mitigation Council, 2005). Similarly, the Red River Floodway which was constructed in the 1960s in Canada from an initial cost of approximately Can\$ 62.7 million is estimated to have prevented \$6 billion in damages in 1997 alone. This Floodway has been used more than 20 times since construction to reduce the impact of floods and has prevented overall damages estimated at \$10 billion. While it was initially built to withstand a 1-in-90-years flood, it has since been upgraded to withstand a much more severe 1-in-300-years flood (Manitoba Floodway Authority, 2006). Similarly, investments of approximately \$3.15 billion on flood control in China are seen to have averted estimated losses of approximately \$12 billion (Benson, 1998). According to the U.S. Geological Survey, the economic losses worldwide from disasters in the 1990s could have been reduced by

The economic losses worldwide from disasters in the 1990s could have been reduced by \$280 billion through investing in disaster risk reduction

## Box III.3

### Community-based preparedness and risk assessment: India, Ethiopia and Kenya

The Government of West Bengal, India, together with an inter-agency group, had developed a community-based project to prepare regional communities, individually and collectively, for the next *flood* disaster which, when it did arrive, became similar to the one that had devastated the region in 2000. The project assumed that communities had to live with natural hazards, and that no external intervention should change the lifestyles of their members. Using a participatory approach, each community prepared an action plan. The plan included a community vulnerability map, which identified safe places, low-risk areas, highly vulnerable areas and the estimated number of families residing in each zone, as well as the number and location of vulnerable populations, such as the aged, the disabled, lactating mothers, pregnant women, seriously ill persons and small children. Then, the plan took note of priority elements at risk, such as life, health, property, livestock and livelihood; listed the resources at hand as well as those required to bring down the level of risk; and, last, outlined key activities that the community would carry out before, during and after a disaster.

When the next flood arrived, in 2004, the results were remarkable. Based on a comparison of damages and losses for one village from two floods, one that had occurred in 2000 and the other in 2004, the project proved to be quite effective. In 2000, the village had lost over 700 cattle, while in 2004, it lost none. In 2000, nearly 3,000 families had lost or suffered damage to other valuable assets, while in 2004, none of the families reported any such loss or damage. The village also relied primarily on food preparedness: each family had stockpiled food for from 7 to 10 days to meet its immediate needs. Furthermore, in 2004, the village experienced almost no outbreak of disease. Observing how the project benefited the community, especially the poor and most vulnerable groups, local authorities requested expansion of this project to other vulnerable areas.

Similarly, a team of researchers developed a systematic approach to classifying and ordering the sources of *drought* risk faced by pastoral populations in arid and semi-arid districts of southern Ethiopia and northern Kenya. The researchers created a robust community participatory method which was less costly and time-consuming than full surveys. The method, which was tested in the field over six months in 1998, involved 120 groups (59 groups of women and 61 groups of men). The responses identified 15 major sources of risk, ranging from availability of food and water to banditry. The most frequently mentioned problems were insecure access to food and water, livestock disease and access to health clinics. Food and water shortages were the only risks mentioned by a majority of informants, indicating that the extent of the other risks varied considerably across the region and its population, even though some (for instance, malaria and conflict) were certainly severe in many places.

**Source:** United Nations, International Strategy for Disaster Reduction, and World Bank (2007).

\$280 billion through investing some \$40 billion in disaster risk reduction (International Federation of Red Cross and Red Crescent Societies (IFRC, 2001), a figure below the annual average flow of aid in that decade.

Low expenditure on disaster risk reduction programmes may be a consequence of the difficulty of assessing the costs and benefits of disaster risk reduction. It is also, however, a consequence of short-sighted policy design, as well as lack of political will. The floods in Tabasco (Mexico), for example, which left 1 million people homeless could have been avoided if planned investments in a modern flood-control infrastructure and other preventive measures and programmes had been undertaken. Policymakers and the international community may be unwilling to spend large sums on disaster risk reduction when faced with limited budgetary resources and when unable to show immediate returns. This is also made apparent by the insufficient levels of private investment in disaster risk reduction. For instance, despite extensive public awareness campaigns, studies show that only about 10 per cent of earthquake- and flood-prone households have adopted loss-reduction measures in the United States (Kunreuther, 2006). Public awareness campaigns and more effective training of emergency personnel will be required to address this gap.

## Linking relief to development

An effective approach to reducing vulnerability may be to link medium-term development strategies to relief activities, as relief measures alone may save lives but not necessarily livelihoods. For many developing countries, diversification of production and livelihoods is a key component of such an approach.

As discussed earlier, many vulnerable countries tend to be highly dependent on a limited number of export commodities. Such dependence amplifies their vulnerability to natural hazards. It is therefore important that reconstruction efforts promote alternative, sustainable livelihood opportunities for those affected. From an individual farmer's point of view, alternatives to monocultures are not always feasible owing, for example, to lack of access to credit which limits a farmer's ability to plant multiple crops or the availability of complementary inputs. Consequently, a combination of public investment and cheap credit is often critical to shifting towards a more diversified pattern of development.

Repairing and reconstructing basic infrastructure are important steps in moving from relief to medium-term recovery, but must be carried out in such a way as to prevent further vulnerabilities from emerging. Following the prompt provision of water and sanitation in the Indonesian communities affected by the 2004 tsunami, some communities, for instance, still did not have electricity after two years of resettlement. Similarly, while by 2006, Sri Lanka had rebuilt over 60,000 houses, much of the housing stock as well as infrastructure such as hospitals, schools and bridges had not yet been repaired (Birkmann, 2007). In the haste to build new infrastructure, well-intentioned mitigation programmes can overwhelm communities' capacities rather than leverage them, overlooking local and regional conditions for dealing with natural hazards. For instance, approaches to disaster risk reduction which are focused on, for example, investment in dams and large infrastructure without adjustment to local geographical conditions have been harmful in Bangladesh: the "cordon approach", where flood plains are cordoned off from the neighbouring river channels through construction of solid embankments, has in fact resulted in less area for the monsoon river-water to spread over as more cordons are built. Consequently, flood levels in these areas have risen (Islam, 2001).

Adequate infrastructural investment, institutional capacity and access to finance are often missing in vulnerable countries and populations. In addition, the absence of adequate transportation networks to provide access to vulnerable populations in case of earthquakes, and the need for availability of sensitive weather communications systems for early warning in case of hurricanes and tsunamis, highlight the variety of challenges that must be tailored to local conditions (see box III.4).

Because disasters may increase food insecurity, preventive measures designed to deal with food vulnerability are crucial in pre-disaster preparedness and recovery activities. These should include mapping by early warning systems of food-insecure households, classified by degree of malnutrition and deficiencies in food consumption, and medium-term policies such as cash transfers and issuance of food stamps, as well as active support to small- and medium-scale crop agriculture, for example, subsidies to agricultural inputs. Prolonged reliance on the distribution of food aid after the disaster may have adverse effects on local farmers, thereby deepening poverty and increasing economic insecurity.

Urban populations settled on hill slopes and terrains are vulnerable to heavy rains and floods, as are those living in fragile housing and under crowded conditions. Dealing with chronic housing crises and insufficient regulations are therefore essential to

Relief must be linked to development strategies

Preventive measures designed to deal with food vulnerability are crucial in pre-disaster preparedness and recovery activities

Fragile housing conditions amplify vulnerabilities

## Box III.4

**Technology and early warning systems**

On 26 December 2004, a massive tsunami in the Indian Ocean claimed about 220,000 lives, injured over 500,000, left 3 million-5 million homeless and cost billions of dollars in damage. The scale of the tragedy could have been substantially reduced if there had been proper early warning systems.

Technical innovations arising from better understanding of the physical causes of disasters, improved forecasting and prediction, and better monitoring and modelling of hazard-related factors represent key elements for mitigating the adverse effects of natural hazards. Technology should therefore be used appropriately to provide effective early warning systems designed to reduce vulnerabilities and enhance adaptive capacity to natural hazards.

Translating available technologies and knowledge into useful tools presents many challenges for developing countries. Technological, financial and institutional factors mainly determine the level of adaptability and responsiveness. For example, it is possible to forecast flash floods as they develop by weather radar. Such radar technology is, however, often absent in African, Asian and Caribbean developing countries where flash floods are more likely to occur.

To reduce some of these shortcomings, several global organizations are assisting developing countries in building up effective early forecasting systems. For example, the collaborative efforts of the World Meteorological Organization (WMO) and the National Meteorological and Hydrological Services (NMHS) are playing a critical role in the reduction of death from disasters in some countries. Similarly, the Food and Agriculture Organization of the United Nations (FAO) Global Information and Early Warning System on Food and Agriculture (GIEWS) and the Food Insecurity and Vulnerability Information and Mapping System (FIVIMS), both related to floods and droughts, are providing useful information for risk reduction plans for developing countries. Broadly, international financial support, knowledge-sharing, capacity-building, training, research and development to address gaps and shortcomings of developing countries can provide guidance for effective early warning systems in these countries. Along these lines and following the devastating floods in South Asia in 2004, an Emergency Flood Damage Rehabilitation Project (EFDRP) with international support has been set up at a cost of \$180 million to improve the technological aspects and effectiveness of early warning systems in the region (United Nations, International Strategy for Disaster Reduction, 2006).

Low-cost technologies can make a difference in the functioning of early warning systems in developing countries. For instance, in the Dominican Republic, warnings are issued on national radio and TV. Relevant maps are delivered to municipal civil defence officials and cellphones and local sirens are utilized to warn the population. The early warning system in Cuba has also proved its effectiveness by reducing dramatically the number of human losses (International Federation of Red Cross and Red Crescent Societies (IFRC), 2006): for instance, four persons had been killed when Hurricane Charley hit the island in 2004, while no one perished when Hurricane Ivan struck one month later. Hurricane Charley had killed 10 persons in Florida, while Ivan killed 52 persons in the United States, 39 in Grenada and 15 in Jamaica.

Similarly, use of low-cost technology has contributed to a significant reduction of cyclone-related deaths in Bangladesh: although 10,000 persons perished during Cyclone Sidr in November 2007, this figure is significantly lower than the 139,000 deaths caused by a similar cyclone in 1991.

There is, however, ample room for improvement. More lives could have been saved in Bangladesh if existing and widely used low-cost technologies had been integrated into the national early warning system. Along the same lines, despite a weather forecast system, heavy rains triggered devastating landslides on the mountainous border between the Dominican Republic and Haiti in May 2004, leaving hundreds of people dead and thousands homeless.

International collaboration and investment on early warning systems have increased. The meteorological institute of Cuba shares information with the United States National Hurricane Center (NHC) and produces regional models to forecast storms and other natural hazards. The institute issues regular scientific-based meteorological information and early warning news on the evolution of a natural hazard and risk. During a hurricane season, the media, local civil protection committees, and regional coordinators are mobilized to disseminate storm updates and related information

**Box III.4 (cont'd)**

to high-risk areas. Public transportation, designated shelters and civil society groups comprising, for example, women, small businesses and doctors are brought together to persuade vulnerable people to relocate and to facilitate relocation, while providing essentials such as food, water and blankets. At the local levels, disaster coordinators are equipped with low-cost technologies to maintain successful coordination of efforts extending from the national to the local level. In this regard, Zambia has an extensive system set up for early risk-mapping of natural hazards. It prepares vulnerability assessment in advance and is mobilizing resources at a wider level as international aid agencies have also become part of the early warning system.

pre-disaster preparedness, as unsafe buildings and lack of enforcement of building codes amplify vulnerabilities (United Nations, International Strategy for Disaster Reduction, and International Recovery Platform, 2007). For instance, the fact that building codes established in the 1980s had required buildings to have steel frames meant that buildings constructed more recently were less affected by the 1995 Kobe earthquake than older buildings. The lesson was learned: since then, older constructions have also been required to comply with the new codes in preparation for future earthquakes (Kawamura, 1995).

There is also a role for legislation and planning in terms of direct risk reduction measures of a non-structural nature. These should encompass risk evaluation programmes, provision of information to people on measures to reduce risk (for example, relevant information on disaster risk and means of protection for people residing in high-risk areas), resettlement plans, establishment of early warning systems, and the inclusion of disaster risk reduction subjects and training programmes in schools and within communities. A recent survey (United Nations, International Strategy for Disaster Reduction, 2006) indicates that effective early warning systems must be people-centred and must comprise four elements: (a) knowledge of the risks faced, (b) a technical capacity, monitoring and warning service, (c) dissemination of meaningful warnings to those at risk and (d) public awareness and preparedness to act. For example, the early warning system in Cuba proved its effectiveness by reducing dramatically the number of human losses relative to those of its neighbours.

Standard use of environmental impact assessments as part of public investment and development programmes would greatly improve the effectiveness of actions directed towards disaster mitigation. For example, the Government of Viet Nam with the support of the International Federation of Red Cross and Red Crescent Societies invested in a “mangrove project” by planting and protecting 12,000 hectares of mangroves along almost 200 kilometres of coastline. While the planting and protection cost about \$1.1 million, the project helped to reduce the cost of dyke maintenance by \$7.3 million per year, and to improve the resilience with respect to further hazards of 7,750 families through their selling of crabs, shrimps and mollusks (United Nations Environment Programme, 2007). Thus, naturally occurring mitigation measures involving, for example, mangroves, seagrass beds and reeds play an important role in reducing the adverse impact of natural hazards.

### Pooling risk

To some degree, disaster insurance schemes can be effective coping mechanisms. Though such insurance will not reduce the direct impact of disasters, it can provide indemnification against damages incurred, enabling those covered to replace lost and repair damaged

assets. As such, it can smooth consumption, reduce economic insecurity and prevent the establishment of an unstable post-disaster investment climate.

As noted earlier, the combination of catastrophic and covariant risks associated with many natural hazards makes their pooling and transfer, through market-based financial instruments, administratively difficult or prohibitively expensive. Even so, the extent to which households, enterprises and States choose to manage disaster risk through insurance varies significantly, even among developed countries.

Typically, insuring public assets against disasters is quite different from insuring against damages incurred by households or firms, as Governments are believed to be able to socialize risk through levying taxes. Although insurance of public assets is not widespread and is actually illegal in some developed countries, it can be an attractive option in small, low-income or highly exposed countries where fiscal capacity is weak, and publicly owned assets account for a large share of the capital stock, or where infrastructure risks are highly correlated (Linnerooth-Bayer and Mechler, 2007). While sovereign insurance instruments such as catastrophe bonds are becoming more widely used (see box III.5), the global market is relatively small, with total coverage having reached \$5 billion in 2003 (Guy Carpenter, 2006).

The availability of disaster insurance to households and firms varies greatly across hazard type: it is most common in the case of storm risk, where it is often bundled with home or business property insurance, but is much rarer in the case of earthquake risk and is virtually non-existent for other types of natural hazards. Moreover, although it is more widespread than insurance of public assets, its uptake on a global level has been rather low: only approximately 1 per cent of damages are covered this way in low-income countries, and even in high-income countries, coverage is less than one third.<sup>12</sup> While insufficiently developed financial markets and lack of appropriate regulatory frameworks have contributed to low insurance penetration in developing countries, households and businesses are often unable to afford commercial insurance, even if it is available, or may not consider disaster insurance a priority, or may simply not trust providers (Linnerooth-Bayer and Mechler, 2007; Syroka, 2007). Consequently, even in high-income countries, households and businesses must often rely extensively on public assistance to recover from the impact of disasters.<sup>13</sup>

Responding to the unwillingness of private insurers to fully underwrite these risks, several countries legislated State involvement in the insurance industry, which has often taken the form of public-private national insurance systems, with the State acting

The combination of catastrophic and covariant risks associated with many natural hazards makes market-based financial instruments, administratively difficult or prohibitively expensive

Insufficiently developed financial markets and lack of appropriate regulatory frameworks have contributed to low insurance penetration in developing countries

<sup>12</sup> In fact, insurance penetration varies greatly across regions: the average catastrophe insurance premium per person in Africa and Asia amounts to less than US\$ 5, approximately 1 per cent of the corresponding amount in the United States, parts of Europe and Australia. Moreover, there is virtually no coverage at all in a number of countries in Africa compared with a per capita premium in South Africa of \$160 (Munich Re, 2005; Swiss Re, 2007).

<sup>13</sup> Significant covariant risk implies that large reserves are required to avoid the threat of insolvency, which can threaten even well-capitalized and diversified insurance companies in developed-market economies, as has recently been the case following hurricane damage in the south-eastern United States. There is, for instance, evidence that insurance companies are not renewing insurance contracts in northern States in the United States owing to the effects of the 2005 hurricane season, although these States were not affected. Likewise, reinsurance premiums increased in Caribbean islands following the impact of Hurricane Andrew in Florida in 1992, although these islands had not suffered extensive damage. In response to perceived greater threats, some insurers in States of the United States have introduced percentage deductibles in lieu of dollar deductibles to limit exposure to catastrophic losses from natural disasters and mandatory deductibles for natural hazards in certain areas.

## Box III.5

### Pooling risks in different contexts: examples of innovative public and private insurance: Mexico and Malawi

In 2006, the Government of Mexico insured its catastrophe reserve fund, FONDEN (Fondo Nacional de Desastres Naturales), against major earthquakes with a mix of reinsurance and a catastrophe bond. The contract is linked to a parametric trigger in terms of magnitude and depth of seismicity for the three-year period 2007-2009 and aims at protecting three regions in Mexico considered to be at highest risk. It pays an interest spread of 230 basis points above the London Interbank Offered Rate (LIBOR) if an insurance claim is not triggered by an earthquake in one of the specified zones with specified magnitude and depth and if an official declaration of a disaster is made by a federal agency.

The Government of Mexico financed the transaction out of its own means, though it did receive technical assistance from the World Bank and the Inter-American Development Bank. Costs for the catastrophe bond transaction, however, were about 2 per cent of cover, approximately twice those usually associated with traditional reinsurance (Lane, 2004). Reduction of costs by substituting outside consultancy firms with internal expertise in estimating risks appears to be a feasible course of action in the future. In Turkey (another earthquake-prone country), for example, universities are developing their capacity to carry out sophisticated catastrophe modelling as a basis for risk assessments.

The potential market for catastrophe bonds is large, as the lack of risk correlation between catastrophe bonds and financial markets makes these instruments particularly interesting for investors. However, as with other hazard-indexed instruments, the major disadvantage is basis risk, which is the lack of correlation of the trigger with the loss incurred. Moreover, there is no guarantee that post-disaster bond payments will reach those most in need.

While the catastrophe insurance in Mexico is publicly financed, a private sector approach has been taken in Malawi, which is one of the more drought-prone countries in the Southern African region. In 2004-2005, the country experienced a devastating drought, throwing 40 per cent of the smallholder population into a dependence on food aid. In fact, although 20 per cent of the country's area is covered by water (Lake Malawi), food insecurity is chronic, particularly as most farmers have small holdings, ranging from 0.5 to 3 hectares.

Loan recovery rates ranged from 50-70 per cent that year; one bank, two micro-finance institutions and a Government- and donor-led agricultural lending programme stopped operating owing to drought-related defaults. In 2005, the Insurance Association of Malawi agreed to offer an index-based weather insurance policy, linked with credit supply, to small-scale farmers. One of the groups interested in testing this approach was the National Smallholder Farmers' Association of Malawi. Groundnut was chosen for the pilot, as the crop is relatively drought-sensitive and as farmers have been reluctant to invest in adopting new varieties because of the high costs of seed.

In accordance with the policy, the farmer enters into a loan agreement with a higher interest rate that includes the weather insurance premium, which the bank pays to the insurer, the Insurance Association of Malawi. The insurance payments are index-based, depending on precipitation measured at one of three weather stations within the region of the pilot programme.

Depending on location, premiums amounted to 6-10 per cent of the insured cost-of-seed values, an amount easily repayable from the increased productivity of the seeds (estimated at about 500 per cent). In the event of a severe drought, the borrower pays a fraction of the loan and the rest is paid by the insurer directly to the bank. The fact that the farmer is less likely to default has a stabilizing effect on the bank's portfolio and risk profile. Without this assurance, banks rarely loan to high-risk, low-income farmers. The advantage for the farmers is that they obtain needed credit to invest in the seeds and other inputs necessary for higher-yield crops.

A survey of 168 farmers participating in the 2005-2006 pilot programme provides reason for both optimism and caution in respect of this scenario. Although the sample was not fully representative (owing to exclusion of defaulting participants), the responses were indicative of farmers' perceptions about the weather insurance scheme. The results showed that, although almost all participating farmers had reported that they would join the scheme if offered the opportunity again, only 55 per cent of respondents reported having understood the scheme before joining it. In addition, over one quarter of respondents did not consider the rainfall measurements from the local stations to be trustworthy.

Source: Linnerooth-Bayer and Mechler (2007).

as the provider of last resort, as in Japan's earthquake programme and national flood insurance in the United States.<sup>14</sup> In many low-income countries, microfinance institutions are taking a more prominent role in providing disaster insurance programmes, often with donor encouragement and support.

Although other types of micro-insurance do exist (see chap. V), the primary focus of microfinance institutions dealing with natural hazards has been on agriculture and crop insurance designed to respond to the threat of food insecurity and the inability to cope with the consequences of destroyed crops, reduced yields and decimated livestock herds. This is particularly relevant when the livelihoods of large proportions of the population are based on subsistence farming and nomadic herding activities.

Global insurance of agriculture is small and skewed

There has, in fact, been a long and well-documented experience with crop insurance products in general. However, the global market remains relatively small, with the total global insurance premiums of agricultural insurance programmes having amounted to approximately \$8 billion in 2006, a mere 0.5 per cent of total value added in agriculture. Moreover, crop insurance is highly skewed, with the North American market accounting for over two thirds of that total (see table III.6).<sup>15</sup> The African continent, excluding South Africa, accounts approximately for less than 1 per cent of total premium payments, despite the fact that it accounts for approximately 13 per cent of global agricultural GDP.

The traditional crop insurance products are *named peril* and *multiple peril* insurance: the former covers particular hazards and in the case of hail, for example, has been available in North America and Europe for over 100 years. The latter establishes an insured yield as a percentage of the historical average yield and, in the event of disaster, pays an indemnity proportional to the difference between the two.<sup>16</sup> However, the high information content and high administering and running costs associated with these schemes have contributed to the large subsidies provided in many developed economies.<sup>17</sup> To avoid expensive verification of claims at the individual-farm level, several countries are piloting *index-based* or parametric schemes where payouts are contingent on an easily verifiable, objective physical trigger which is usually related to weather, such as rainfall measured at a regional weather station (see box III.5).<sup>18</sup>

The current structure of index-based insurance schemes, and their essentially pilot status, raises questions, however, as to their resilience with respect to large-scale

<sup>14</sup> Japan's earthquake programme, for instance, is backed by Government reinsurance and taxpayers. Similarly, the Government of the United States serves as the primary insurer in the United States National Flood Insurance Program (NFIP). In France, catastrophe insurance is offered as part of an all-hazards policy bundled with property insurance.

<sup>15</sup> Table III.6 lists the 10 largest programmes in the world by agricultural premium for risk that is transferred to the international reinsurance market. It does not take Government-retained risk into account.

<sup>16</sup> Such schemes are the basis for most federal crop insurance programmes in the United States, and most Provinces of Canada, and also exist, for instance, in Italy, Spain, Portugal, Austria, Brazil and Japan.

<sup>17</sup> To reduce the cost to farmers of purchasing such insurance, significant subsidies exist. For instance, the United States Federal Government subsidizes approximately 70 per cent of the total cost of the federal crop insurance programmes, costing taxpayers \$3 billion per year.

<sup>18</sup> Other indices, however, are equally possible. In Mongolia, livelihoods of nearly half the population depend on livestock farming. This has given rise to an index-based livestock insurance scheme where the trigger is based on the overall mortality rate of adult animals in a given county, which has enabled herders to protect themselves against livelihood losses from extreme weather conditions, such as a harsh winter (*dzud*) (Mahul and Skees, 2007).

Table III.6  
Estimated agricultural insurance premium payments, top 10 countries

Country	Estimated insurance premiums	
	Millions of United States dollars	Percentage of global total
United States of America	4 600	57.5
Canada	900	11.3
Spain	550	8.9
Italy	350	4.4
France	300	3.8
Germany	200	2.5
South Africa	100	1.3
Australia/New Zealand	100	1.3
China	80	1
Republic of Korea	60	0.8
Total	7 240	90.5 <sup>a</sup>

Source: Carpenter (2006).

<sup>a</sup> Discrepancy due to rounding.

impacts in the face of major catastrophic events, as well as the extent to which they can be relied upon to reduce farmers' insecurity.<sup>19</sup>

The benefits of providing access to insurance against the threat of disasters are clear: indemnification against damages encourages investment, contributes to income growth and reduces income insecurity. However, high costs limit the reach of insurance, particularly in the case of poorer countries and communities. Also, serious questions have been raised regarding the likelihood of keeping disaster insurance schemes solvent, given the catastrophic and covariant nature of the risks involved (see note 13 above). Consequently, the role of the insurance types discussed may be more relevant to smaller-scale disasters. Moreover, competent regulatory bodies are needed to monitor conditions for both insurers and clients and ensure that the market provides sustainable insurance contracts. In this respect, it is worth remembering that deeper financial markets are as much a consequence as a cause of sustained economic development. Therefore, pooling risks against disaster through financial markets cannot be the only pillar of an effective coping mechanism.

Serious questions have been raised regarding the likelihood of keeping disaster insurance schemes solvent, given the catastrophic and covariant nature of the risks involved

## Multilateral initiatives for disaster relief and prevention

The international community has intensified its efforts towards reducing the adverse effects of natural hazards and man-made disasters. Building on the 1994 Yokohama Strategy for

Focus is moving from relief and emergency action to increasing resilience

<sup>19</sup> As triggers are essentially one-dimensional, for example, based only upon rainfall, insured crops must be highly correlated with the object underlying the index. Otherwise, the lack of correlation of the trigger with the loss incurred (*basis risk*) is high. Some crops may therefore need a more broad-based index. Moreover, constructing a weather index requires consistent historical records of daily weather data, ideally covering at least 25-30 years, as well as historical production and yield data. Data in few countries are likely to meet these requirements. Finally, coverage of many piloted index-based schemes reduces the financial impact of hazards only by paying off insured farmers' loan obligations, rather than by paying direct indemnification to farmers. They therefore do not provide greater income security per se or address the plight of the agriculture sector when crops are wiped out.

a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action<sup>20</sup> and as a follow-up to the International Decade for Natural Disaster Reduction, the International Strategy for Disaster Reduction has promoted public awareness and commitment, expanded networks and partnerships, and improved knowledge of causes of disaster and options for risk reduction. The international community has thus been moving away from a relief and emergency action approach towards a broader strategy for increasing resilience of vulnerable populations and countries which includes prevention and preparedness as well as a focus on medium-term recovery and mitigation mechanisms.<sup>21</sup> The key objectives of the United Nations Millennium Declaration of 8 September 2000<sup>22</sup> form an important pillar of strengthening resilience with respect to hazards by reducing vulnerability on a general level.

However, there is still a long way to go. Indeed, as noted earlier, only a tiny fraction of international funding is directed towards strengthening resilience against hazards through investments in disaster resilience and adaptation, and in planning. Moreover, the large proportions of funding mobilized in response to disasters that are directed towards providing basic essentials such as food and health highlight the reactive nature of these responses.<sup>23</sup>

Climate change is sharpening socio-economic vulnerabilities of already fragile populations and countries such as those in sub-Saharan Africa and small island developing States, while testing the coping mechanisms of other previously less vulnerable groups (United Nations Development Programme, 2007; Intergovernmental Panel on Climate Change (IPCC), 2007). For example, increased adverse effects of droughts and floods threaten to be long-lasting and adversely affect biodiversity and human settlements. Multilateral programmes have been created to support these countries. For instance, the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa,<sup>24</sup> adopted in 1994, and the Programme of Action for the Least Developed Countries for the Decade 2001-2010,<sup>25</sup> adopted in 2001 by the Third United Nations Conference on the Least Developed Countries, call for greater priority to be given to substantive programmes and related institutional arrangements. Similarly, in 2005, the International Meeting to Review the Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States called for increased commitments to reduce the vulnerability of small island developing States due to their limited capacity to respond to and recover from disasters.

Further international cooperation for sharing information, raising awareness and building capacities, however, is still needed. In particular, as suggested by the Plan of Implementation of the World Summit on Sustainable Development (“Johannesburg Plan of Implementation”),<sup>26</sup> actions for an integrated approach to address vulnerability, disaster risk management and mitigation as “an essential element of a safer world in the

Climate change is sharpening vulnerabilities of fragile populations

<sup>20</sup> A/CONF. 172/9, chap. I, resolution 1, annex I.

<sup>21</sup> The Agenda for Humanitarian Action adopted by the International Conference of the Red Cross and Red Crescent in December 2003 includes, for instance, goals and actions aimed at reducing the risk and impact of disasters and improving preparedness and response mechanisms.

<sup>22</sup> See General Assembly resolution 55/2.

<sup>23</sup> In 2006, for instance, more than 55 per cent of funding of appeals was directed to food (United Nations, Office for the Coordination of Humanitarian Affairs, 2008).

<sup>24</sup> United Nations, Treaty Series, vol. 1954, No. 33480.

<sup>25</sup> A/CONF. 191/13, chap. II.

<sup>26</sup> *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations Publications, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex.

twenty-first century” (para. 37) are needed. The General Assembly has echoed this call and encouraged the Intergovernmental Panel on Climate Change to continue to assess the adverse effects of climate change on the socio-economic and disaster reduction systems of developing countries.

These above-mentioned initiatives provide necessary, albeit essentially normative frameworks at the broader institutional level. However, they need to be translated into specific actions at national and regional levels to reduce the vulnerability to disasters and yield tangible outcomes.

In this respect, greater attention is being placed by donors and national Governments on specific programmes to reduce income insecurity. Cash transfer programmes have formed an important component of these efforts: they have, for instance, been introduced in several developing countries to reduce poverty among older persons and the poor (United Nations, 2007a). These developments are also affecting the international community’s response to disasters.

Greater attention is being placed by donors and national Governments on specific programmes to reduce income insecurity

## Cash transfers

The principal response to dealing with the impact of disasters has in general focused on the provision of goods and services, particularly in developing economies. This has included supply of food, subsidized loans, work-for-cash and work-for-food programmes and other cash-similar tools such as vouchers, direct food and housing support.<sup>27</sup> Providing support by granting direct cash handouts has traditionally been shunned, however, by international donors and national politicians.

Nevertheless, there is growing evidence that, in the medium term, cash transfers to affected households may be preferable to in-kind support, and interest is growing in this respect among international development agencies, bilateral donors, non-governmental organizations and national Governments. Commodity-based aid is likely to remain the primary response in dealing with the immediate aftermath of a disaster so as to ensure that basic commodities are available. However, cash-based transfers constitute a viable alternative to in-kind aid once the local capacity for providing basic goods and services has been restored: as households are more likely to know their most urgent needs, providing a cash transfer enables them to purchase the goods and services most needed. This contributes to greater aid effectiveness. In addition, evidence suggests that cash transfers can be less expensive to administer than in-kind handouts (such as food aid) (Barrett, Holden and Clay, 2001), and thus increase the efficiency of aid. They also offer a faster and more transparent mode of delivering support (Standing, 2007) and are better able to sustain recovery, since there is one portion that is invested rather than consumed and because more is spent on goods and services produced locally (Department for International Development, 2005).

Cash transfers may be preferable to in-kind support

Recent examples of the use of large cash transfer schemes to respond to the aftermath of disasters have been provided by Maldives and Sri Lanka (in response to the 2004 tsunami), by Pakistan (in response to the 2005 earthquake in Pakistan-administered Kashmir) and by Turkey (in response to the 1999 Izmit earthquake). In each case, payment was conditional on the impact of the disaster, involving determining whether, for example, household members were injured or killed in Pakistan or whether houses were damaged or destroyed in Maldives, and so on. Transfers per individual were equivalent to

<sup>27</sup> For instance, officially designating an event a disaster has significant implications in the United States, as a wide range of the above-mentioned forms of assistance are then made available to the affected area. Up to \$25,000 in federal assistance can be provided to individuals and households (Federal Emergency Management Agency (FEMA), 2007, p. 44).

approximately 2.9 per cent of annual GDP per capita in Sri Lanka, and ranged between 1.5 and 4.5 per cent of annual GDP per capita in Maldives, and between 3.4 and 8.6 per cent of annual GDP per capita in Turkey. Owing mainly to generous compensation for deaths and injury, payments were considerably more generous in Pakistan, reaching up to 48.3 per cent of annual GDP per capita (Heltberg, 2007). Other successful schemes have been employed in response to drought in Ethiopia and floods in Mozambique (see chap. V).

### International pooling initiatives

Individual countries have difficulty managing disaster risk with their own resources

The ability of a single country to manage disaster risk is often limited by serious resource constraints. Accordingly, international institutions, including at the regional level, have an important role to play, as they are often better able to employ pooling strategies, realize synergies and hence cope with covariant risk.

Seeking formal mechanisms for transferring risks is one option for donors and international organizations. Incurring an annual payment to address financial risk rather than responding to irregular and unpredictably large requests for post-disaster aid can enable donors to leverage their commitments. The Turkish Catastrophe Insurance Pool, launched in 2000, represented the first such pool of its kind to tackle the problem of insurance affordability in a middle-income developing country. Within the Turkish Catastrophe Insurance Pool, earthquake insurance is obligatory for all property owners in Istanbul and other urban centres at high seismic risk (poorer property owners in rural areas are therefore excluded). While premiums are based upon risk, they are made more affordable owing to a contingent loan facility with favourable conditions provided by the World Bank.

In a similar vein, several members of the Caribbean Community (CARICOM) established in 2007 the Caribbean Catastrophe Risk Insurance Facility (CCRIF) under the auspices of the World Bank. This is in fact the first multi-country catastrophe insurance pool and is intended as a pilot for other regions. The objective of the facility is to pool risks relating to natural hazards and hence provide a mechanism through which to assist affected members in absorbing the adverse impact of disasters. To do so, the programme provides budgetary support by bearing up to 20 per cent of estimated government losses resulting from earthquakes and hurricanes.<sup>28</sup> The need for such a mechanism is particularly acute for Caribbean countries, as they are prone to various types of natural hazards (see box III.2) and as the impact of those hazards often exceeds an individual country's ability to deal with them exclusively through its own means. In its first year, the Facility was able to secure \$110 million of total coverage. While the Facility itself retains responsibility for the first layer of claims (approximately \$10 million), the remaining \$100 million are transferred to international markets through reinsurance as well as a catastrophe swap provided by the World Bank.

Transferring the responsibility for estimating losses to the Caribbean Catastrophe Risk Insurance Facility eliminates the risk of losses' being overstated so as to obtain higher payouts. However, as estimates of losses are based upon a hazard index and on predetermined models of damages that vary with wind speed, basis risk remains a major concern of the Facility.

<sup>28</sup> These include damages to government buildings and infrastructure, estimated losses in tax revenue and government relief expenditures. Claims are contingent on a trigger depending on an index for hurricanes (wind speed) and earthquakes (ground shaking) and payments are provided immediately in the event of a disaster. Annual contributions to the facility range between \$200,000 and \$4 million, depending on the size of the country. Payouts are available up to a predetermined limit: Jamaica has the highest premium (\$4 million) and the highest coverage (\$95 million), of which \$50 million relates to hurricanes. To jump-start the reserve fund, the Governments of Bermuda, Canada, France and the United Kingdom of Great Britain and Northern Ireland, as well as the Caribbean Development Bank and the World Bank, have pledged a total of US\$ 47 million.

An action that could be quickly implemented by the international community to assist countries affected by disasters would be to introduce a simple mechanism for extending a moratorium on debt servicing. Debt relief has occasionally been offered to countries affected by disasters: for instance, the Paris Club offered debt relief to a number of countries affected by the 2004 Indian Ocean tsunami; the deferred payments were to be repaid over five years, with a one-year grace period.

Such a simple mechanism must be one that is not dependent upon an International Monetary Fund (IMF) programme to avoid new conditionality. Rather, a meeting of all creditors should be coordinated to carry out the process in a single operation rather than through bilateral agreements with all Paris Club and non-Paris Club creditors (Schneider, 2008). Moreover, the mechanism would need to waive interest payments for the period of emergency in order to prevent both a bunching of repayments and future rescheduling and borrowing in order to meet repayment obligations. In doing so, such a mechanism would enable affected countries to address their domestic needs related to reconstruction and rehabilitation in a timelier manner. Through the easing of the revenue constraint, the need to divert previously earmarked budgets to accomplish these tasks decreases. This would also enable the Government to protect spending, for example, on education, health and water and sanitation, that benefits the poor in particular. Moreover, introducing such a procedure would remove the political considerations that arise in the process of disbursing funds and reduce the time lags in obtaining these funds, as well as eliminate the negative signals that acceptance of ad hoc offers could send to markets.<sup>29</sup> This mechanism might indeed benefit heavily indebted poor countries with significant debt servicing; on the other hand, countries with lower debt-servicing commitments would be less affected.

### A global disaster mechanism

The international community, through both public and private organizations, is often quick to respond to emergency calls following large-scale disasters. However, there has been a persistent tendency for pledges to fall short of delivery, while funds requested by the United Nations for disasters have consistently failed to reach the desired level: for instance, in 2007 only 72 per cent of requested funds through consolidated and flash appeals materialized, leaving a shortfall of \$1.4 billion (United Nations, Office for the Coordination of Humanitarian Affairs, 2008). In addition, the fact that funds for such appeals frequently come from existing budgets results only in a reallocation of existing resources. This financial uncertainty hampers disaster relief planning. Moreover, the scale and direction of international disaster relief aid appear to be heavily influenced by economic and geopolitical interests, including colonial ties and geographical proximity, and by biases in news coverage. The consequences are significant. According to one estimate, such biases may have reduced the flow of funds to disasters in Asia by over one third, to disasters in Africa by over one fifth and to disasters in South America by more than one sixth (Strömberg 2007, p. 220). Moreover, the tied nature of such aid and the conditionalities attached to it remain a significant obstacle to its effectiveness.

Financing a more integrated approach to disaster management is likely to be best undertaken through a *global disaster mechanism*. This could begin with a move to consolidate the current existing approaches to financing disaster emergencies. A proposal for a \$4 billion-\$5 billion fund was put forth in 2006 by the then Chancellor of the

A moratorium on debt servicing could assist countries affected by disasters

Pledges of funds often fall short of delivery

A global disaster mechanism is needed

<sup>29</sup> In fact, Thailand did not sign up for the moratorium offered by the Paris Club: the potential spillover effect on the country's credit ratings may have been an underlying reason.

Exchequer of the United Kingdom, Gordon Brown, as part of a wider plan to “make poverty history” (Brown, 2006). However, until very recently, this plan had not moved beyond the conception stage.

Several compensatory financing facilities were proposed in the recent past. Most were too small, however, to be really effective. For instance, an ACP-EU Natural Disaster Facility has been created to strengthen disaster risk reduction and management as well as improve disaster preparedness, mitigation and post-disaster rehabilitation in African, Caribbean and Pacific (ACP) States. The 12 million euros of seed capital provided by the European Development Fund falls short, however, of the funding called for, amounting to at least 250 million euros, to assist ACP States (ACP-EU Joint Parliamentary Assembly, 2007). Similarly, the Inter-American Development Bank has an Emergency Reconstruction Facility which can provide loans of up to \$30 million to assist members affected by disasters. It also has a Disaster Prevention Fund which provides grants for disaster risk management activities; the maximum grant for individual projects is limited, however, to US\$ 1 million.

A Global Facility for Disaster Reduction and Recovery has been set up under the International Strategy for Disaster Reduction to develop and implement the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters<sup>30</sup> through coordinated programmes designed to reverse the trend in disaster losses by 2015. As reducing vulnerability is its core objective, the Global Facility seeks to provide technical and financial resources for disaster risk research with an annual budget of \$5 million. It also aims at incorporating disaster risks into development strategies through, for example, risk management, research and establishing recovery financing mechanisms with an estimated \$350 million for a 10-year period. It further aims to provide fast and reliable financing for recovery, primarily to low-income high-risk countries through a Standby Recovery Financing Facility.

The World Bank has most recently introduced a Catastrophe Risk Deferred Drawdown Option (CAT DDO) facility (World Bank, 2008a). Targeted at low-income countries affected by disasters, this facility provides rapid access to funds. Disbursements, however, take the form of loans and although they can reach up to \$500 million, they are limited to a maximum of 0.25 per cent of the country’s GDP.

Financing must be quick and automatic

These examples of multilateral facilities serve to highlight the importance that vulnerability to disasters is beginning to receive. However, considering the magnitude of the damages that disasters can cause, measured either in nominal terms or in relation to GDP (as outlined above), it is clear that any multilateral facility must be well funded so as to provide *sufficient* financing *quickly* and *automatically*. Existing facilities fail to pass this acid test. Creating a *global disaster mechanism*, possibly under the auspices of the United Nations, could bring together and scale up in a more holistic manner the existing fragmented resources available for large-scale disaster relief. While the details would need to be worked out, the proposed global disaster mechanism could be set up under the following guiding principles.

Access to the global disaster mechanism would be linked to predetermined triggers so as to remove the distortions associated with the current practices of disbursing relief. More specifically, as the aim of the facility would be to provide financing for countries significantly affected by disasters, the following three proxy variables are proposed to measure the impact of the disaster and identify disasters that would qualify for access to the facility:

30 A/CONF. 206/6 and Corr. 1, chap. I, resolution 2.

- (a) The total population affected as a percentage of the country's total population, to capture the scope of the disaster;
- (b) The resulting damages expressed as a percentage of the country's total public revenue, to highlight the potential strain on public resources;
- (c) The resulting damages as a percentage of the country's total GDP, to highlight the economic scale of the impact.

To assist in reconstruction and recovery, the mechanism should disburse to affected countries an amount equivalent to 25 per cent of damages caused. Any disaster meeting one of the following conditions would trigger eligibility with respect to the mechanism:

- (a) It has affected 5 per cent or more of a country's population;
- (b) It has caused damages equal to 5 per cent or more of GDP;
- (c) It has caused damages that exceed 10 per cent of government revenue.

Using the global experience of disasters since the turn of the millennium, approximately one third of countries experiencing a disaster during the period 2000-2006 would have been eligible if the mechanism had been in place. Moreover, the selected thresholds would have implied average financing requirements for that period of \$2.5 billion per annum.

Funding for the global disaster mechanism should be based on assessed contributions with more developed countries contributing relatively more than less developed ones. This would spread the cost of the facility more equitably. Hence, while high-income non-OECD countries would pay a proportion of their GDP equal to 80 per cent of that paid by high-income OECD countries, upper middle income countries would pay a proportion of GDP equal to 75 per cent, and lower middle income countries would pay a proportion of a GDP equal to 50 per cent, of that of high-income OECD countries. Low-income countries would be exempted from contributing. Under such a financing scheme, high-income countries would have contributed less than 0.007 per cent of their GDP annual over the period 2000-2006. For the United States, this would have translated into an annual contribution equal to approximately \$800 million (\$2.7 per person), less than 3 per cent of its total official development assistance (ODA) provided in 2005. In contrast, a lower middle income country such as Guyana, which is also classified as a heavily indebted poor country, would have contributed on average \$27,000 per year to the facility (\$0.04 per person), yet would have been a net recipient of \$158 million over the total period 2000-2006 (net payments to such a proposed facility for low-income and lower middle income countries are given in table III.7).

Given what has been said about the links between relief, recovery and development in countries prone to disasters, this mechanism should, however, ultimately aim to assume a much larger role in financing ex ante investments in disaster planning and preparedness, including a range of services to assist in disaster recovery. Such services could include disseminating best practises and related capacity-building and monitoring environmental protection and regulatory standards to the extent that they related to the threat of disasters.

The global disaster mechanism should therefore eventually coordinate the delivery of funds, and could act as an umbrella mechanism for unifying existing mechanisms and responsibilities, such as those outlined above, with their respective institutions. In any case, the importance of such a mechanism would be to automatically provide predictable funds needed for reconstruction, risk mitigation and recovery from shocks.

This mechanism must ultimately aim at disaster planning and preparedness

**Table III.7**  
**Hypothetical net payments<sup>a</sup> of selected low-income and lower middle income countries and areas to the proposed global disaster mechanism for the period 2000-2006**

Millions of United States dollars			
Country or area	Net payments	Country or area	Net payments
<b>Low-income</b>			
Afghanistan	0.00	Viet Nam	-78.60
Lao People's Democratic Republic	-0.30	Mozambique	-119.50
Mongolia	-30.00	Myanmar	-130.00
Cambodia	-47.10	India	-284.70
Tajikistan	-50.50	Bangladesh	-666.70
Sudan	-60.90	Pakistan	-1 300.00
Madagascar	-69.10	Democratic People's Republic of Korea	-1 609.40
<b>Lower middle income</b>			
Indonesia	61.10	Lesotho	0.30
Colombia	27.00	Suriname	0.30
Egypt	22.10	Cape Verde	0.20
Ukraine	17.00	Bhutan	0.20
Peru	16.90	Djibouti	0.20
Morocco	11.60	Samoa	0.10
Iraq	7.80	Vanuatu	0.10
Ecuador	7.40	Micronesia, Federated States of	0.10
Dominican Republic	6.40	Marshall Islands	0.00
Tunisia	6.30	Kiribati	0.00
Belarus	6.10	Moldova	-12.20
Syrian Arab Republic	6.00	Tonga	-19.10
Angola	5.50	Azerbaijan	-30.00
Cameroon	3.70	Armenia	-35.00
Jordan	2.70	Thailand	-36.80
Bolivia	2.20	Maldives	-120.20
Bosnia and Herzegovina	2.10	Guyana	-158.30
Honduras	1.80	Georgia	-202.50
Albania	1.80	Guatemala	-239.80
Paraguay	1.50	Philippines	-243.80
Turkmenistan	1.40	Jamaica	-251.00
Namibia	1.30	Sri Lanka	-359.60
The former Yugoslav Republic of Macedonia	1.30	Cuba	-543.10
Congo	1.20	El Salvador	-617.80
Nicaragua	1.10	Iran (Islamic Republic of)	-1 073.40
West Bank and Gaza	0.80	Algeria	-1 674.00
Fiji	0.70	China	-5 590.40
Swaziland	0.60		

**Source:** UN/DESA, based on data from the OFDA/CRED International Disaster Database (EM-DAT) (available at [www.emdat.net](http://www.emdat.net)), Université Catholique de Louvain, Brussels.

**a** Insurance premium minus indemnization.

Any proper design of a global disaster mechanism would need to deal with several critical issues. For one, independent assessments of damages would be important to prevent overinflation of figures.<sup>31</sup> In this regard, and notwithstanding the availability of various methodologies for assessing damages, valuing damaged assets at replacement cost, including the cost of disaster mitigation and prevention to reduce vulnerability to future similar events, might be preferable (United Nations, Economic Commission for Latin America and the Caribbean, 2003), as it would automatically introduce an important disaster risk reduction component to the facility. This component could be strengthened by explicitly making the facility responsible for investment in disaster planning and mitigation (through, for example, earmarking a certain percentage of disbursements for mitigation). Moreover, through consolidation of existing resources, such as those listed above, and involvement of the insurance industry and international organizations, available funds could be greatly enhanced. Combining these financing responsibilities with various technical assistance and capacity-building responsibilities, as well as information gathering and monitoring, would enable countries to reduce their vulnerabilities to natural hazards and would reinforce the public-good dimension of the global disaster fund. Sufficiently well funded, such a facility could also go a long way towards increasing the likelihood of sustained recovery from large-scale events. However, to eliminate problems of adverse selection, participation of countries would have to be as wide as possible. Pooling risks across *all* countries would contribute to increased financial sustainability of the facility as well as highlight the collective challenge associated with climatic shocks.

## Dealing with disasters

Natural hazards are not preventable, and the risks surrounding them are intrinsically difficult to manage. However, this cannot be said of the damage and insecurity that they can cause. Rather, the threat to economic insecurity from disasters is the result of compounded socio-economic vulnerabilities which expose particular communities and countries to this danger.

High priority must be given to disaster risk reduction in the design and implementation of national development strategies. One of the principal components of disaster risk reduction must be increased investment in hazard-mitigation measures. Moreover, vulnerability assessments will play an important role in identifying risks and those groups that are the most vulnerable in order that concrete policies may be designed.

The development dimension of disasters underlines the need, however, for a more integrated approach which combines development and risk management. Countries that are vulnerable to disasters must therefore not only be given sufficient policy space within which to design the appropriate integrated development strategies but also have access to adequate funding. For many countries, a fundamental challenge remains, namely, how to mobilize funds and resources for *ex ante* disaster mitigation in an environment where financial resources are already scarce. Regional and international cooperation will likely be critical in providing such resources. Cooperation ahead of time is also needed for designing policies and procedures for information exchange, strengthening linkages

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<sup>31</sup> The United Nations has undertaken numerous independent disaster assessments, involving national and international experts, since the early 1970s, mainly in the Latin American and Caribbean region but, more recently, also on a more global basis (see United Nations, Economic Commission for Latin America and the Caribbean, 2007b, and United Nations Development Programme, 2007).

between scientific and technical institutions, and building mutual understanding among national disaster agencies.

There are a number of strategies available to households, communities and Governments for dealing with the threat that disasters pose to economic insecurity. These strategies will differ, however, according to development level and can comprise market- as well as non-market-based approaches. For instance, non-market strategies designed to strengthen coping capacities of households and communities *ex ante* may involve voluntary mutual arrangements. In more developed economies, relevant market-based arrangements are likely to involve property and life insurance, while in developing economies, crop and livestock insurance may be more relevant. In developed economies, at the national level, taxation may be the implicit form of insurance, while for less developed countries, formal insurance through, for example, catastrophe bonds, or in fact reliance on aid, may be the only feasible alternative.

In this regard, there is a role for pooling individual, or national risk through financial markets. Its potential, however, should not be overstated. For one, risk transfer in the form of public and/or private insurance through market-based strategies is often a real option only at higher levels of development. While high- and middle-income countries have more degrees of freedom for including insurance programmes as part of a set of mitigation tools for disaster risk reduction, insurance is less relevant to countries with underdeveloped financial sectors and in contexts of widespread income insecurity. Moreover, while non-market community-based strategies can quickly be exhausted even by small-scale localized disasters, the covariant nature of larger-scale disasters and the resulting impact can threaten even well-capitalized insurance markets. More formal mechanisms of pooling risks through (financial) markets are therefore unable to address the risks posed by large-scale catastrophic disasters.

Transferring the responsibility for sufficient protection against disasters to individuals by merely ensuring that risk transfer and risk pooling, such as insurance, are *available* can therefore not be the primary pillar for addressing the insecurity challenge. Rather, the main responsibility for strengthening economic security must lie with *Governments* and must focus on decreasing vulnerability by reducing economic and social risk to hazards *ex ante*.

This chapter has therefore proposed the creation of a global disaster mechanism as key to a more integrated approach to disaster management. The mechanism might begin by providing disaster relief but should quickly gear up to assume a wider set of responsibilities linked to disaster mitigation. Moreover, particularly in the light of climate change, the function of this facility should be perceived as encompassing more than a response to challenges in poorer countries. Recent experiences stand as a reminder that the threat to economic security from disasters is not one faced exclusively by the poorest countries. Indeed, more than one half of the world's population is now highly exposed to at least one natural hazard yearly and the impact of Hurricane Katrina in the United States in 2005 highlights not only the vulnerability of communities even in the richest parts of the world, but also the enormity of the challenge of repairing the damage to the social and economic fabric that such events can inflict. Indeed, to the extent that, as the Intergovernmental Panel on Climate Change has already suggested, the increased incidence of disasters is linked to man-made climate changes, finding more effective ways of managing climatic shocks, at both the national and international levels, would appear to be essential for ensuring a more secure future for everyone.