THE HUMAN COST OF NATURAL DISASTERS 2015

A global perspective

Centre for Research on the Epidemiology of Disasters
CRED

UCL Université catholique de Louvain

Institute of Health and Society (IRSS)

USAID FROM THE AMERICAN PEOPLE

UNISDR The United Nations Office for Disaster Risk Reduction

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Foreword

Over the last ten years, following the adoption by UN Member States of the Hyogo Framework for Action, the first compre-hensive global blueprint for disaster risk reduction, much progress has been made in disaster risk management. Efforts at raising awareness, promoting prevention, preparedness and mitigation have been stepped up around the world and some countries have had significant success in reducing mortality from weather-related disasters notably Cuba, Bangladesh, India and the Philippines.

What this 20-year review of disaster impacts reveals is that there is still much progress to be made on tackling the underlying drivers of risk such as poverty and more proximal factors. We need to have better understanding of the specific risks that link negative impacts to disaster events. Sound studies that provide such convincing evidence on ways in which disasters affect individuals, families and communities are badly needed.

This report helps frame the debate on disaster risk reduction in the Post-2015 Development Agenda. It also underlines that climate-related disasters have come to dominate the risk landscape to the point where they now account for more than 80% of all major internationally reported disasters.

As resources get tighter, objective evidence is needed to fine tune the focus of our investments in preparedness and mitigation. For this, we need sound and convincing data. We also need equally sound analyses. We need to know which disasters are priorities for which countries, who are most likely to be affected and why, are disasters losses really increasing and where.

More countries than ever before now have national disaster loss databases which, combined with the research and data collection expertise of insurance companies and organizations like CRED and its EMDAT database, means that policy-makers and decision-takers have a wealth of evidence on which to base investment decisions which will reduce existing levels of risk and avoid the creation of new risk.
Now, increasing attention is placed on improving the quality and the accuracy of data on the impact of the catastrophes. The next important step to be taken remains the development of appropriate methodology and technical guidelines to enable countries and region to collect and analyze their own data.

This is necessary to set meaningful, manageable and measurable targets for disaster risk reduction over the next decade.

Margareta Wahlstrom
Head of the UN Office for Disaster Risk Reduction,
Special Representative of the Secretary-General
for Disaster Risk Reduction

Debarati Guha-Sapir
Director of the Centre for Research
on the Epidemiology of Disasters (CRED)

Who we are

The Centre for Research on the Epidemiology of Disasters (CRED) was established in Brussels in 1973 at the School of Public Health of the Université catholique de Louvain as a non-profit-making institution. In 1980, CRED became a World Health Organization (WHO) collaboration centre as part of the Global Programme for Emergency Preparedness and Response. Since then CRED has increased its international network substantially and works closely with numerous United Nations agencies, inter-governmental and governmental institutions, non-governmental organizations (NGOs), research institutes and other universities.

Our goals

With a special focus on public health, epidemiology, structural and socio-economic issues, CRED promotes research, training, information dissemination and technical services in the field of international disaster and conflict health studies.

Our scope

CRED's activities focus on all emergencies with a major human impact. These include sudden, natural and technological disasters including hurricanes, earthquakes and industrial accidents as well as longer-term disasters and complex emergencies such as famines and armed conflicts. CRED focuses primarily on public health and sanitary aspects of mass disasters as well as socio-economic and developmental effects. Disasters preparedness, mitigation and prevention for vulnerable populations have also gained a higher profile within CRED's activities.

Our staff

The centre is headed by Professor Debarati Guha-Sapir. The multinational, multidisciplinary team includes experts in medicine and public health, geography, biostatistics, economics, informatics and database management, international relations and nutritional sciences. The working languages are English and French.

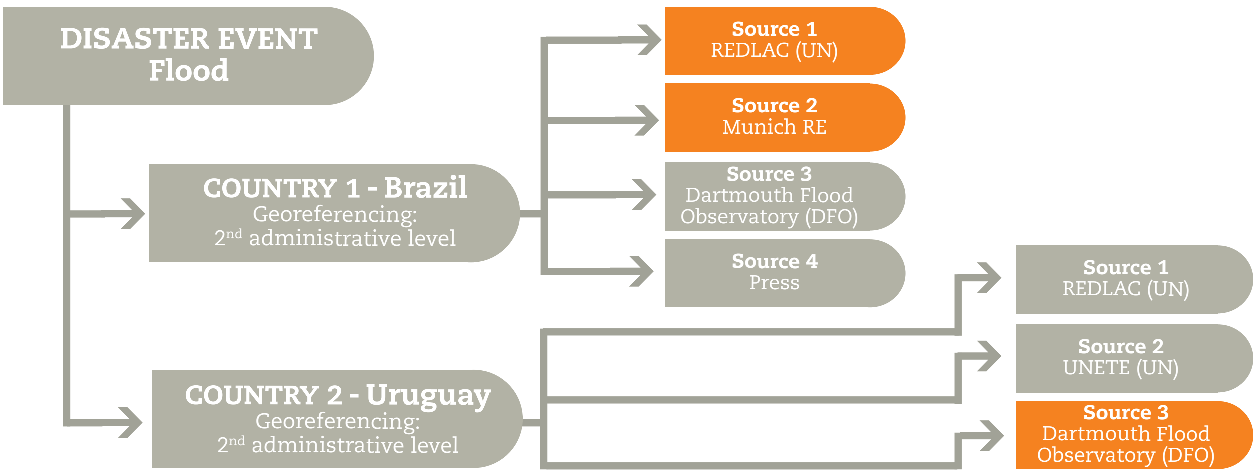
EM-DAT

Since 1988, CRED has maintained an Emergency Events Database (EM-DAT). Initially created with the support of the WHO and the Belgian government, the main objective of EM-DAT is to inform humanitarian action at the national and international levels in order to improve rational decision-making in disaster preparedness, provide objective data for assessing communities' vulnerability to disasters and to help policy-makers set priorities.
EM-DAT contains core data on the occurrence and effects of more than 21,000 technological and natural disasters from 1900 to the present day. It is compiled from various sources, including UN agencies, the US Office of Foreign Disaster Assistance (OFDA), national governments, the International Federation of Red Cross and Red Crescent Societies (IFRC), NGOs, insurance companies, research institutes and the media, according to a priority list.
The list does not reflect the quality or value of the data. Instead it recognizes that few reporting sources cover all disasters and some may have political limitations that could affect their figures.
Since 2014, EM-DAT also georeferences natural disasters, adding geographical values to numeric data which is essential for deeper analysis. The increasing value of georeferencing for disaster preparedness and response is discussed further in **Chapter 6** of this report.

Methodology

When a disaster occurs, related information is entered at three different levels (see below):

- The event/disaster level.
- The country/countries level (EM-DAT is currently developing a project to increase the precision of location of a disaster at the 2nd administrative level).
- The sources level (the chosen sources are shown in orange frames).



Sources /Partners

UN agencies	• IRIN (Integrated Regional Information Networks) • OCHA (Office for the Coordination of Humanitarian Affairs) • WFP (World Food Programme) • WHO (World Health Organization)
Governments	• Official country figures
US governmental sources	• NASA (National Aeronautics and Space Administration) • NOAA (National Oceanic and Atmospheric Administration • OFDA (Office of US Foreign Disaster Assistance) • USGS (United States Geological Survey)
Non-governmental institutions	• IFRC (International Federation of the Red Cross and Red Crescent)
Private sector	• AON Benfield • Lloyd Casualty Week magazine • Munich RE • Swiss RE
Research centres and academic sector	• DFO (Dartmouth Flood Observatory) • GVP (Global Volcanism Programme) • IRIS (Incorporated Research Institutions for Seismology)

Other Partners

UN agencies	• GRIP (Global Risk Identification Programme) • IRDR (Integrated Research on Disaster Risk) • UNDP (United Nations Development Programme) • UNISDR (Secretariat for the International Strategy for Disaster Reduction)
Government and multilateral agencies	• ADRC (Asian Disaster Reduction Centre) • European Union (Joint Research Centre, Humanitarian Aid and Civil Protection) • USAID (US Agency for International Development) • World Bank
Non-governmental institutions	• IDMC (International Displacement Monitoring Centre) • ODI (Overseas Development Institute)

Executive Summary

Between 1994 and 2013, EM-DAT recorded 6,873 natural disasters worldwide, which claimed 1.35 million lives or almost 68,000 lives on average each year. In addition, 218 million people were affected by natural disasters on average per annum during this 20-year period.

The frequency of geophysical disasters (earthquakes, tsunamis, volcanic eruptions and mass movements) remained broadly constant throughout this period, but a sustained rise in climate-related events (mainly floods and storms) pushed total occurrences significantly higher. Since 2000, EM-DAT recorded an average of 341 climate-related disasters per annum, up 44% from the 1994-2000 average and well over twice the level in 1980-1989.

From a disasters analysis point of view, population growth and patterns of economic development are more important than climate change or cyclical variations in weather when explaining this upward trend. Today, not only are more people in harm's way than there were 50 years ago, but building in flood plains, earthquakes zones and other high-risk areas has increased the likelihood that a routine natural hazard will become a major catastrophe.

EM-DAT data show that flooding caused the majority of disasters between 1994 and 2013, accounting for 43% of all recorded events and affecting nearly 2.5 billion people. Storms were the second most frequent type of disaster, killing more than 244,000 people and costing US$936 billion in recorded damage. This makes storms the most expensive type of disaster during the past two decades and the second most costly in terms of lives lost.

Earthquakes (including tsunamis) killed more people than all other types of disaster put together, claiming nearly 750,000 lives between 1994 and 2013. Tsunamis were the most deadly sub-type of earthquake, with an average of 79 deaths for every 1,000 people affected, compared to four deaths per 1,000 for ground movements. This makes tsunamis almost twenty times more deadly than ground movements.

Drought affected more than one billion people between 1994 and 2013, or 25% of the global total. This is despite the fact that droughts accounted for just 5% of disaster events in this period. Some 41% of drought disasters were in Africa, indicating that lower-income countries are still being overwhelmed by drought despite effective early warnings being in place.

In absolute numbers, the USA and China recorded the most disasters between 1994 and 2013, due mainly to their size, varied landmasses and high population densities. Among the continents, Asia bore the brunt of disasters, with 3.3 billion people affected in China and India alone. If data are standardized, however, to reflect the numbers of people affected per 100,000 head of population, then Eritrea and Mongolia were the worst-affected countries in the world. Haiti suffered the largest number of people killed both in absolute terms and relative to the size of its population due to the terrible toll of the 2010 earthquake.

While disasters have become more frequent during the past 20 years, the average number of people affected has fallen from one in 23 in 1994-2003 to one in 39 during 2004-2013. This is partly explained by population growth, but the numbers affected have also declined in absolute terms.

Death rates, on the other hand, increased over the same period, reaching an average of more than 99,700 deaths per year between 2004 and 2013. This partly reflects the huge loss of life in three megadisasters (the 2004 Asian tsunami, Cyclone Nargis in 2008 and the 2010 Haitian earthquake). However, the trend remains upward even when these three events are excluded from the statistics.

Analysis of EM-DAT data also shows how income levels impact on disaster death tolls. On average, more than three times as many people died per disaster in low-income countries (332 deaths) than in high-income nations (105 deaths). A similar pattern is evident when low- and lower-middle-income countries are grouped together and compared to high- and upper-middle-income countries. Taken together, higher-income countries experienced 56% of disasters but lost 32% of lives, while lower-income countries experienced 44% of disasters but suffered 68% of deaths. This demonstrates that levels of economic development, rather than exposure to hazards per se, are major determinants of mortality.

In CRED's view, EM-DAT data presented in this report point to several major conclusions:

- Rising death rates at a time when the numbers of people affected are falling highlights the continued vulnerability of communities to natural hazards. Given the accuracy of today's weather forecasting and developments in early warnings, our data raise questions about the effectiveness of global disaster mitigation efforts. We believe more work must be done to evaluate the real outcomes of disaster risk reduction (DRR) interventions on human lives and livelihoods.

- In view of the disproportionate burden of natural hazards in lower-income countries, including the huge disparity in death rates in richer and poorer countries, mitigation measures in less developed countries require significant improvement.

- Better flood control for poorer communities at high risk of recurrent flooding would be an important step in the right direction. Effective, low-cost solutions exist, including afforestation, floodplain zoning, building embankments, better warnings and restoration of wetlands. Such actions would bring development benefits too, since EM-DAT data show that flooding is the main cause of disaster damage to schools, hospitals and clinics etc. in lower-income countries.

- In light of predictions that climate change will increase the frequency of storms and other extreme weather events, better management, mitigation and deployment of storm warnings could save more lives in future.

- Reducing the size of drought-vulnerable populations should be a global priority over the next decade, given the effectiveness of early warnings and the vast numbers of people affected, particularly in Africa.

- Better research into how and why households and communities are affected by disasters is urgently needed so that responses are based on evidence, rather than assumptions. Without such micro-level research, future DRR and disaster prevention will not be effective.

Chapter 1

Global natural disasters: patterns & trends

Introduction

Between 1994 and 2013, an average of **218 million people** was affected by natural disasters every year, according to the EM-DAT database. Over this period, EM-DAT recorded **6,873 disasters**[1]**,** which claimed a total of **1.35 million lives,** an average of almost 68,000 deaths per year.

In order to be recorded as a natural disaster in EM-DAT, an event must meet at least one of the following criteria:

- Ten or more people reported killed
- 100 or more people reported affected
- Declaration of a state of emergency or
- Call for international assistance.

While EM-DAT is the most comprehensive disaster database available worldwide, and every effort is made to collect and validate information from our sources, we are aware that certain regions, including Africa, tend to under-report events.

ACTION POINT

More comprehensive data collection, following standardized protocols, would aid research into natural disasters, which in turn would improve the focus and quality of advice available to policy-makers and help target disaster preparedness and response measures more effectively.

[1] Excluding biological disasters

BOX 1

Definitions used in this report

Total deaths

Persons confirmed as dead and persons missing and presumed dead, excluding indirect deaths from diseases, epidemics and other effects which occur after the emergency phase of the disaster. Thus, for example, the majority of drought-related deaths are beyond the scope of this report because they are due to malnutrition, disease and displacement after the emergency phase of the event. In this report, the variable "total deaths" is used for all analyses.

Injured

People suffering physical injuries, trauma or an illness that requires medical treatment as a direct result of a disaster.

Homeless

People needing immediate assistance for shelter.

Affected

People requiring immediate assistance during a period of emergency, including displaced or evacuated people.

Total affected

Sum of injured, homeless and affected. In this report, the variable "total affected" is used for all analyses.

Displaced

People forced to leave their homes due to the damage or destruction of housing and other essential property & infrastructure by a natural disaster.

Mitigation

Any procedure or action undertaken to reduce the adverse impacts that a disaster may have on the human and built environment.

Global trends and patterns in disaster occurrence

Natural disasters hit every continent in the world in the period 1994-2013. Asia bore the brunt of them in terms of frequency and the total numbers of people killed and affected **(Figure 1 & Figure 2)**. This is due mainly to Asia's large and varied landmass - with multiple river basins, flood plains, mountains, active seismic and volcanic zones etc. at high risk from natural hazards - plus high population densities in disaster-prone regions.

In total, **Asia** was hit by 2,778 disasters over the 20-year period, with 3.8 billion people affected in addition to nearly 841,000 deaths. Within Asia, the Southern, Eastern and South-Eastern regions were hit most frequently by natural disasters, recording 2,481 events or 36% of all disasters recorded worldwide between 1994 and 2013.

In 2014, 48% of disasters occurred in Asia. Over 85% of those killed and 86% those affected globally were also in Asia.

In terms of countries, the USA and China reported the highest numbers of natural disasters during this period **(Figure 2)**. Again, this can be attributed to their large and heterogeneous landmasses and densely populated regions. These factors tend to push all big, heavily-populated states up the ranking of disaster-prone countries simply by virtue of their size and because so many people are in harm's way.

Natural disasters increased in frequency substantially in the 1990s before stabilizing, then declining from a peak in 2005. Overall, however, the number of disasters reported annually was significantly higher at the end of the period 1994-2013 than it was at the start.

The preliminary results for 2014[2] show that the number of disasters (246) was much lower than the annual average during the previous ten years (369 disasters in the period 2004-2013).

This increase in disaster frequency was largely due to a sustained rise in the number of **climate-related disasters** such as storms and floods **(Figure 3)**. EM-DAT recorded nearly 240 climate-related disasters per year before 2000, compared to 341 per year after that date, a 44% increase. While occurrences of climate-related disasters have declined from their peak in the last three years, they remain at more than double the levels recorded in 1980-1989 (an average of 140 climate-related disasters per year) and 50% higher than in 1994.

Meanwhile, the numbers of geophysical disasters (mainly earthquakes, tsunamis and volcanic eruptions) have remained more or less stable throughout the past 20 years.

[2] 2014 preliminary data exposed here are the one at the date of the 16th December 2014.

Figure 1

Number of disasters worldwide and by continent over the period 1994-2013

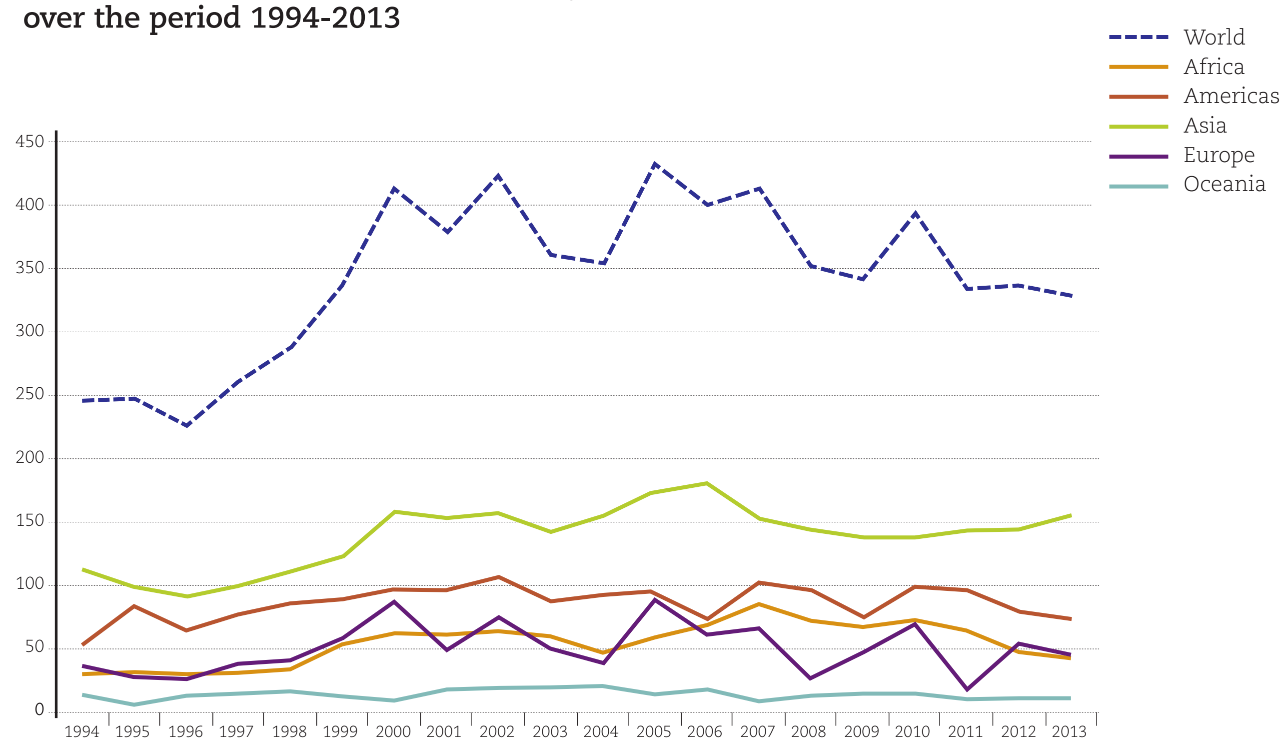
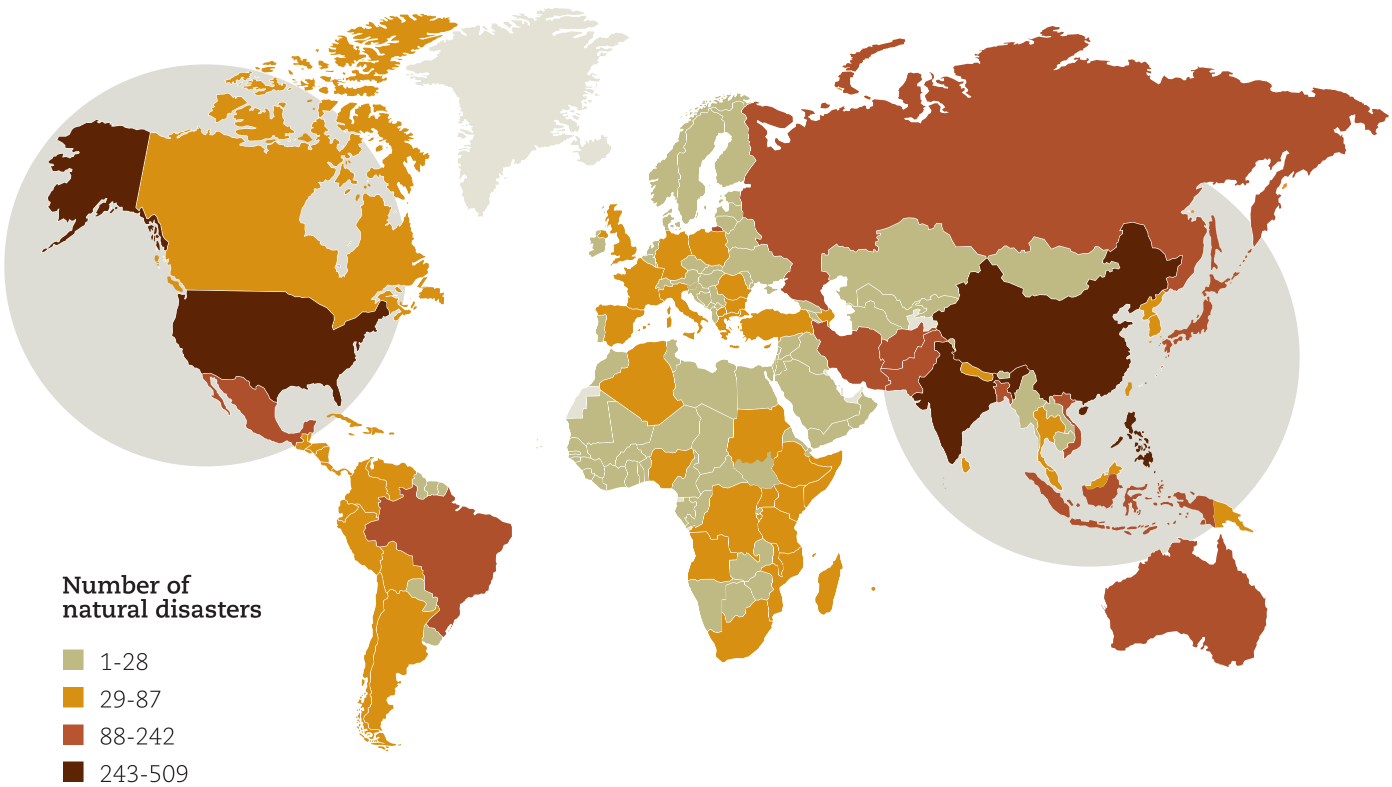


Figure 2

Number of disasters reported per country (1994-2013)



BOX 2

Hazards versus disasters

In this report, the term hazard refers to a severe or extreme event such as a flood, storm, earthquake, volcanic eruption etc. which occurs naturally in any part of the world. Natural hazards only become natural disasters when human lives are lost and livelihoods damaged or destroyed. EM-DAT does not record hazards that occur in unpopulated regions so this report, too, is exclusively concerned with natural events that impact on human populations.

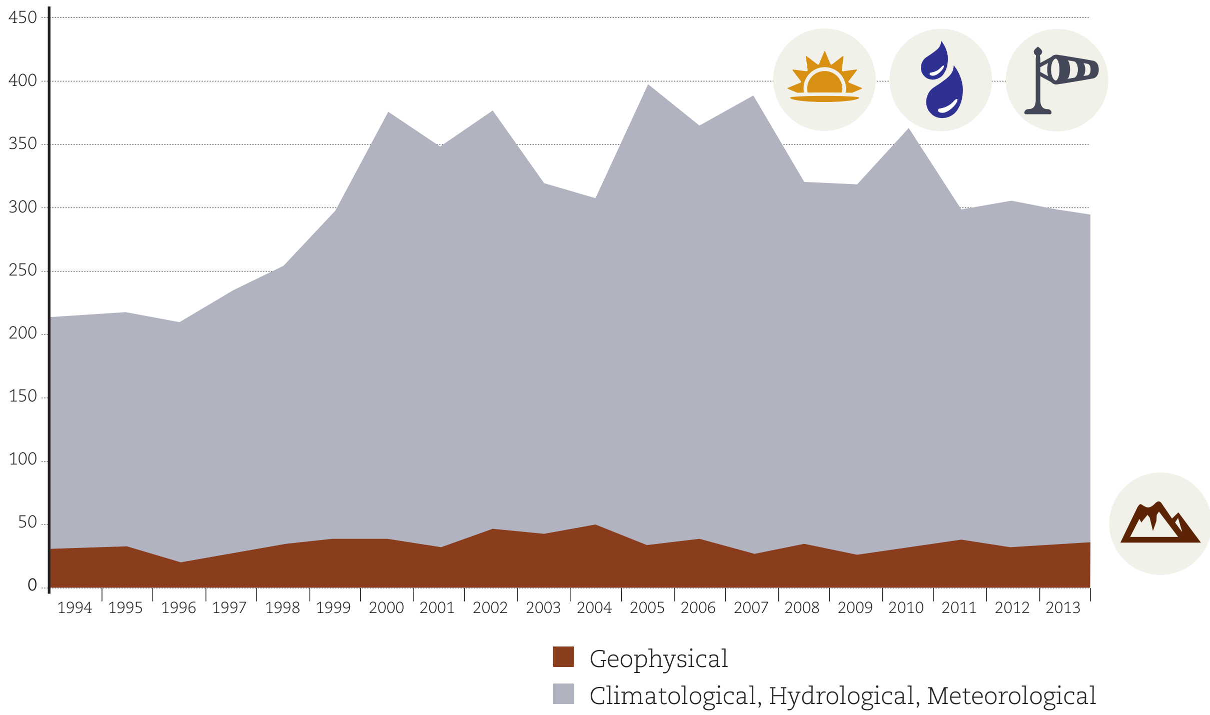
Changes in climate patterns (whether cyclic or human-induced) are among the major causes of more frequent climate-related events. From a DRR policy point of view, however, the weather is less important than **population growth and patterns of economic development.** Today, not only are more people in harm's way than there were 50 years ago, but development in earthquakes zones, flood plains and other high-risk areas has increased the likelihood that a routine hazard will become a major catastrophe.

ACTION POINT

While climate change is likely to maintain the upward global trend in natural disasters for the foreseeable future, the impacts on human populations can be mitigated. Better flood control is one "low-hanging fruit" in policy terms since affordable and effective technologies already exist such as dams, dykes, mobile dykes and better early warning systems.

Figure 3

Number of disasters by major category (climate-related & geophysical) (1994-2013)



Global trends in human impacts of natural disasters

The proportion of the global population **affected** by natural disasters has **declined** over the past two decades **(Figure 4)** from an average of one in every 23 people on the planet in the period 1994-2003 to one in 39 during 2004-2013. The affected total peaked in 2002, due mainly to drought in India, which hit 300 million people, and a sandstorm in China which affected 100 million of people.

While this overall decline is partly explained by a rising global population, the absolute numbers of people affected by natural disasters have also fallen, from an annual average of 260 million in 1994-2003 to 175 million per year in the period 2004-2013.

Preliminary EM-DAT data for 2014 show that even fewer than average people were affected by disasters worldwide last year (102 million in total), extending the declining trend in the numbers of people affected.

Average **death rates,** on the other hand, **increased** during the same 20-year period. The annual toll from natural disasters averaged more than 99,700 deaths per year between 2004 and 2013, compared to 68,000 deaths on average for the full 20-year period (1994-2013). This increase was due largely to the huge numbers of lives lost during three **megadisasters:** the 2004 Asian tsunami, Cyclone Nargis in 2008 and the 2010 Haitian earthquake. **But even excluding these megadisasters, death rates still increased over the past two decades, with an average of 41,000 people killed each year in the period 2004-2013, up from 35,000 in 1994-2003.**

Preliminary data for 2014 show there were fewer than 7,500 deaths from disasters last year, well below the annual average for the previous ten years (99,700) and also the lowest total for any year since 1986.

While last year's lower mortality figures are good news, the overall rise in average death tolls at a time when the total number of people affected is falling demonstrates the continued vulnerability of communities to natural hazards. It also implies that DRR programmes need to increase their effectiveness.

Given the development of early warning systems, and the accuracy of modern weather forecasting, these data suggest that more work should be undertaken to evaluate the efficiency and the real outcomes on human lives and livelihoods of DRR interventions.

ACTION POINT

More focused studies to understand exactly how residents interpret disaster warnings (and why they did not evacuate in time) will help reorient communication strategies for early warnings.

BOX 3
Points to bear in mind when interpreting historical trends in disaster occurrence

The volume and quality of data about natural disasters increased enormously after 1960 when the US's OFDA actively began to collect information about these events. The arrival of CRED in 1973 further improved data recording, while the development of global telecommunications and the media, plus increased humanitarian funding and reinforced international cooperation, also contributed to better reporting of disasters. Thus part of the apparent increase in the frequency of disasters in the past half-century is, no doubt, due to improved recording.

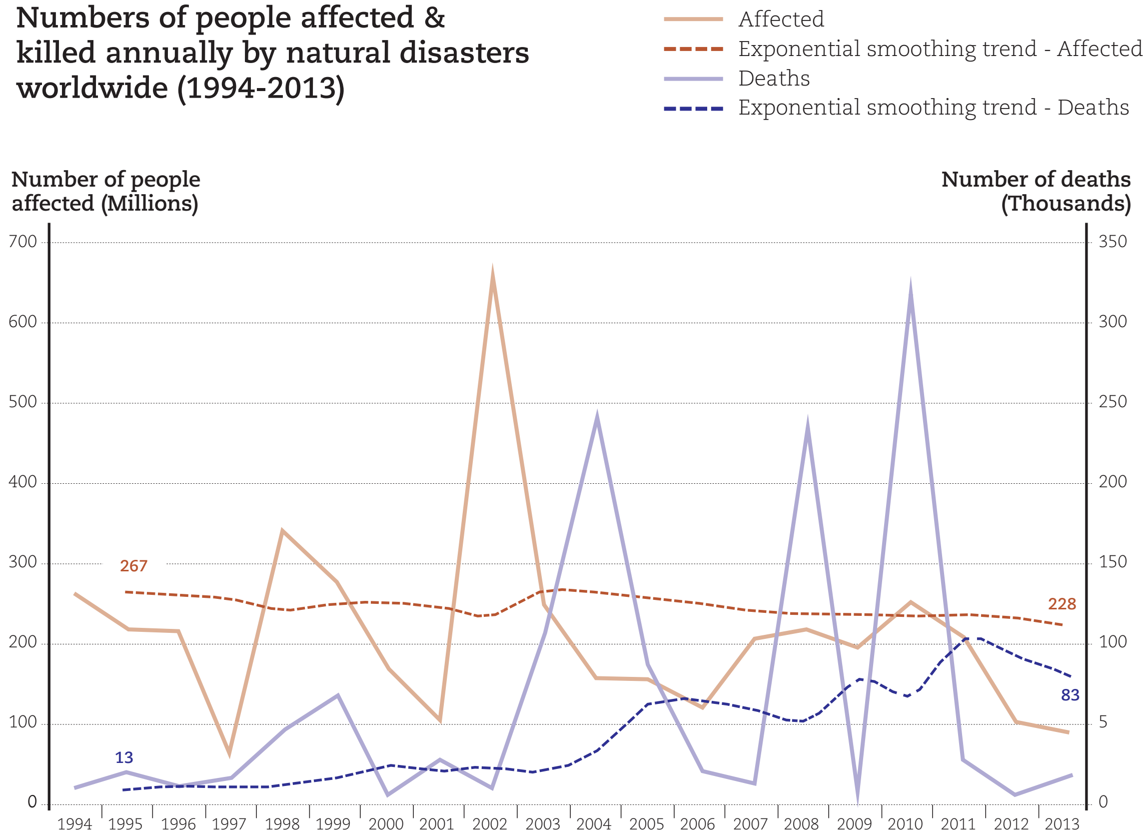
Of greater significance, however, is the rising number of people on the planet. Since disasters only occur when a natural hazard impacts on human beings, the total number of people in harm's way increases the chances of a disaster occurring. The growth of cities and other high-density communities accentuates this risk.

BOX 4
Megadisasters

A megadisaster is an event that kills more than 100,000 people. Megadisasters impact significantly on EM-DAT total figures and therefore have to be taken into account when interpreting our data. Three megadisasters occurred in the period 1994-2013. The impact of the 2004 Asian tsunami, which killed 226,400 people in 12 countries, can be seen in Figure 4. The 2008 peak reflects the 138,000 lives lost in Cyclone Nargis in Myanmar, and 2010 peaked due to the 222,600 deaths in Haiti earthquake. To put these totals into context, high-income countries together lost 181,900 people to natural disasters throughout the period 1994-2013.

Figure 4

Numbers of people affected & killed annually by natural disasters worldwide (1994-2013)



BOX | 5

The HFA Decade: A United Nation's Office for Disaster Risk Reduction perspective

Within weeks of the Indian Ocean tsunami in 2004, representatives of 168 UN member states met in Kobe, Japan, at the 2005 World Conference on DRR to adopt the Hyogo Framework for Action (2005-2015): Building the Resilience of Nations and Communities to Disasters (HFA). Though voluntary and non-binding, the HFA has been embraced by central and local governments, the private sector and civil society groups.

A clear sign of how the HFA has improved the global culture of disaster risk management lies in the fact that 121 countries have undertaken legislative and policy changes in line with its recommendations. There are now HFA focal points in 191 countries and 85 platforms for DRR, while 141 countries have carried out at least one review of their efforts to implement this framework for action through advances in risk governance, stronger institutions, education and science, as well as addressing underlying drivers of risk and strengthening preparedness and response mechanisms.

The HFA's five priorities have also spurred the growth of the urban resilience movement through UNISDR's four-year-old Making Cities Resilient Campaign. More than 2,400 towns and cities now participate in this campaign worldwide, including 73 capital cities. Political and social commitment has grown around the HFA's goals of reducing mortality and economic losses.

The experience of the HFA's implementation since it was unanimously endorsed by the UN General Assembly in 2005 has fuelled consultations on its successor - the post-2015 framework for DRR. The main challenges during these consultations have repeatedly been identified as the need to address the underlying drivers of risk such as poverty, climate change, poor governance, eco-system decline, rapid urbanization and population growth. All of these factors highlight the cross-cutting nature of DRR and underline the importance for the post-2015 global development agenda of a strong outcome document from the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015.

Classifying natural disasters

EM-DAT classifies disasters according to the type of hazard that provokes them (cfr. technical notes). Thus, for example, tsunamis are geophysical disasters because their root cause is seismic activity (earthquake). This report focuses on four major categories: geophysical, hydrological, meteorological and climatological disasters[3]. Taken together, hydrological, meteorological and climatological events are also referred to as climate-related disasters.

Overall, **climate-related events** account for the overwhelming majority (91%) of natural disasters that occurred worldwide between 1994 and 2013. Floods and storms alone account for 71% of the global total **(Figure 5)**. Climate-related events also outnumbered geophysical disasters in the ten most disaster-affected countries in the world **(Figure 6)**.

The trend was confirmed in 2014, with 87% of disasters climate-related.

[3] Biological disasters are excluded from this report as they have distinct characteristics and DRR strategies. Disasters with an extra-terrestrial origin are also excluded because only one event was recorded in this category since 1900 (the Chelyabinsk meteor in Russia in February 2013).

BOX | 6

Modelling cascading disasters

Some hazards trigger other natural and/or technological disasters, thereby creating a cascading chain of events. For example, floods can cause mudslides which cut roads and power lines, while extreme heat may spark wildfires, heavy pollution and outbreaks of bronchial disease.
A notorious example of a cascading disaster was the March 2011 earthquake off the coast of Japan, the seismic waves and tsunami from which damaged the Fukushima nuclear power plant.

A better understanding of the ways in which such events escalate will, in future, help the disaster response community to anticipate consequences of natural hazards and either break an expected chain of events or respond more effectively to likely impacts. Databases such as EM-DAT are valuable tools in such studies. CRED, for example, is part of the EU-funded Snowball Project which seeks to model, simulate and predict chain reactions within cascading disasters.

Geophysical	Hydrological	Meteorological	Climatological	Biological	Extra-terrestrial
Earthquake	Flood	Storm	Drought	Animal accident	Impact
Mass Movement (dry)	Landslide	Extreme temperature	Glacial lake outburst	Epidemic	Space weather
Volcanic activity	Wave action	Fog	Wildfire	Insect infestation	

Figure 5

Share of occurrence of natural disasters by disaster type (1994-2013)

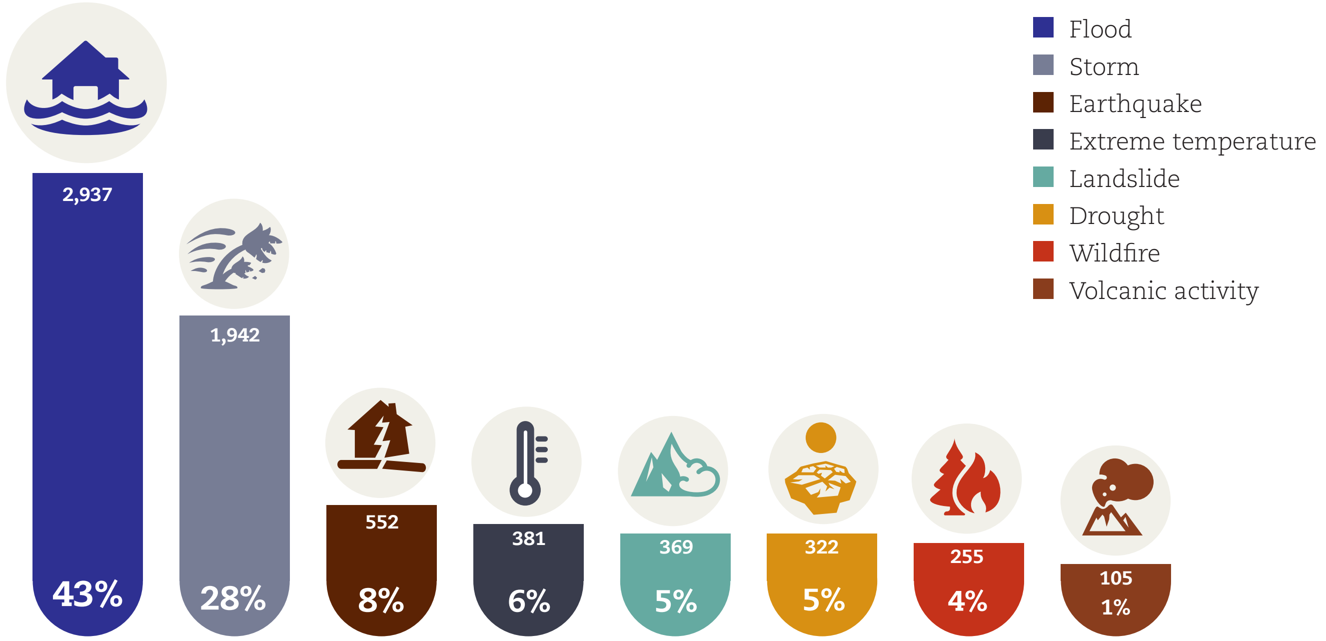
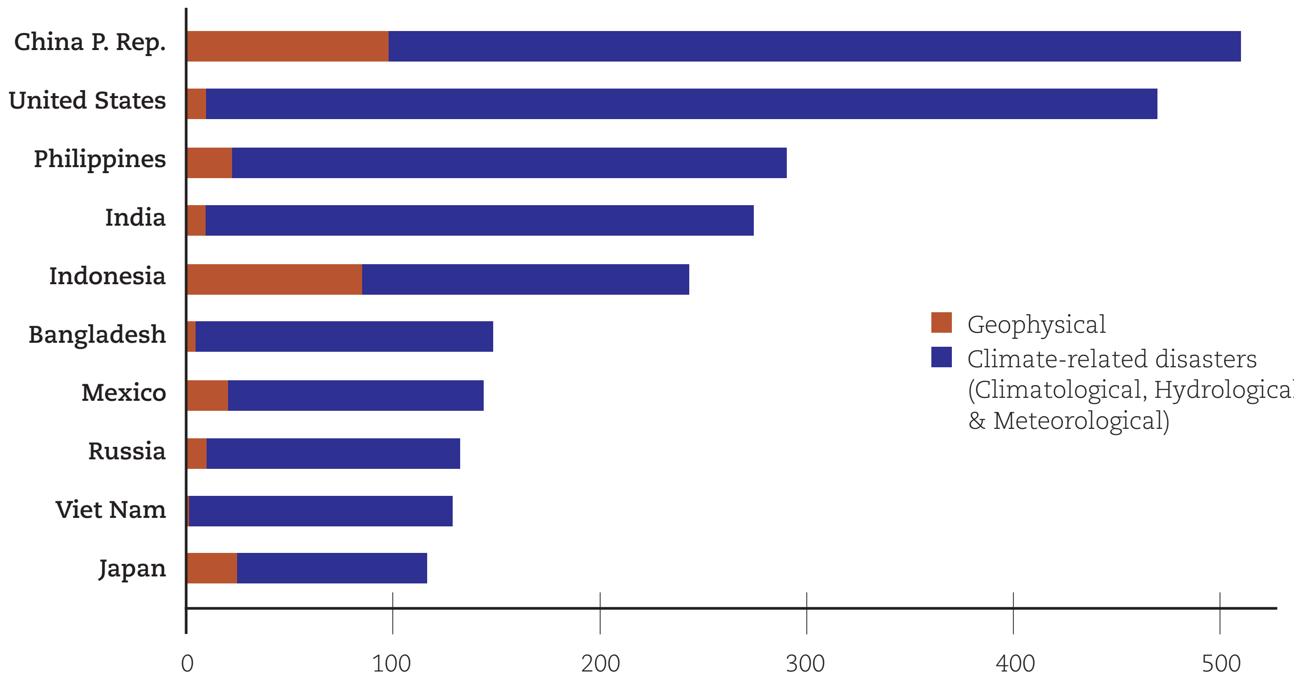


Figure 6

Climate-related vs. geophysical disasters: number of events by sub-group : 10 most disaster-affected countries (1994-2013)



Chapter 2

Human impacts of natural disasters

Introduction

The impact of natural disasters on human beings depends on multiple, inter-locking factors, including the type of hazard, its location and duration, and the size and vulnerability of the population in harm's way. This report employs two main yardsticks to measure the severity of impacts:

- The absolute and relative numbers of people affected and killed in the emergency phase of a disaster;
- The economic costs, including assets and infrastructure damaged and destroyed **(Chapter 3).**

Other costs, including repairs, rehabilitation and rebuilding expenditure, plus lost productivity and increased poverty, are harder to quantify but nevertheless must be taken into account when analyzing the overall economic burden of natural disasters.

Human impacts of disasters by type

The impact of disasters is different according to their type **(Figure 7)**. **Flooding** impacted on more people than any other type of disaster, accounting for 55% of the total people **affected** (nearly 2.5 billion people) in the period 1994-2013.

Preliminary 2014 data show that hydrological disasters (floods and landslides) were responsible for 71% of deaths last year and 36% of the total number of people affected.

Earthquakes (including tsunamis) are typically far more **deadly** than any other type of disaster, accounting for 55% of the disaster deaths over the 20-year period, claiming nearly 750,000 lives **(Figure 8)**.

Figure 7

Number of people affected by disaster type (1994-2013)
(NB: deaths are excluded from the total affected)

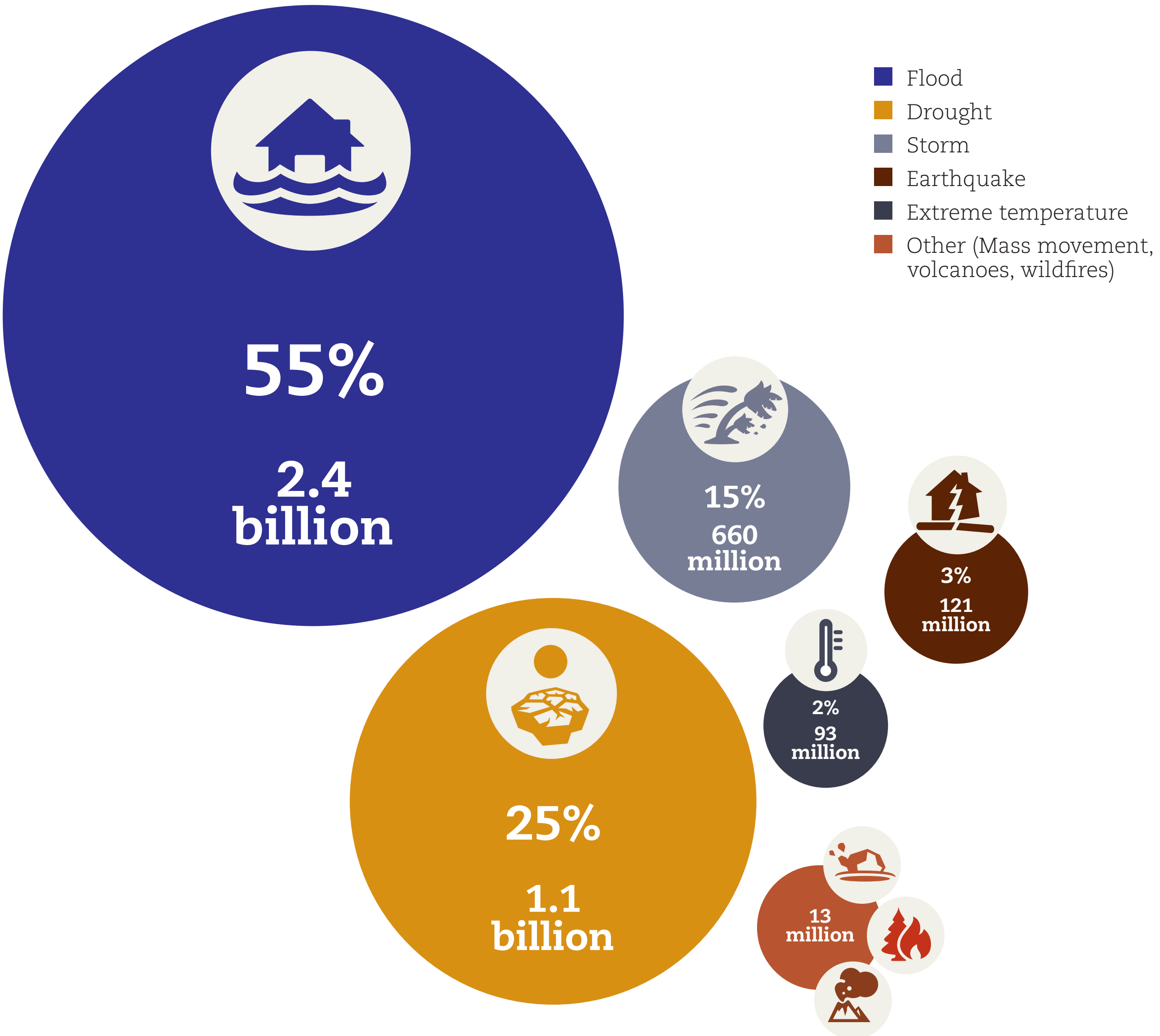
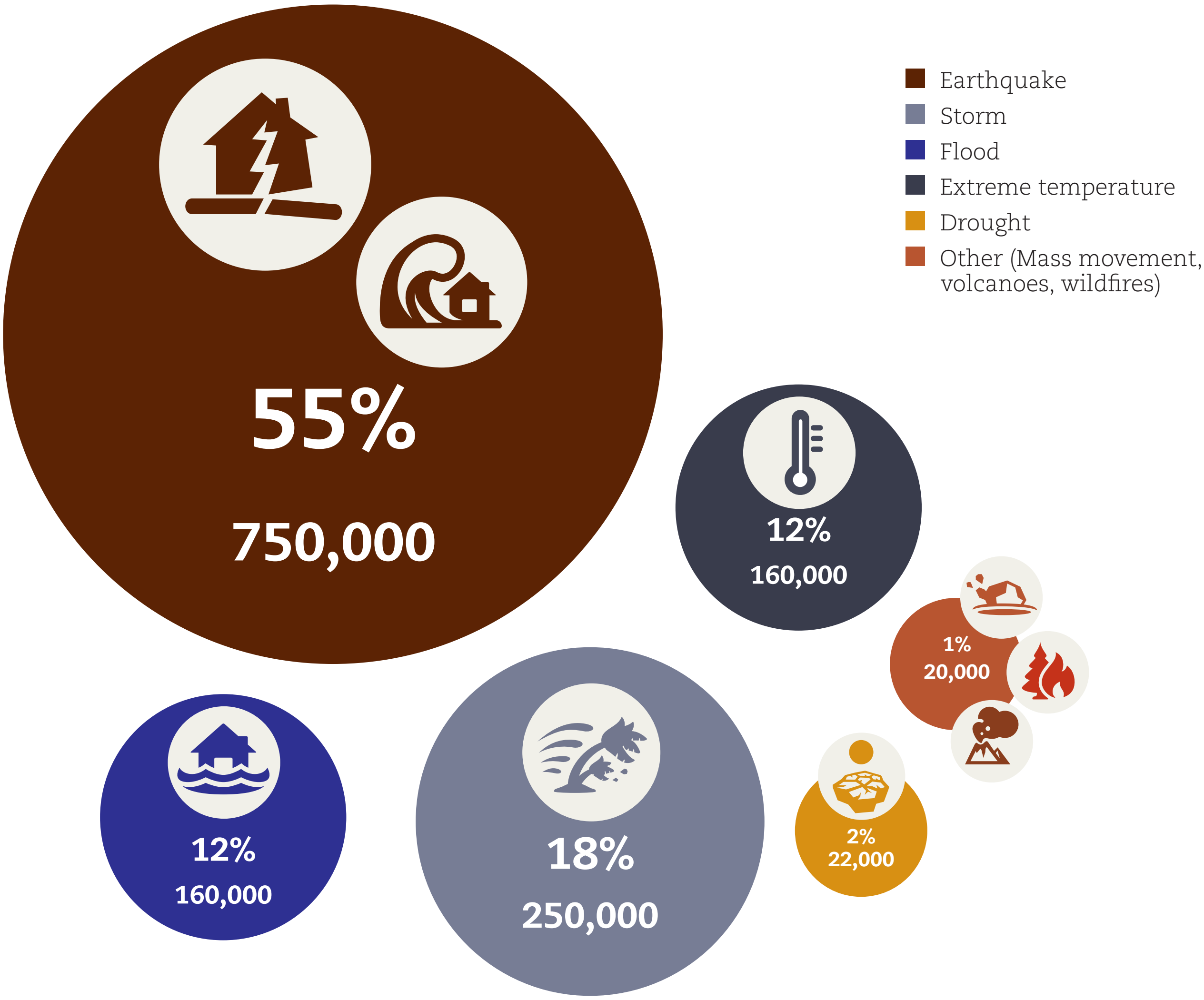


Figure 8

Number of deaths by disaster type (1994-2013)



Floods

Floods were the **most frequent** type of disaster in 1994-2013, accounting for 43% of all events **(Figures 5)**. They also **affected more people** than all other types of natural disaster put together, i.e. 55% of the global total in the past 20 years (Figure 7). Floods also became increasing frequent, rising from 123 per year on average between 1994 and 2003 to an annual average of 171 in the period 2004-2013.

Asia and Africa were hit by floods more than other continents, but these were also an increasing danger elsewhere. In South America, for example, 500,000 people were affected by flood on average between 1994 and 2003. By the following decade (2004-2013) that number had risen to two million people, a four-fold increase.

Floods were less deadly than earthquakes or storms in terms of the numbers of lives lost as a direct result of the event. However, the nature of disastrous floods has changed in recent years. Flash floods have become more frequent, as have acute riverine and coastal flooding. Urbanization has also significantly increased flood run-offs. Together, these factors have pushed up the average death toll from floods in many parts of the world. In Asia, for example, flooding affected very large areas of agricultural land as well as human habitations on alluvial flood plains. Since 2004, when the numbers of people killed per flood reach a significant low (around 50 deaths per event), mortality has again crept up **(Figure 9)** due mainly to high tolls in three particular years. In 2007, floods killed 3,200 people in India and Bangladesh alone. In 2010, flooding killed 2,200 people in Pakistan and another 1,900 in China, while in 2013, an exceptionally high number of 6,500 people died due to floods in India.

Studies have shown that recurrent flooding has severe and long-term impacts on livelihoods and health, particularly in poor rural regions dependent on farming. In rural India, for example, children in households exposed to recurrent flooding have been found to be more stunted and underweight than those living in non-flooded villages. Children exposed to floods in their first year of life also suffered the highest levels of chronic malnutrition due to lost agricultural production and interrupted food supplies[4].

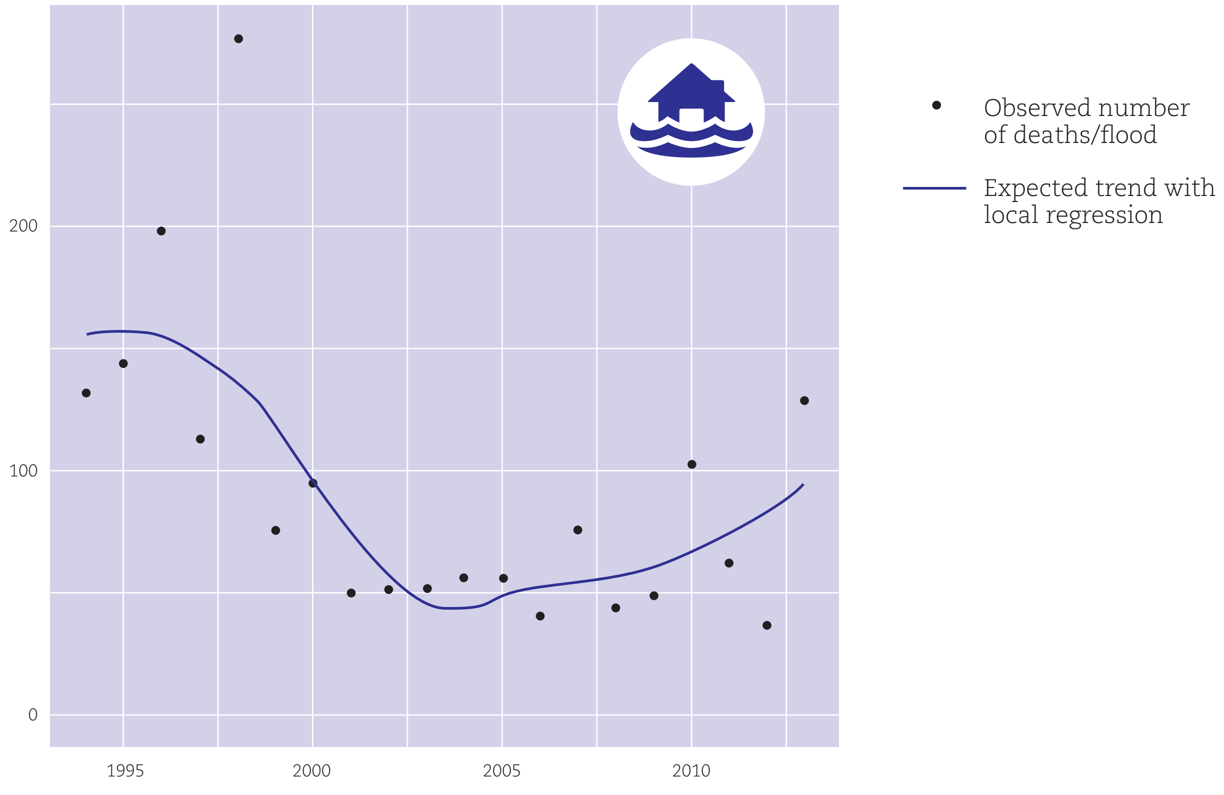
Many of these impacts are preventable, since flooding - unlike most types of natural disaster - lends itself to primary prevention through affordable technologies such as dams and dykes. Other measures such as practical education of mothers have also been shown to be effective in protecting children from flood-related malnutrition.

ACTION POINT

In view of the serious health and socio-economic impacts of flooding, CRED believes that flood control should be regarded as a development issue, rather than largely a humanitarian concern. Priority should be given to cost-effective mitigation measures in poor regions at high risk of recurrent flooding, together with malnutrition prevention programmes.

Figure 9

Number of deaths per flood (1994-2013) in Asia



[4] Rodriguez-Llanes, J.M., Ranjan-Dash, S., Degomme, O., Mukhopadhyay, A., Guha-Sapir, D. (2011). "Child malnutrition and recurrent flooding in rural eastern India: a community-based survey". BMJ Open 2001;1: e000109.

Storms

EM-DAT recorded 1,942 storms over the period 1994-2013, making this type of disaster the second most frequent after floods. Storms, including cyclones, killed more than 244,000 people in this 20-year period and cost US$936 billion in recorded damage. This makes storms the **most expensive** type of natural disaster during the past two decades, and the **second most costly in terms of lives lost.**

Cyclones typically cut through wide swathes of densely populated regions, while frequent storms tend to affect large populations. Storms also affect higher-income countries more often than lower-income nations (Figure 10a), hence their high cost in terms of recorded lost assets.

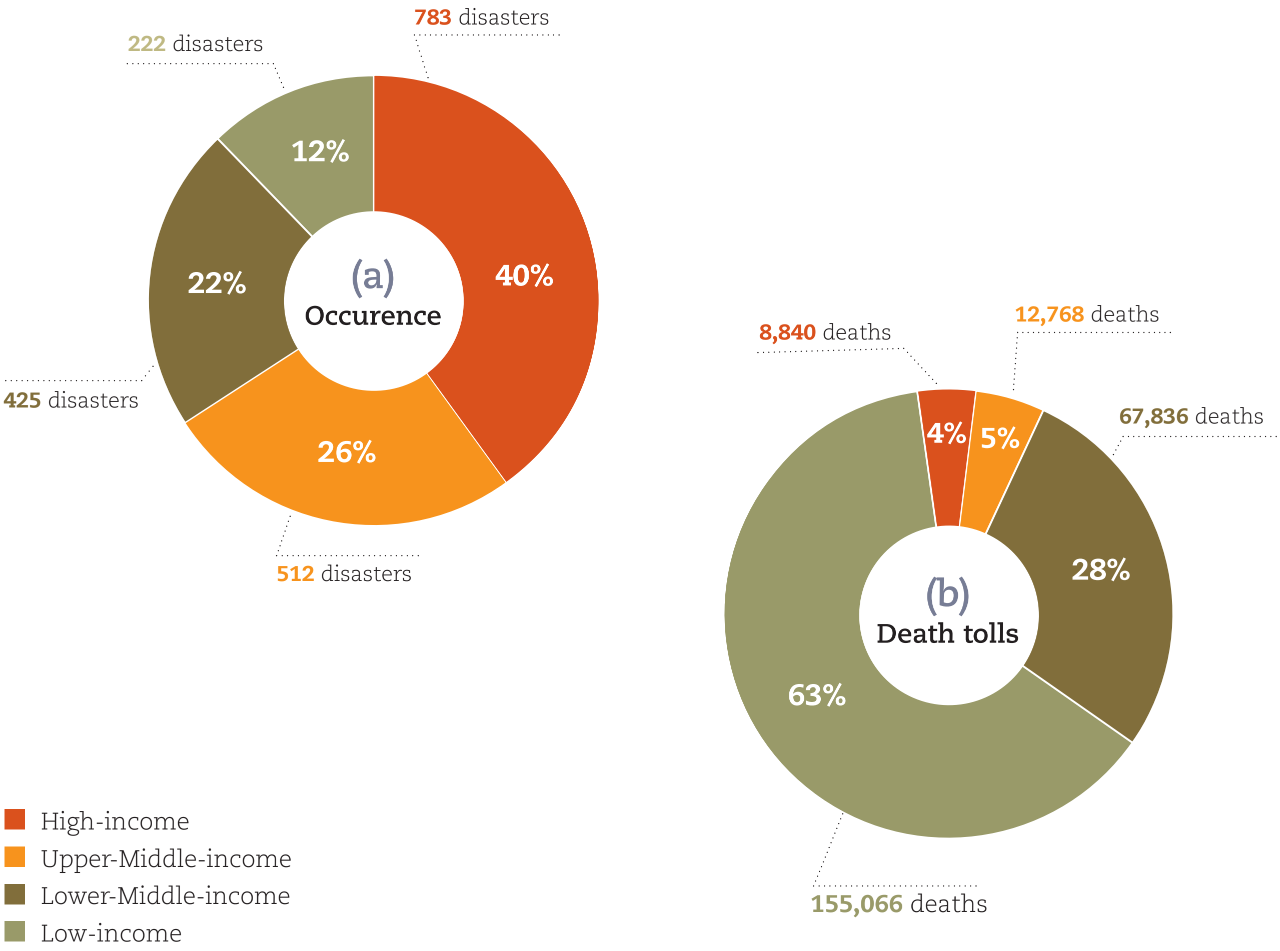
In terms of lives lost, low-income countries bore the brunt of storms, suffering 63% of all deaths from this type of disaster, even though they experienced just 12% of global total of such events (Figure 10b). If income groups are bracketed together, the division between rich and poor is even more stark, with low- and lower-middle-income countries accounting for 91% of all storm deaths, against just 9% for high-income and upper-middle-income countries.

Regionally, the impacts of storms have increased in Asia, especially in the South and South-East. The average death rate per event on that continent rose until 1997, decreased for the next seven years, then returned to a rising trend from 2004 (Figure 11). Cyclone Nargis was the most deadly storm in this period, claiming 138,000 lives in Myanmar in 2008, the highest toll since Cyclone Gorky in Bangladesh in 1991.

Scientific evidence suggests that climate change will increase the upward trend in the numbers of floods and storms worldwide, while the population requiring protection can, at best, be expected to increase by same rate of population growth in the affected regions. On the positive side, weather forecasting has made extraordinary progress in recent years, with predictions now highly reliable within a 48-hour period. Arguably, better forecasting may be one reason behind the global decrease in deaths from storms identified by EM-DAT over the past 20 years.

Figure 10

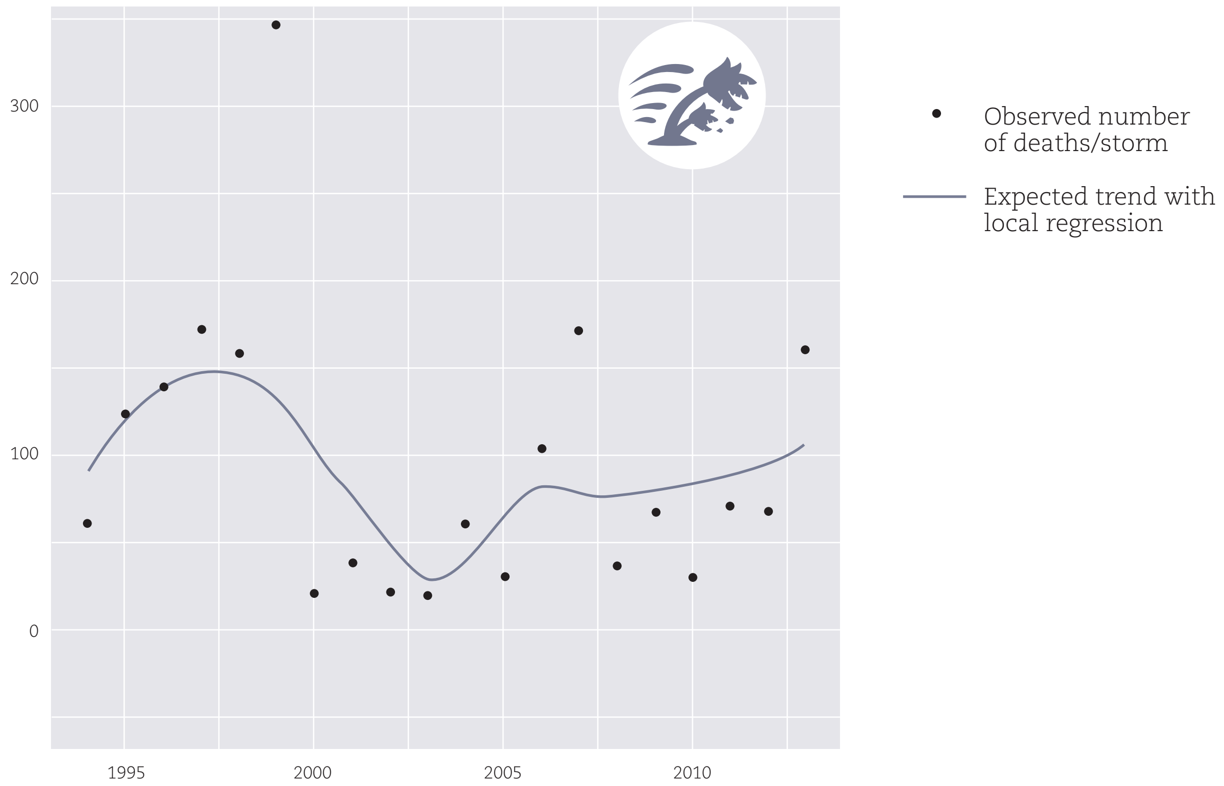
Occurrence (a) and death tolls (b) of storms broken down by national income bracket (1994-2013)



However, given that EM-DAT data also show a rising number of people affected by storms **(Figure 11)**, plus an increasing death toll in Asia and huge financial losses, we conclude that storm preparedness needs strengthening. Of course, the occurrence of storms cannot be controlled, but better management and mitigation could reduce deaths tolls and other losses from these predictable hazards.

Figure 11

Number of deaths per storm in Asia (1994-2013)



ACTION POINT

Storm early warning systems need to be deployed more effectively, particularly in poor rural communities at higher risk. Proven preventive measures, such as cyclone shelters and wind-resistant buildings, are also options which (according to resources available) could help protect vulnerable populations.

Drought

More than one billion people were **affected** by droughts in the period 1994-2013, a larger number than for any other type of disaster apart from flooding **(Figure 7)**. **Africa** suffered droughts more frequently than any other continent, with 131 droughts, of which 75 occurred in East Africa **(Figure 12)**.

Droughts are associated with agricultural failures, loss of livestock, drinking water supply shortages and outbreaks of epidemic diseases. Since droughts can last for several years, some have extensive, long-term economic impacts and result in the displacement of large sections of the affected population. Consecutive failures of seasonal rains in Eastern Africa in 2005, for example, led to food insecurity for at least 11 million people.

The figure of just 2% of disaster deaths worldwide being due to drought **(Figure 8)** is rather misleading since it excludes the vast majority of indirect deaths caused by drought-related malnutrition, disease and displacement. These indirect deaths are often poorly documented or not counted at all.

Furthermore, while droughts represented a relatively small proportion of the global total of occurrences (5% of all disasters between 1994 and 2013), the drought-affected population accounted for a disproportionately high 25% of the worldwide total **(Figure 7)**. This is despite the effectiveness of weather warnings and early warning systems.

The available data point to two broad conclusions:

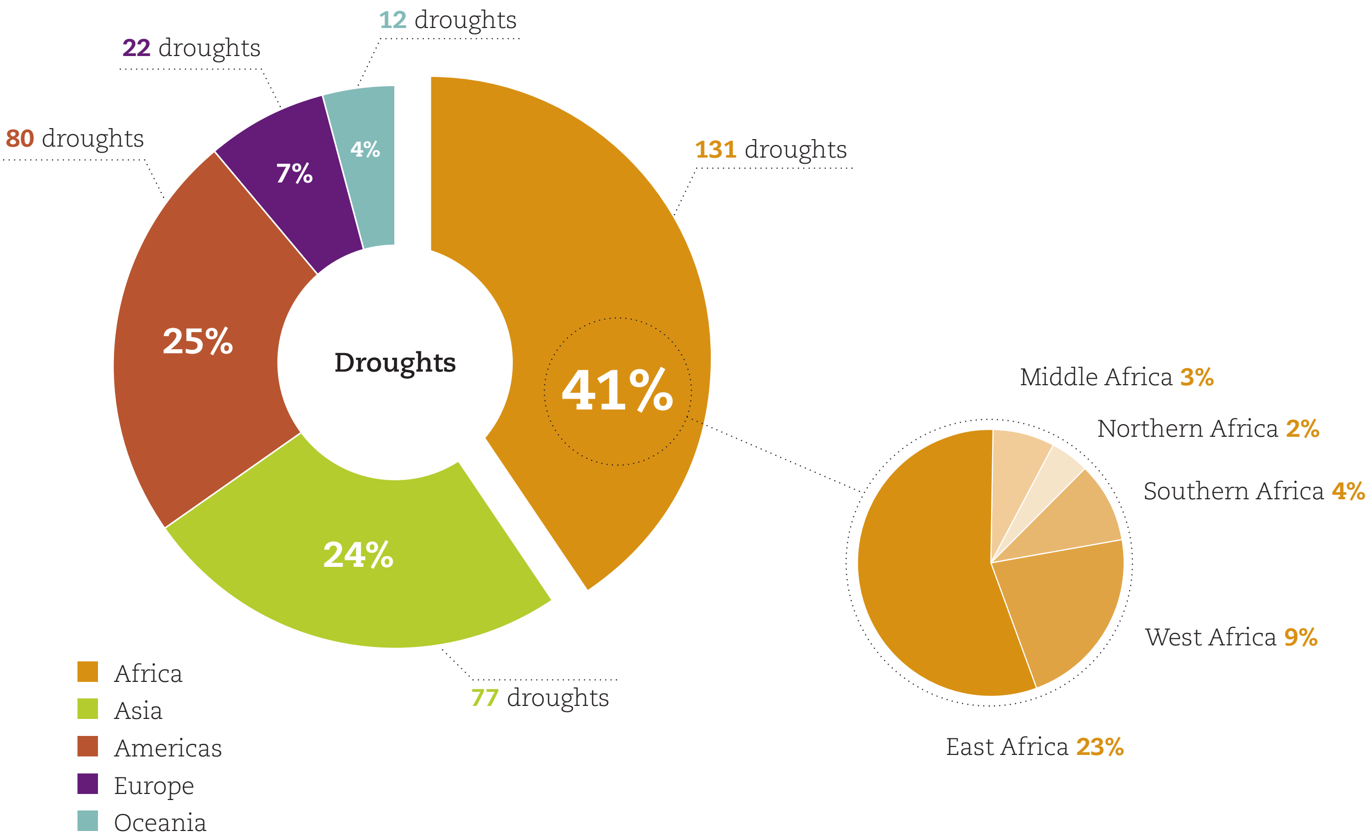
- The fact that 41% of all drought disasters were recorded in Africa suggests that drought overwhelms the ability of poorer African countries to cope far more frequently than it does in richer countries which also suffer from this extreme form of climate variability.
- While indirect drought-related deaths are extremely difficult to quantify (given poor record-keeping) there is little doubt that drought-disaster mortality, plus the associated economic costs, have taken a high toll in terms of increased hunger, poverty and the perpetuation of under-development. (Below et al., 2007)

ACTION POINT

Reducing the size of drought-vulnerable populations should be a global priority over the next decade. Better accounting systems for indirect deaths should also be put in place, and linked to early warning systems and response mechanisms, in order to monitor the impacts of drought more comprehensively.

Figure 12

Occurrence of droughts by continent and by region within Africa (1994-2013)



Earthquakes, including tsunamis

Earthquakes and tsunamis are **rarer** phenomena than storms and floods, but tend to cause very high numbers of casualties in extremely short periods of time. The tsunami that hit South-East Asia in 2004 resulted in 226,000 direct deaths in 12 countries, while the Haiti earthquake of 2010 killed 223,000 in the emergency phase.

Overall, earthquakes and tsunamis were the **deadliest** types of disaster during the past 20 years, accounting for nearly 750,000 direct deaths, which is more than all other direct deaths from disasters put together **(Figure 8)**.

Urbanization within highly seismic zones has increased significantly in the last few years, exacerbating the deadliness of these events. Slums and squatter dwellings frequently expand on the highest risk areas, such as slopes and embankments. As a result, ground movements and landslides (even after small earthquakes) dislodge friable land, killing almost all the local population. This was the case in the San Miguel/Santa Tecla earthquake in El Salvador in January 2001 where the majority of the 944 deaths were caused by a large landslide in Santa Tecla and Comasugua.

Protecting people from tsunamis is in many ways an even greater challenge than reducing the impacts of ground movements. People's livelihoods depend on the coast (in tourism and fishing, for example) so they are unable or unwilling to move inland. Also, the return periods between tsunamis are so long that it is difficult to keep safety or early warning messages alive in people's mind. While very strict building regulations would, in theory, be an effective option to reduce tsunami deaths, in practice such laws would be very hard to implement in resource-poor settings.

One major advance, following the 2004 Asian tsunami, was the establishment of the Indian Ocean Tsunami Early Warning System which now provides alerts through three regional watch centres in India, Indonesia and Australia, and a network of 26 national tsunami information centres. It is an efficient system which disseminated early warnings within eight minutes of the Banda Aceh earthquake in 2012.

Table 1 shows that ground movements accounted for 500,000 deaths between 1994 and 2013, which is equivalent to 66% of total mortality for geophysical disasters. Ground movements also affected a cumulative total of more than 100 million people, almost 96% of all people affected by earthquakes worldwide in this period.

However, **Table 1** also illustrates that tsunamis were almost 20 times more deadly than ground movements in terms of the proportion of victims killed. ("Victim" in this context means the numbers killed and the numbers affected combined.) On average, for every 1,000 tsunami victims in this 20-year period, 79 were killed, compared to just 4 deaths per 1,000 for ground movements.

Table 1

Occurrence, mortality and number affected by geophysical disasters and their relative % of the global total (1994-2013)

	Occurrence	Total Deaths	Total Affected	% Occurrence	% Total deaths	% Total affected
Ash fall	105	721	2,099,075	16.0	0.1	1.7
Ground movement	525	497,097	118,328,863	80.2	66.5	95.9
Tsunami	25	250,125	2,898,178	3.8	33.4	2.4
TOTAL	655	747,943	123,326,116	100	100	100

Impacts of natural disasters by country and income grouping[5]

Introduction

The relative burden of natural disasters on individual countries depends upon the dataset studied. Gross or absolute figures give a sense of the scale of natural disasters, while data standardized by population is a better indicator of the relative impact. For instance, the deaths of 20,000 people is a tragedy wherever it occurs, but the social and economic consequences will differ radically if these deaths occur in the USA or China, rather than a less developed country or small island nation. In poorer countries lost assets not only cause immediate financial hardship, particularly in poor households, but disaster deaths also have wide-reaching consequences for future family wellbeing as well as economic development.

This sub-chapter gives an overview of countries most affected by natural disasters in relative and absolute terms. Countries are then grouped by income level to demonstrate the greater burden experienced by lower-income countries. By analyzing EM-DAT data in this way, CRED is contributing to current knowledge about which populations are most vulnerable to disasters and the relative resilience of different national economies.

Impacts of disasters by country

In absolute terms, the population giants China and India top the league tables in terms of the cumulative number of people affected by natural disasters between 1994 and 2013 **(Figure 13)**. They account for more than 3.3 billion people affected over this period or 76% of the global total of 4.3 billion people.

The picture is radically different, however, when the data is standardized to reflect the numbers of people affected by natural disasters per 100,000 head of population. In this case, only three of the most-affected countries are in Asia (China still appears in seventh position), while six are in Africa. Moldova is the only European country on either list, ranking ninth in the standardized league table **(Figure 13)**.

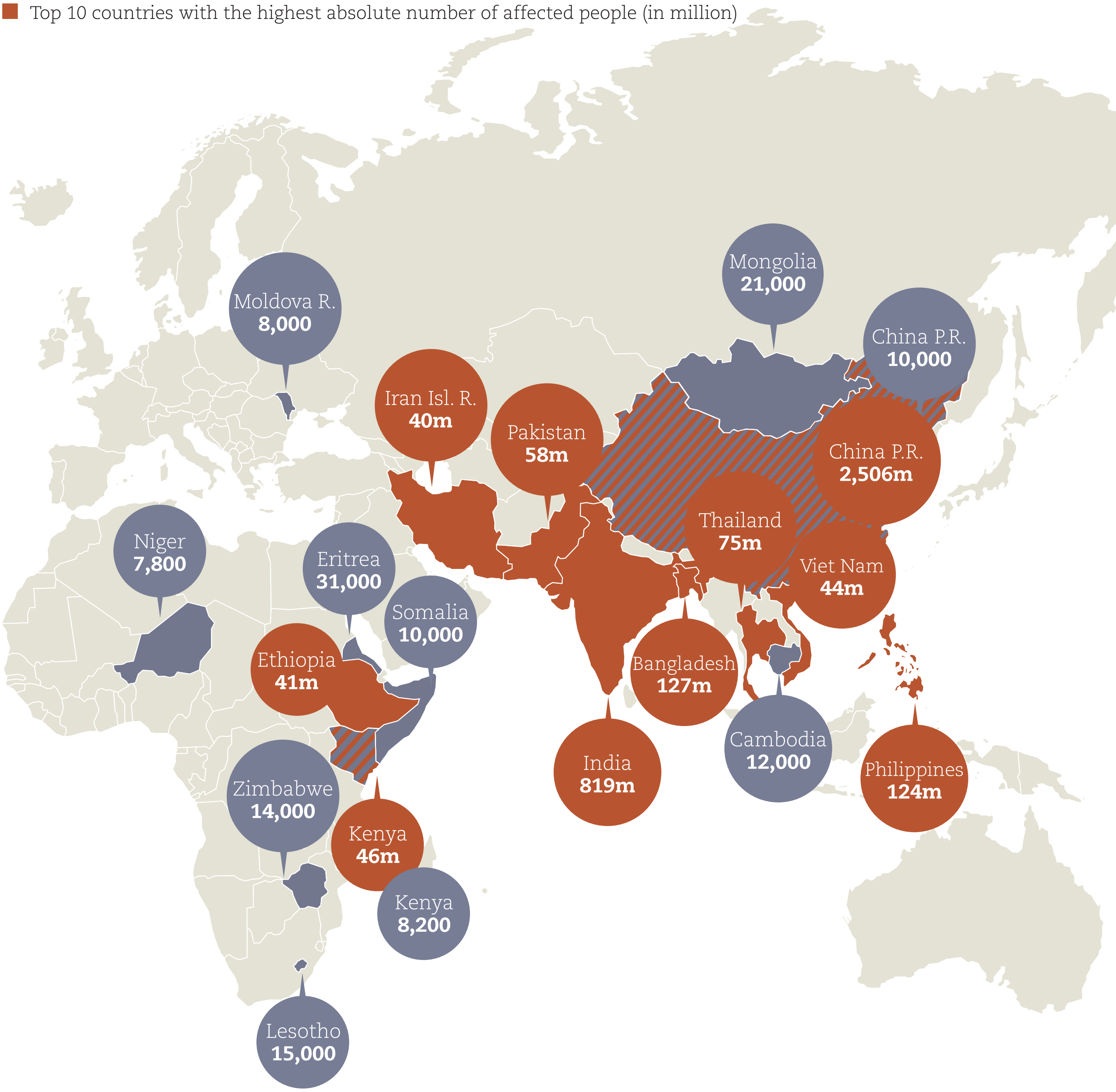
[5] From this sub-chapter and onwards, smaller states are excluded from EM-DAT data. Chapter 5 focuses on small states.

Figure 13

Top 10 countries by population affected by natural disasters vs. countries most affected per 100,000 inhabitants (1994-2013)

■ Top 10 countries with highest proportion of affected people over the total population (per 100,000 inhabitants)

■ Top 10 countries with the highest absolute number of affected people (in million)

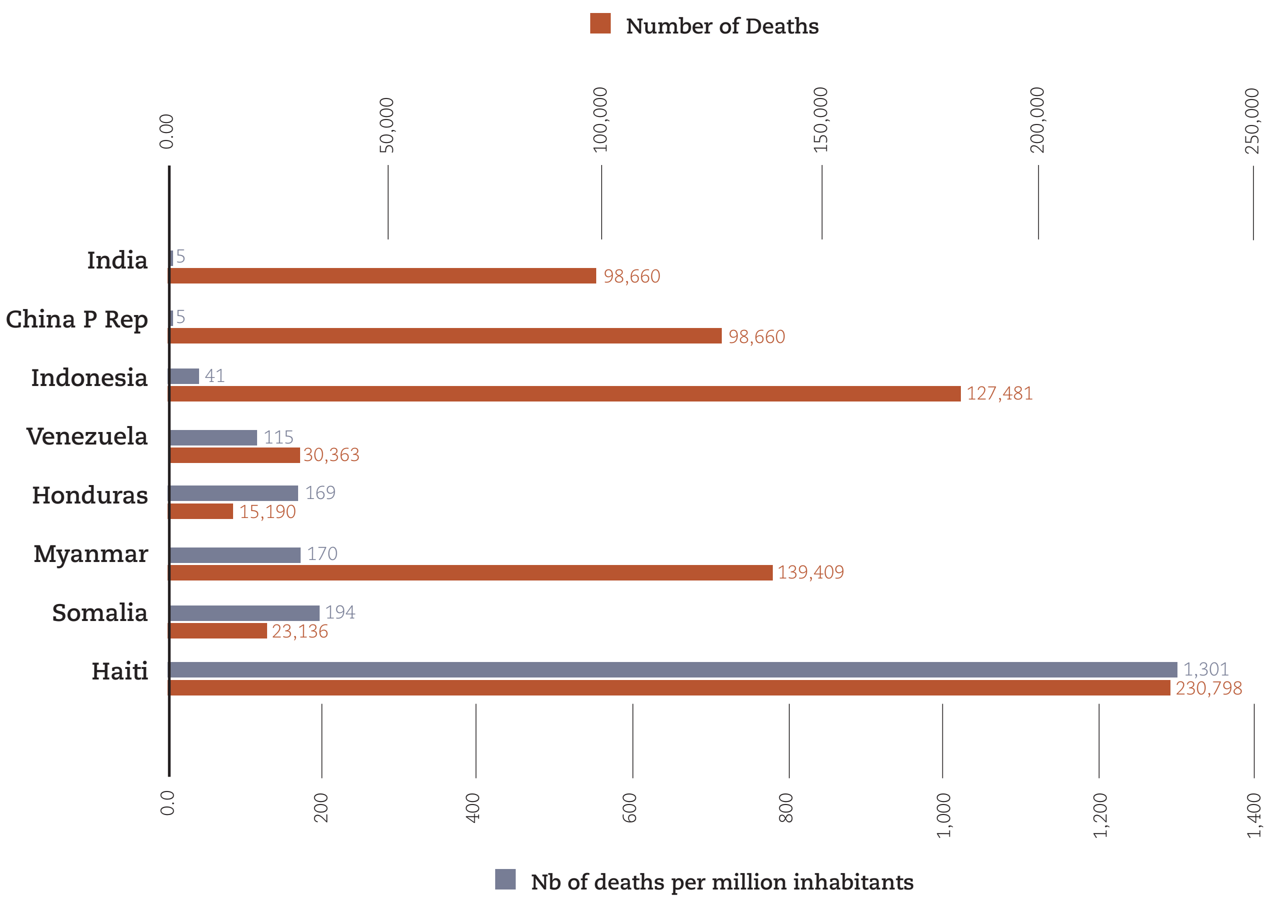


Ranking by death tolls also varies significantly when mortality is standardized by population size. Figure 14, for example, shows that India, China and Indonesia experienced low death rates as a proportion of their overall population, despite very high absolute numbers.

Tragically, Haiti suffered the largest numbers killed both in absolute and relative terms **(Figure 14)** due largely to the terrible toll of the 2010 earthquake and its immediate aftermath. Haiti experienced more than six times the number of fatalities per population compared to Somalia (where 20,000 people died from a drought in 2010) and more than seven times the number of fatalities per head of population compared with the third ranked country, Myanmar (where, as noted previously, Cyclone Nargis claimed 138,000 lives in 2008).

Figure 14

Number of deaths and relative mortality (deaths/million inhabitants) for 8 selected countries (1994-2013)



Impact of natural disasters by national income level

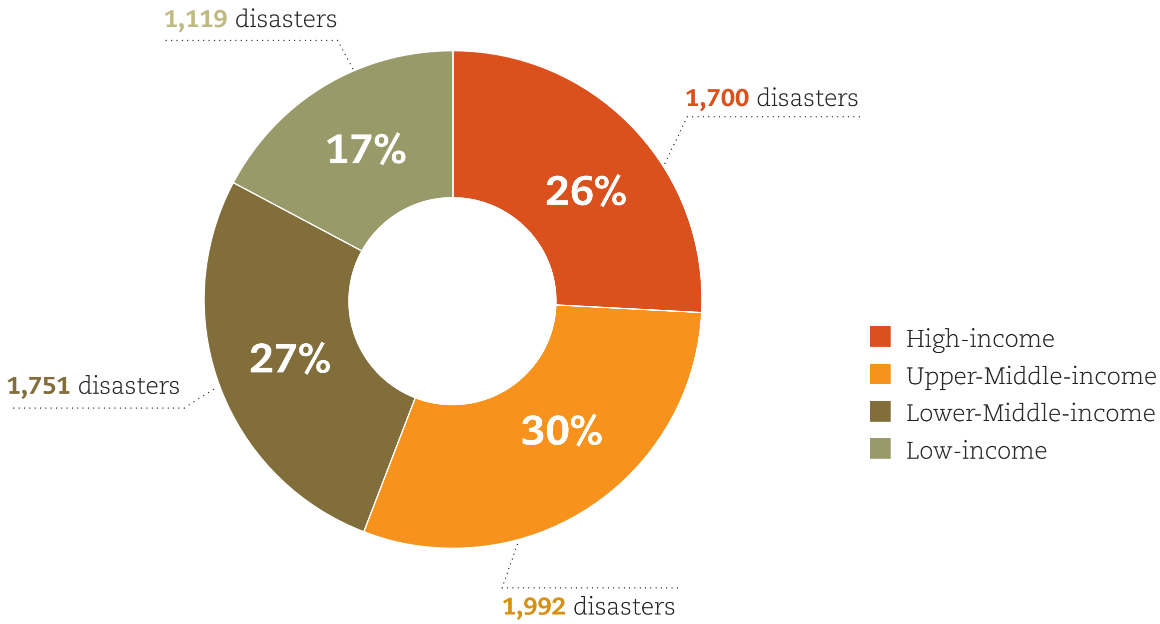
As noted previously, the impact of a disaster partly reflects its magnitude and intensity. National preparedness and the efficiency of responses to disasters are also major determinants of death tolls. Thus the vulnerability of affected populations has a direct and significant bearing on the numbers killed.

It is noticeable that India, China, Indonesia and Myanmar have made major commitments to reduce disaster losses by acting on the priorities of the Hyogo Framework for Action. In the case of Indonesia, DRR became a pillar of national development immediately after the catastrophe of the Indian Ocean tsunami. Similarly, for India a key trigger was the 1999 cyclone which claimed around 10,000 lives in Odisha State; casualties in two recent major cyclones were minimal. China has also reported that it has succeeded in keeping economic losses within a target of 1.5% of GDP.

EM-DAT data show that when countries are grouped by income (Annex A) they experienced broadly similar disaster events regardless of their income **(Figure 15)**. In fact, the highest number of disasters occurred in upper-middle-income countries (1,992 events or 30% of the global total) while low-income countries experienced 17% of global disasters (1,119 events).

Figure 15

Number of disasters per income group (1994-2013)



Disparity of deaths between lower- and higher- income countries

Unlike disaster occurrences, the pattern for death tolls is very different when the income level of each country is taken into account. Taken together, high- and upper-middle-income countries experienced 56% of disasters **(Figure 15)** but lost 32% of lives **(Figure 16)** in the past 20 years. In the same period, low- and lower-middle-income countries experienced 44% of disasters but suffered a disproportionately high 68% of global mortality.

This **disparity between rich and poor** is further illustrated by average death rates per disaster. On average, more than three times the number of people died per disaster in low-income countries than in high-income countries, with 332 deaths for the poorest countries against 105 deaths on average in the richest countries in 1994-2013 **(Figure 17)**.

Figure 16

Number of deaths per income group (1994-2013)

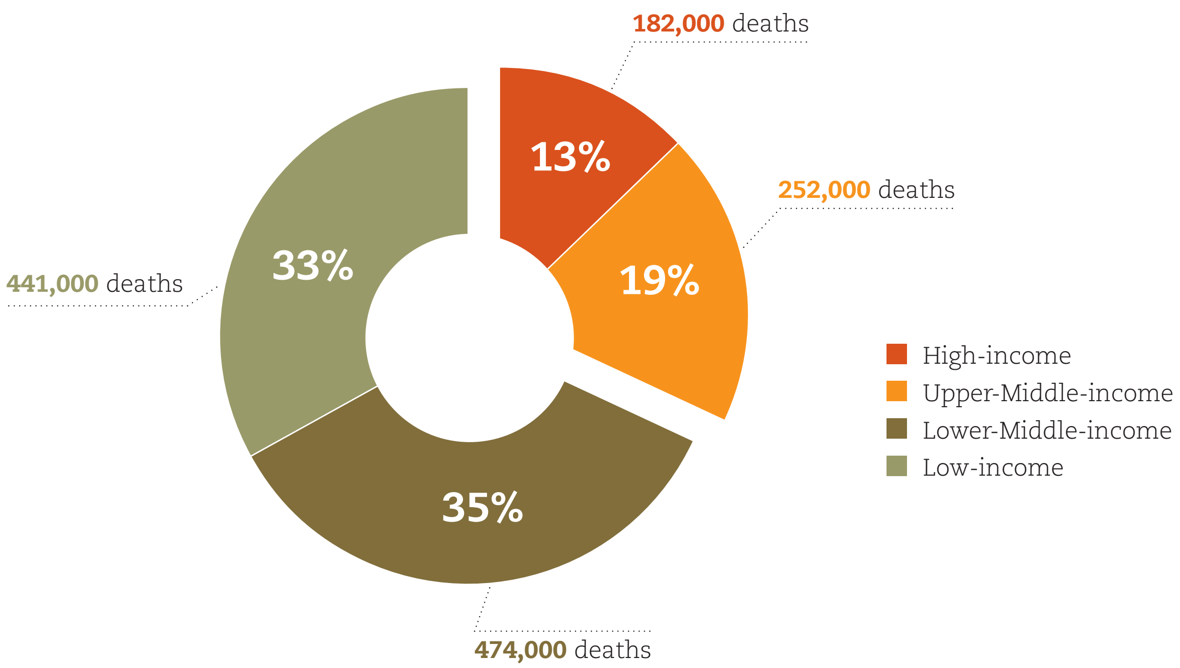
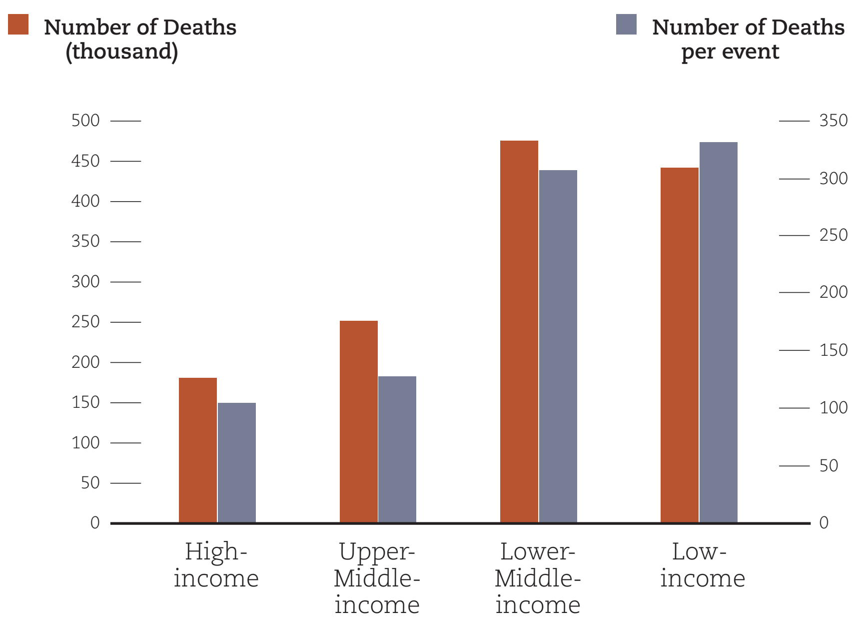


Figure 17

Total numbers of deaths compared to the average number of deaths per disaster by income group (1994-2013)



Furthermore, low-income countries account for 43 deaths per one million inhabitants, while in high-income countries the death rate is only nine per million (Figure 18).

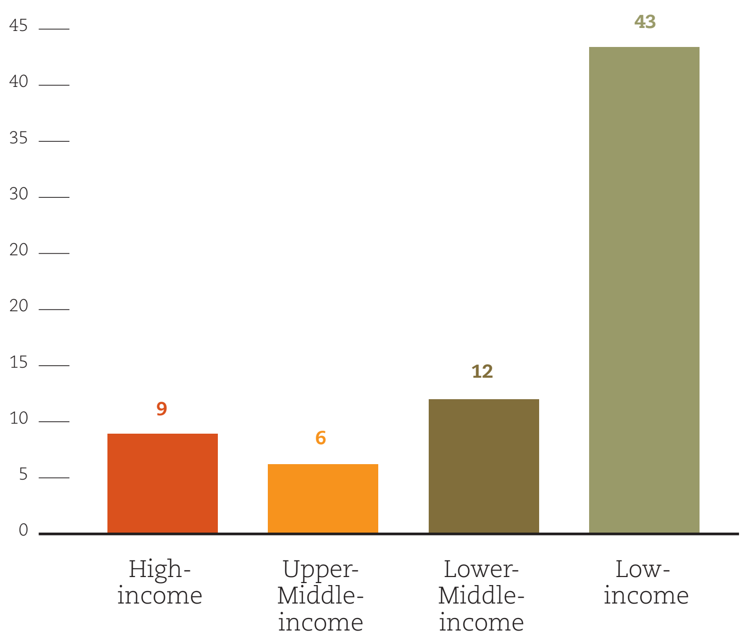
These data demonstrate that the **developmental level** of a country is a **major determinant** of the death rate, rather than a country's exposure to natural disasters per se. National resilience to natural disasters, and its ability to recover from such events, also depend largely on the developmental level of the country or region in question.

ACTION POINT

Disaster mitigation measures need significant improvement in lower-income countries to reduce the burden of disasters on them.

Figure 18

Number of deaths per one million inhabitants by income group (1994-2013)



Chapter 3

Disaster damage to housing & infrastructure[6]

Introduction

Poor and unregulated construction is another key determinant of mortality during natural disasters, particularly in lower-income countries, when badly-built houses, offices, schools, work-places and health facilities collapse and kill people. For example, thousands of schoolchildren have died in major earthquakes during the past 20 years. Disaster damage and destruction also generate significant rebuilding costs as well as a host of longer-term social and economic consequences when people are forced to flee their homes.

[6] Damaged includes partially damaged and fully destroyed in this report. EM-DAT records about the physical impacts of disasters are partial: 129 events (of 6,500 events) report health facilities damaged and 248 report education infrastructures damaged.

Damage to health facilities also reduces a country's ability to respond to disasters in the first instance, increasing the likelihood that an international **humanitarian operation will be required.** This was the case after the Bam earthquake in 2003 in Iran when all of the city's key health facilities were damaged, and patients and staff were killed.

In the aftermath of disasters, international reconstruction efforts are needed when major events cause more damage to vital infrastructure than the national economy can afford to repair. After Cyclone Nargis hit Myanmar in May 2008, for example, the IFRC took three years to rebuild more than 16,000 houses, 25 schools and 20 rural health centres.

In the long-term, the **loss of education and health infrastructure** can in some cases **slow economic and social development** for generations. Many studies have shown that the health and nutritional status of children in particular are especially vulnerable to disasters, both in the emergency phase and also due to malnutrition and under-nutrition in the aftermath[7]. These effects need to be quantified to improve the effectiveness of DRR interventions.

Meanwhile, UNISDR is actively campaigning for **safe schools and hospitals** in earthquake and flood zones to reduce fatalities, injuries and physical damage. Turkey, for example, has given a commitment to make all schools and hospitals earthquake-proof by 2017.

Disparities between disaster types and between income groups

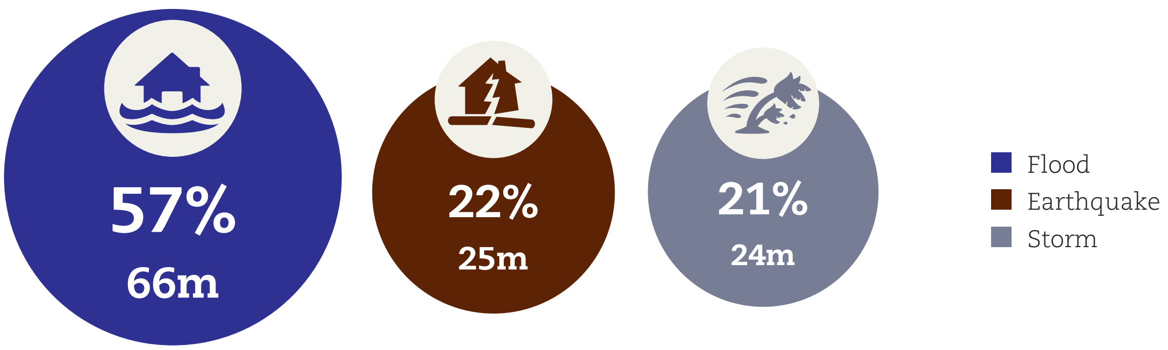
Flooding damaged more housing worldwide **(Figure 19)** and more schools and hospitals **(Figure 20)** than any other type of disaster. In total, EM-DAT recorded more than 185,000 health and education facilities either damaged or destroyed worldwide over the 20-year period **(Figure 20)**.

Once again, EM-DAT data highlight **disparities** between upper- and lower-income countries, with lower-income countries experiencing greater damage to all three types of property recorded in the database: housing, health facilities and education infrastructure. For example, higher building standards in high-income countries are reflected in the fact that just 3% of damaged housing occurred in these countries **(Figure 21)**, even though they suffered a broadly similar number of disasters as other income groups between 1994 and 2013.

In total, more than 116 million homes were damaged by disasters worldwide in the period 1994-2013, with the majority (60%) in upper-middle-income countries. This total largely reflects events in China where 64 million homes were damaged (i.e. 93% of the total for upper-middle-income countries). Excluding China, lower-middle income countries ranked highest in terms of damaged housing.

Figure 19

Houses damaged[7] per disaster type (1994-2013)



[7] Rodriguez-Llanes, J.M., Ranjan-Dash, S., Degomme, O., Mukhopadhyay, A., Guha-Sapir, D. (2011). "Child malnutrition and recurrent flooding in rural eastern India: a community-based survey". BMJ Open 2001;1: e000109.

Figure 20

Health and education facilities damaged by disaster type (1994-2013)

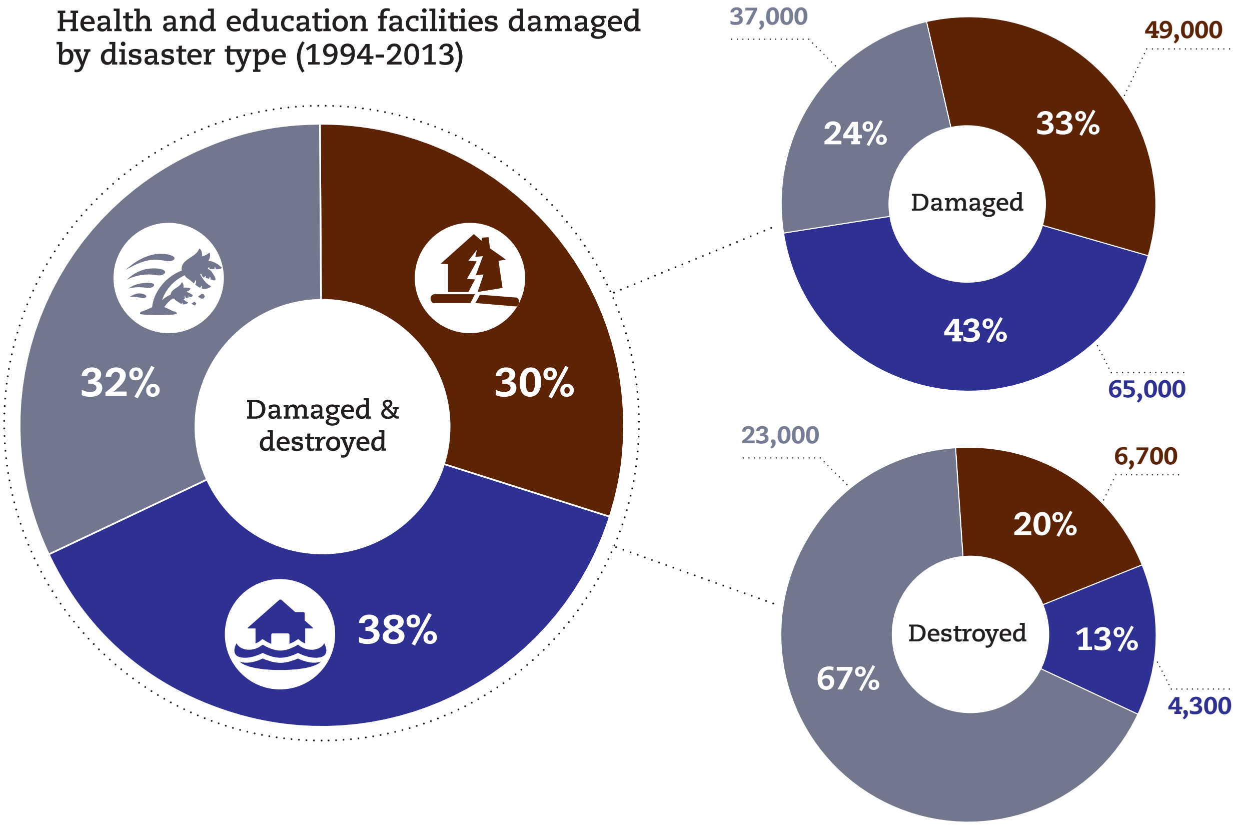
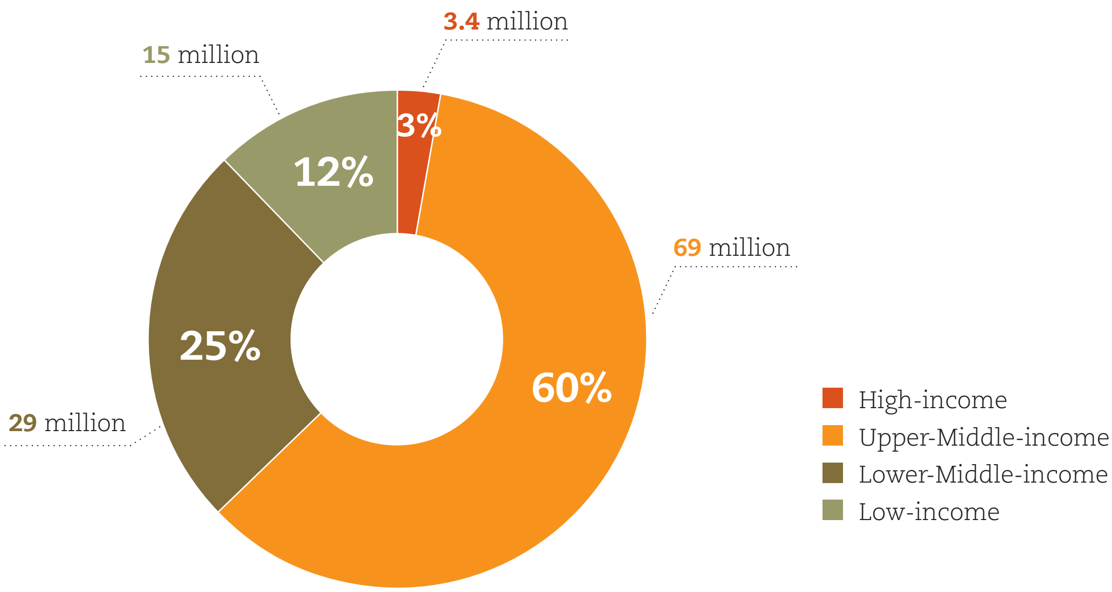


Figure 21

Houses damaged per income group (1994-2013)



BOX | 7

Nepal vs Chile: how national income level affects earthquake impacts

Impacts will, of course, depend on the magnitude of the disaster, its location, the local population density, the warning systems available, the strength of local buildings and policies in place to strengthen "non-resistant-to-earthquakes" infrastructure. Some of these characteristics can be altered, but the geographical location and the magnitude of the disaster cannot.

Table 2 illustrates how much harder low-income countries are hit by natural disasters than high- income countries experiencing a similar event. In this case, two earthquakes: one in low-income Nepal, the other in high-income Chile.

In this example, the total number of deaths was slightly higher in Chile than Nepal (the magnitude of the earthquake was also higher in Chile than Nepal) but all other indicators show that Nepal suffered a greater impact, with 168,000 people affected and more than 33,000 houses damaged or destroyed, compared with fewer than 28,000 people affected in Chile and the damage and destruction of 9,300 houses.

Table 2

	Chile	Nepal
Disno	2005-321	2011-351
Magnitude (Richter scale)	7.9	6.9
Deaths	11	7
Affected	27.645	167.949
Houses damaged	8.800	25.272
Houses destroyed	550	8.300
Commercial damaged	0	204
Commercial destroyed	0	63
Health damaged	0	38
Health destroyed	1	26
Education damaged	0	387
Education destroyed	0	111

Damage to health and educational infrastructure occurred overwhelmingly (85%) in low- and lower-middle income countries **(Figure 22)**. In lower-income countries, for example, Cyclone Sidr destroyed more than 4,000 schools in Bangladesh in 2007. Peru lost 600 health facilities in one cyclone in 1997, an earthquake in Pakistan destroyed more than 600 health facilities in 2005, while a tropical cyclone in 1999 devastated 11,000 schools in India.

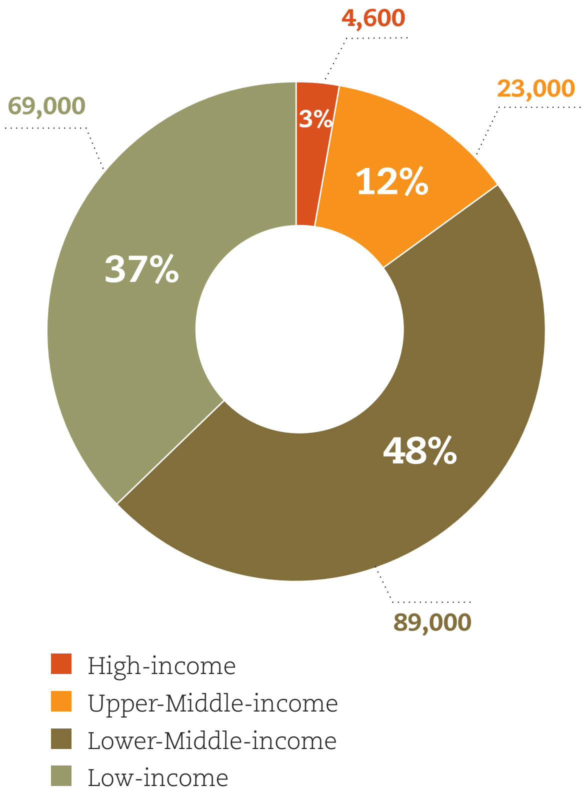
As other studies have shown, **preparedness and response planning** would be aided by a better **understanding of the relative** impact of poor building practices on disaster mortality figures. DRR managers could then compare quantified data with the effectiveness of evacuation procedures, for example, and identify where it would be best to target new measures. Meanwhile, given the vulnerability of health and education infrastructure in lower-income countries, initiatives such as the UNISDR Safe Schools campaign should be fully supported.

ACTION POINT

In view of the importance of health and education to development, a high priority should be given to national and international efforts to protect health and education infrastructure from disaster damage and destruction in lower-income countries.

Figure 22

Health and education facilities damaged by income group (1994-2013)



BOX 8

Homelessness, displacement and need for better data for planning

Improvements in preparedness for natural disasters in recent years, including effective early warning systems and evacuation procedures, mean that more people now survive these events than in the past. Without homes, however, many survivors become displaced.

Based on EM-DAT data, the IDMC last year estimated that 22 million people in at least 119 countries were displaced by natural disasters in 2013, about three times as many as were newly displaced by conflict and violence[8].

In CRED's view, more systematic data collection about damage to housing and infrastructure, using standardized protocols, would be a valuable step towards better disaster analysis at the global level. One useful move in this direction is the creation of 72 loss accounting databases at national levels by UNISDR/UNDP/LaRed.

They can be consulted on:
http://www.desinventar.net/index

ACTION POINT

Given the importance of data for effective planning, better disaster data collection about damage to buildings would improve global and local impact analyses, aid monitoring of mitigation efforts and help decision-makers to target new measures more effectively.

[8] IDMC 2014: Global Estimates 2014: People displaced by disasters

BOX | 9

Combining severity & frequency data: a guide to resilience

As economies develop, industrialization and urbanization increase population densities. When this development occurs in areas at high risk of natural hazards, the frequency of disasters increases because more people are in harm's way.

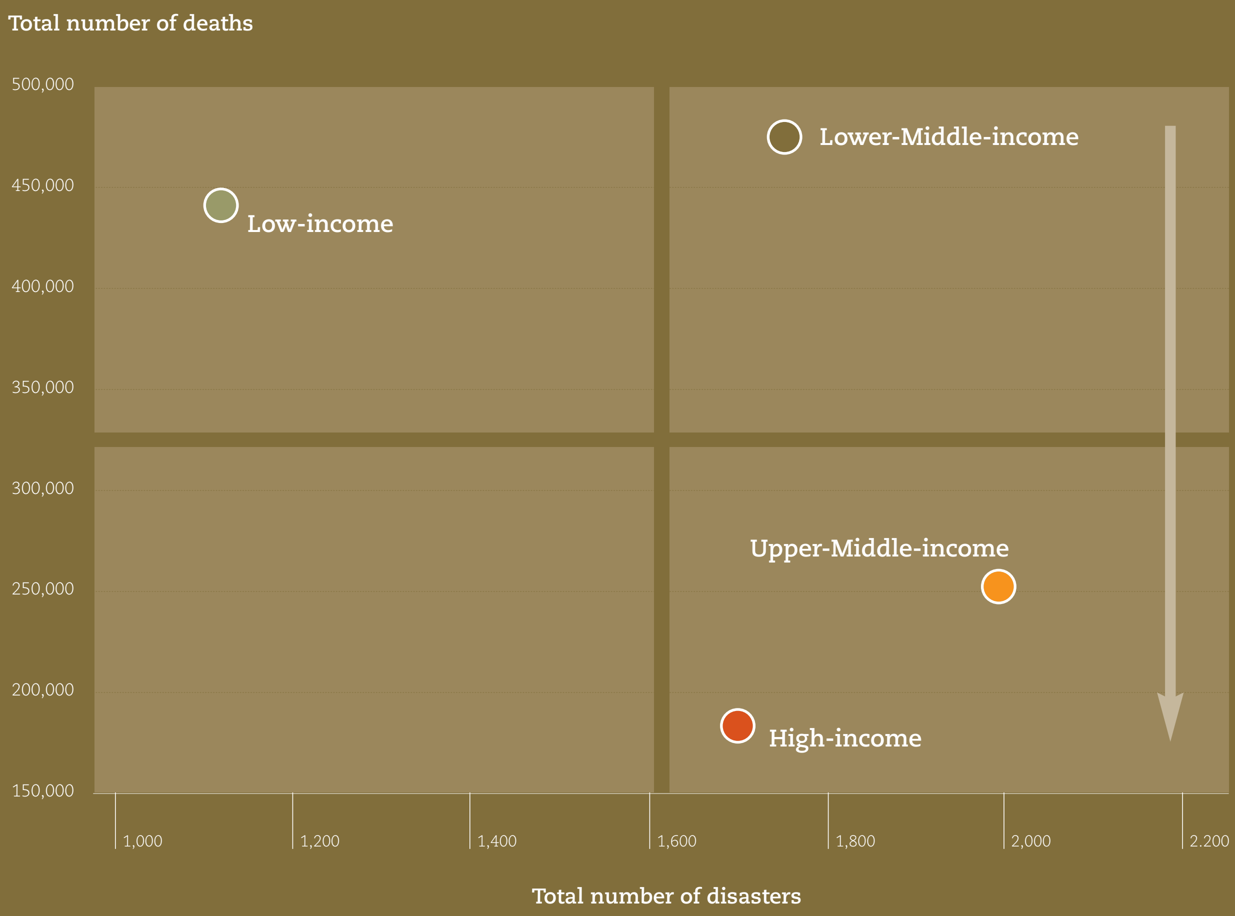
The number of deaths per event is one important measure of the severity of a disaster. The combination of the total of disaster deaths with the frequency over the period 1994-2013 (Figure 23) illustrates relative exposure to natural disasters, in this case for countries grouped by income level. The graph is divided into quadrants to aid comprehension and also to demonstrate its usefulness as a policy tool.

When applied at the country level, its principal use is to review the relative experience of disasters within a region, balancing the frequency of disasters and the magnitude of their impact. It can thus serve as a guide to identify which population's risk factors require closer analysis and which countries have been able to control disaster impacts more effectively. If there are lessons to be learnt from positive local experiences, these could potentially be translated into policies in neighbouring countries.

This graph could also help to monitor the evolution of mitigation efforts over time. While the frequency of hazards cannot be altered, deaths can be reduced (as indicated by the downward arrow on the right). If Country A moved from the "bad" upper-left quadrant to the lower-left quadrant, that would show disaster deaths were falling, suggesting successful mitigation efforts. But if Country B rose from the "good" lower-right quadrant to the upper- right quadrant, that might flag up a need to re-evaluate preparedness and response measures since death tolls would be rising. Of course, during any such monitoring, the intensity of disasters which hit these countries would also have to be taken into account.

Figure 23

Severity and frequency of natural disasters by income group (1994-2013)



Chapter | 4

Counting the economic costs of disasters

Introduction

Natural disasters cause major economic losses around the globe, with the recorded costs of climate-related disasters far outweighing the direct economic impacts of earthquakes and other geophysical events. In sum, EM-DAT recorded total losses of US$ 2,600 billion[9] over the period 1994-2013. Some commentators suggest that this total may be underestimated by as much as 50%. However, in the absence of standard methodology, the degree of bias is guesswork.

[9] All economic losses and GDP are adjusted at 2013 US$ value

EM-DAT data show that **storms** are the **most expensive** type of disaster in terms of recorded lost assets (US$ 936 billion), followed by earthquakes (US$ 787 billion) and floods (US$ 636 billion) **(Figure 24)**. In terms of absolute values, losses in **Asia** accounted for 50% of the total, followed by the Americas at 35% **(Figure 25)**. Insured losses were much greater in higher- income countries, dwindling to almost nothing in low-income ones where insurance is beyond the reach of most people **(Figure 26)**.

As previously noted, while the occurrence of disasters was broadly similar in all income groups, low- and lower-middle-income countries reported more than two-thirds of the deaths **(see chapter 2)** but just 10% of economic losses. **High- and upper-middle-income countries** reported one third of the deaths but **90% of losses** in absolute values **(Figure 27)**.

Figure 24

Breakdown of recorded economic damage (US$) by disaster type (1994-2013)

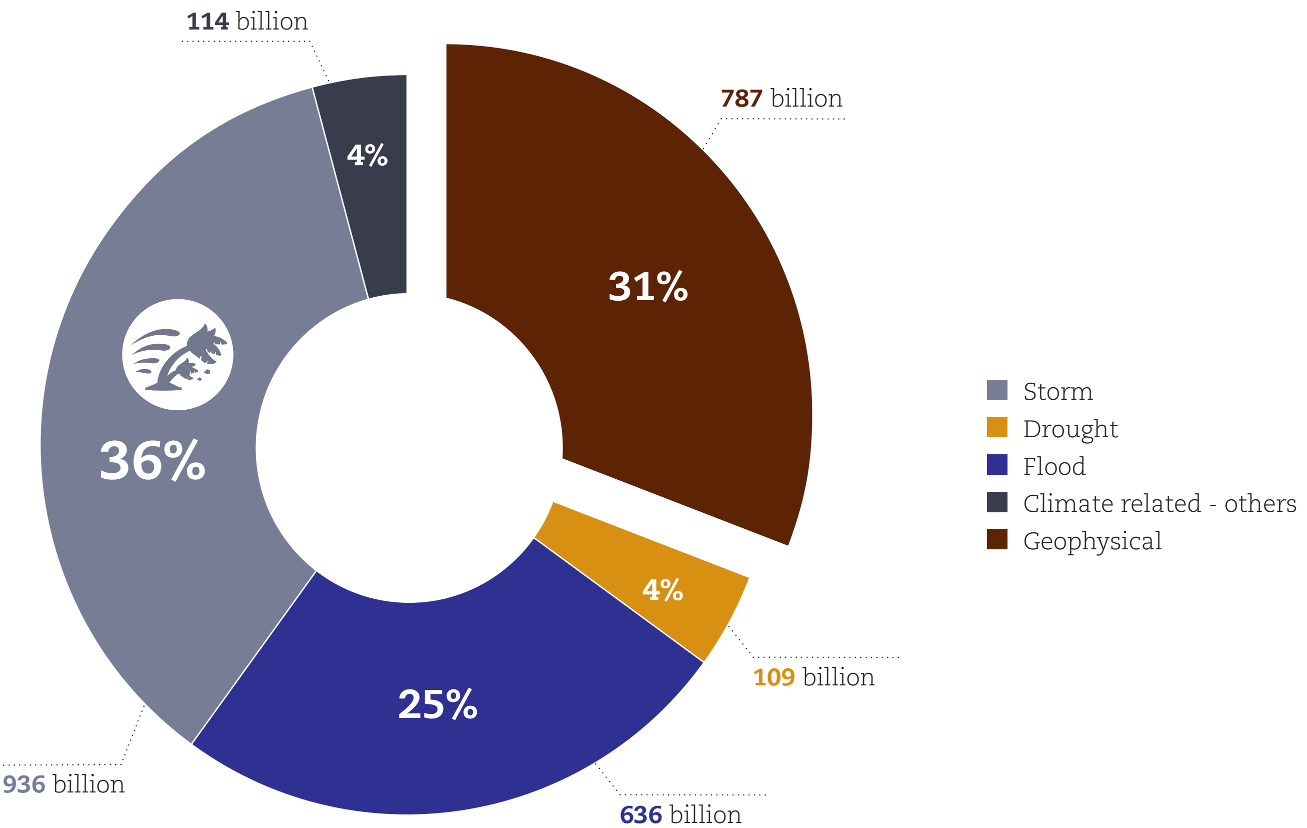


Figure 25

Absolute losses by continent (1994-2013)

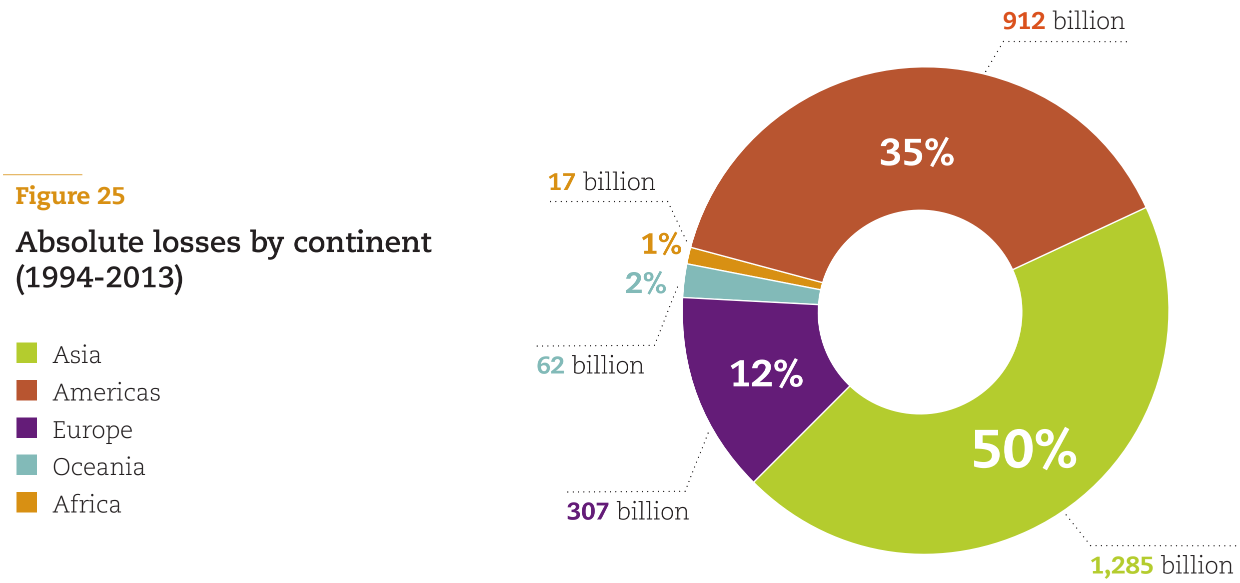


Figure 26

Economic losses and insured losses (US$) per income group (1994-2013)

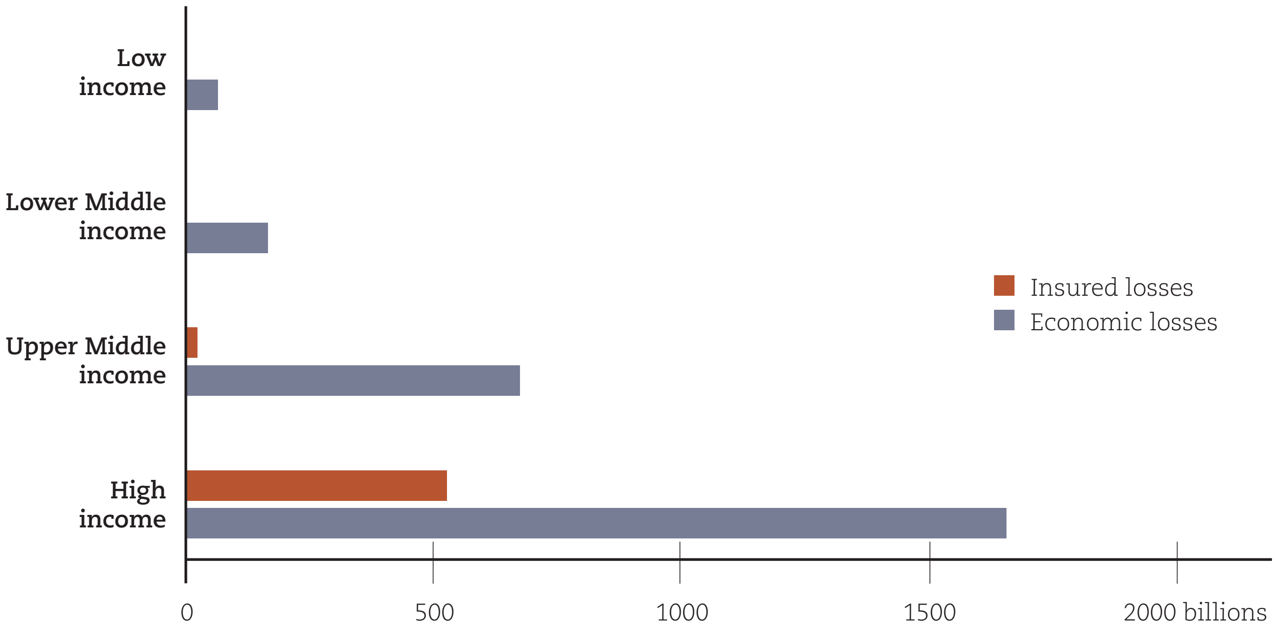
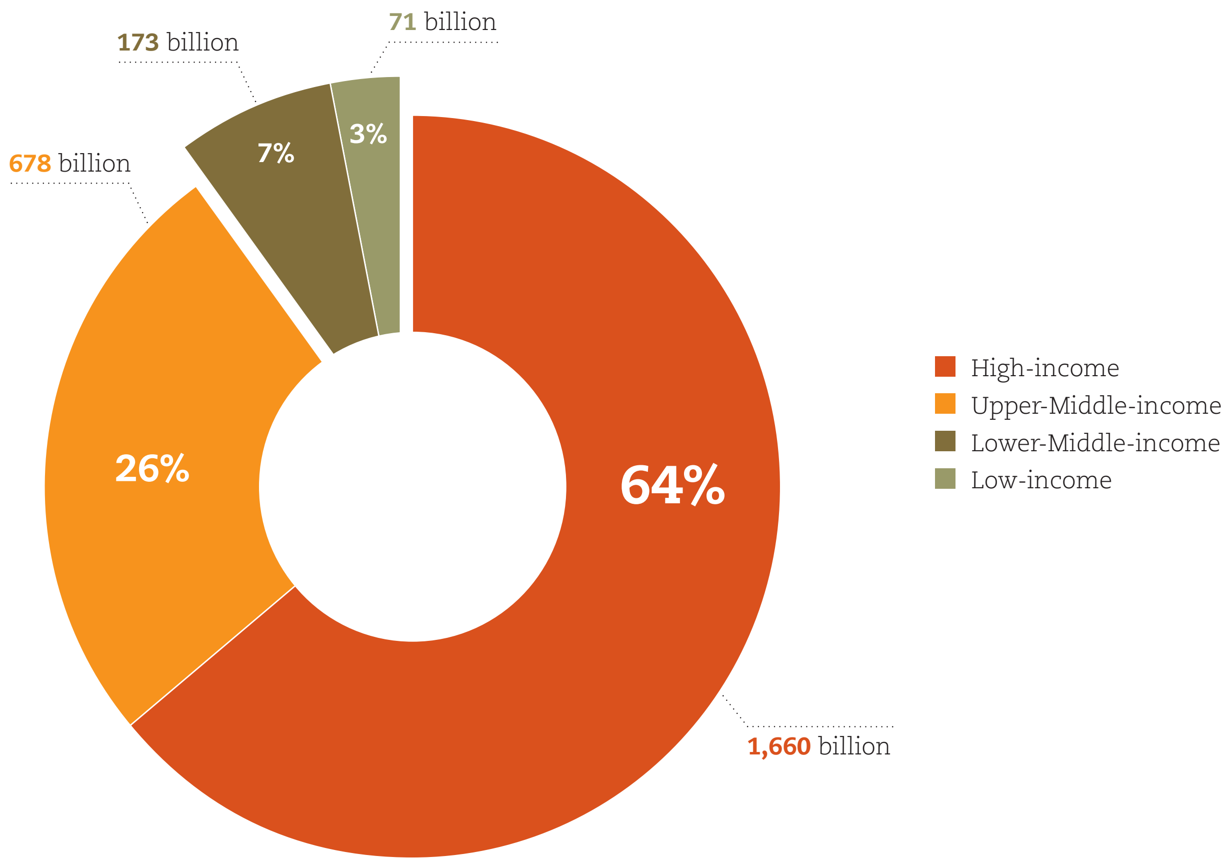


Figure 27

Income group analysis of economic damage (US$) (1994-2013)



BOX | 4.1

Economic losses due to one major disaster in most-affected countries

In the most disaster-affected countries in terms of GDP, just one type of disaster is the cause of the overwhelming majority of the recorded economic damage. For example, in DPR of Korea, 76% of recorded losses were due to floods between 1994 and 2013 (Figure 30). These losses correspond to 33% of the country's GDP on average. Similar percentages can be seen in Mongolia, Haiti, Yemen and Honduras. These data suggest that mitigation policies need to focus on the single most costly type of disaster.

Economic losses: absolute values vs. percentage of GDP

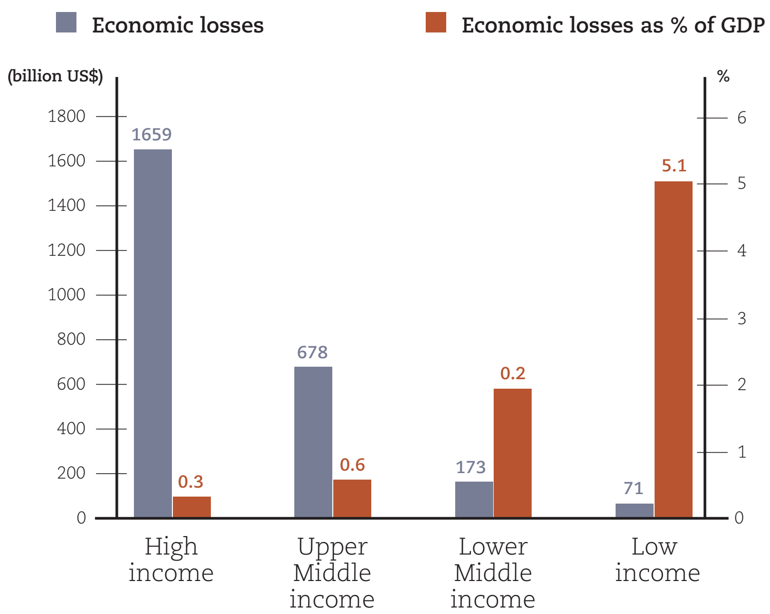
The global pattern of losses as a percentage of Gross Domestic Product (GDP) varies starkly from the pattern of global losses in absolute terms, reflecting the much smaller economies of low- and lower-income countries and the relatively greater economic impact of disasters on them. **Figure 28** illustrates how high asset values in high-income countries pushed up their recorded losses to US$ 1,660 billion dollars over the period 1994-2013. This compares to just US$ 71 billion recorded in low-income countries. As a proportion of GDP[10], however, the situation is reversed, with recorded losses amounting to just 0.3% of GDP in high-income countries, against 5.1% in low-income countries.

These GDP figures understate the real **disparity between rich and poor,** since under-reporting of losses is greater in low-income countries than high-income ones, a phenomenon discussed in more detail below.

The impact of natural disasters on national economies also varies greatly at the country level, depending on yardstick used **(Figures 29 & 30)**. In absolute values, the USA lost more than any other country between 1994 and 2013, following by Japan and then China. In terms of GDP, however, the losses were greatest in the Democratic People's Republic of Korea, followed by Mongolia and then Haiti.

Figure 28

Economic losses in absolute values and compared to GDP



[10] See technical notes for methodology

Figure 29

Top 10 countries reporting economic losses from natural disasters in absolute values (US$) 1994-2013

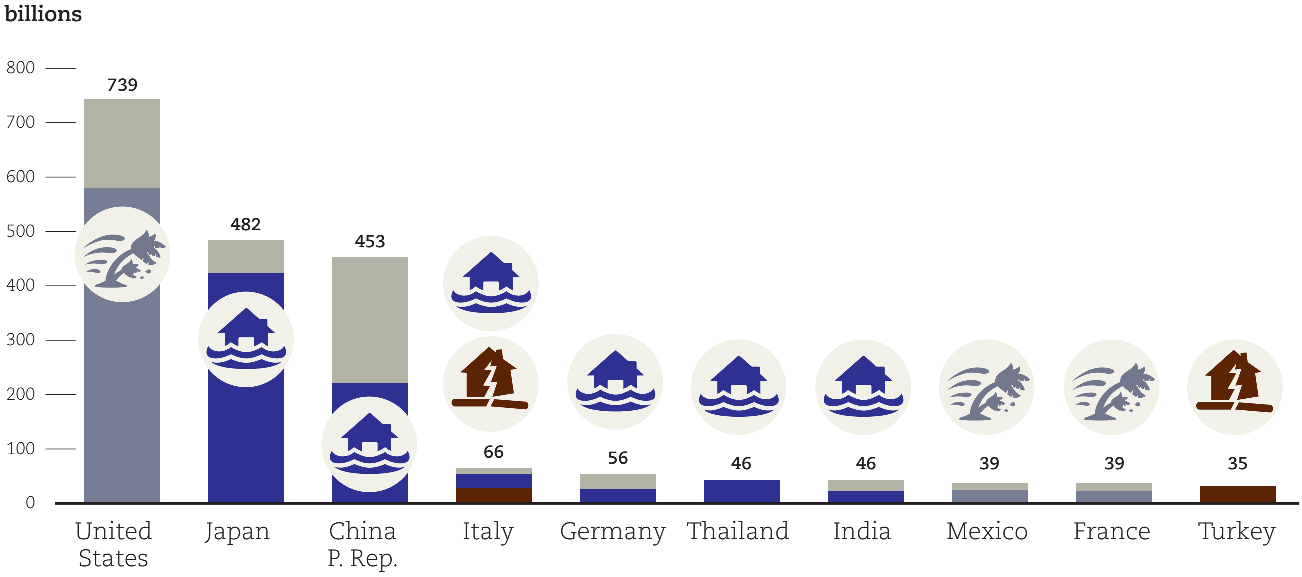
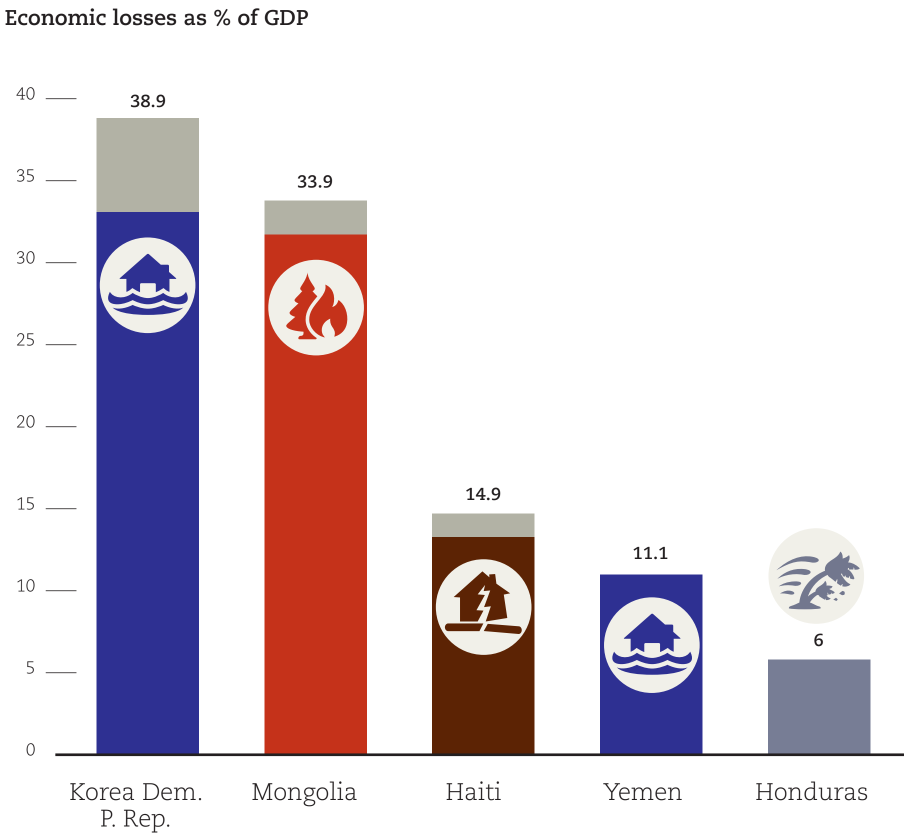


Figure 30

Top five countries ranked by losses as a percentage of GDP showing the impact of one disaster type (1994-2013)



Under-reporting of economic losses

Information on the economic damage caused by natural disasters is only available for 36% of disasters reported from 1994 to 2013. Records are particularly partial from Africa, where losses were reported from just 13% of events. Reporting levels vary according to the continent **(Table 3a)**, type of disaster **(Table 3b)** and the national income **(Table 3c)**. Such gaps in our knowledge should be of international concern at a time of limited financial resources and competing priorities.

With climate-related disasters set to increase, it is essential in our view to help lower-income countries to estimate their losses effectively in order for them (and the international community) to better understand which types of disaster cause the greatest losses. Choices about DRR action would then be more evidenced-based and therefore more likely to be effective. A review of case studies using different methodologies to calculate losses would be a major step forward in establishing a common and tested approach to estimating economic losses worldwide.

ACTION POINT

Reporting of economic losses should be improved, particularly for lower-income countries. Priority should also be given to a review of existing methodologies to estimate losses and the development of realistic, standard operational methods.

Table 3

Percentage of disasters (a) per continent, (b) by disaster type and (c) per income group for which economic losses were reported (1994-2013)

a)	%
Africa	12
Americas	39
Asia	41
Europe	40
Oceania	52
b)	
Drought	30
Earthquake	41
Extreme temperature	11
Flood	33
Landslide	11
Mass movement (dry)	10
Storm	53
Volcanic activity	11
Wildlife	33
c)	
High-income	51
Low-income	14
Lower-Middle-income	34
Upper-Middle-income	37

Chapter | 5

Spotlight on Small States[11]

Introduction

Small states are defined by the World Bank as those with populations of 1.5 million or less. Many of them face **economic challenges** which larger countries do not, due, for example, to their small domestic markets, narrow resource bases, limited diversification in terms of produce and exports, and diseconomies of scale. Some small states are isolated, which increases transport costs; others have open economies, making them vulnerable to external shocks from global markets.

[11] See technical notes

Many small states are also **highly vulnerable to natural disasters.** Hurricanes, cyclones, droughts, volcanic eruptions and tsunamis typically affect the entire population of small nations, while some small island states and archipelagos also have to contend with storms, storm surges, landslides and flooding.

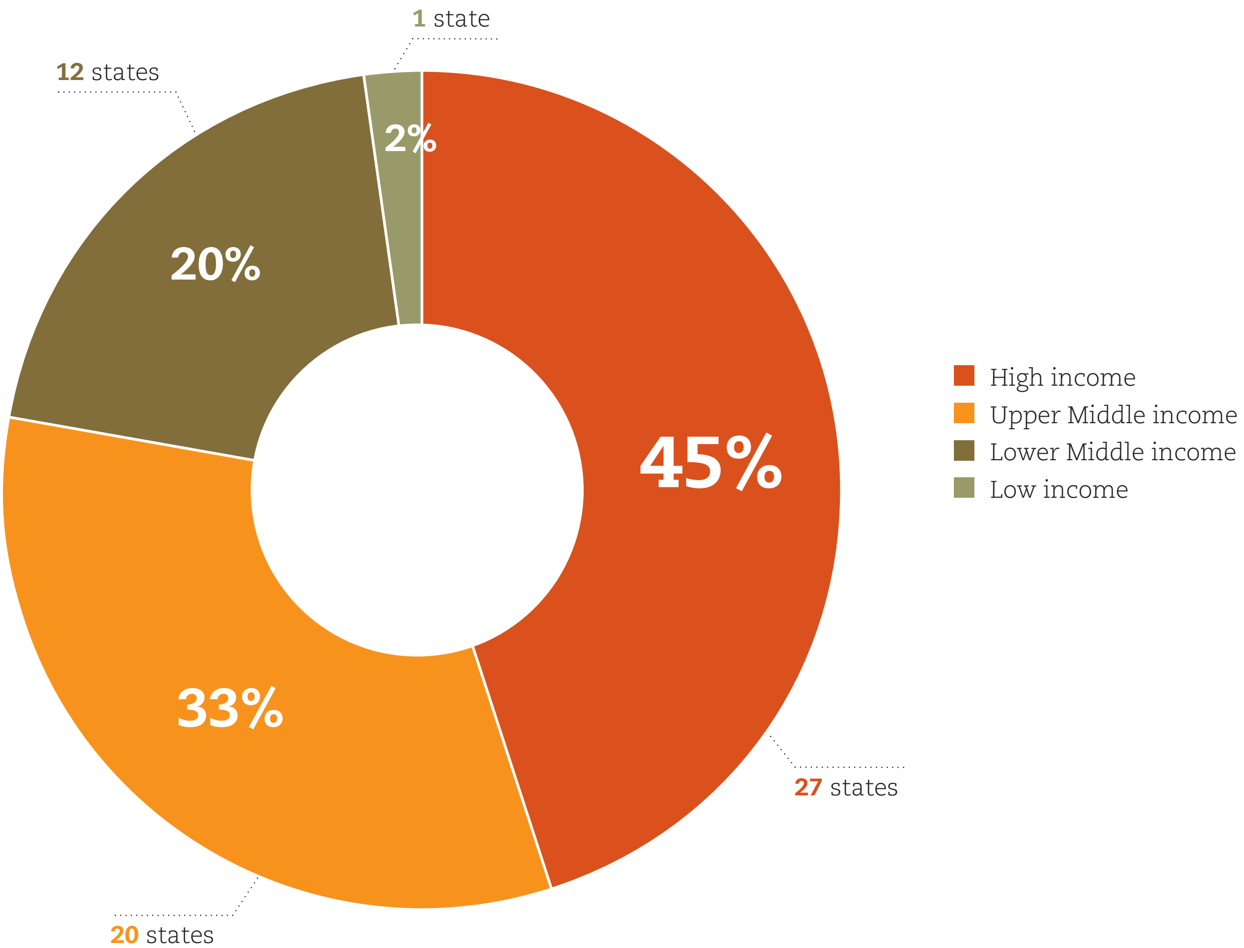
Small population sizes increase these vulnerabilities. If a high percentage of the national population is affected or killed, a natural disaster can have devastating **long-term impacts** on development and overall economic activity in these countries.

These problems are particularly severe for Small Island Developing States **(SIDS)**, many of which depend on agriculture, fishing (both subsistence and commercial) and tourism. SIDS with a high proportion of productive capital located on the coast are particularly at risk. Indeed, climate change and rising sea levels due to climate change threaten to destroy some low-lying SIDS altogether.

For others, the cost of recovering from natural disasters can overwhelm public finances, curtailing their options for future development. This can be true even if they are classified as high-income countries **(Figure 31)**. In high-income Grenada, for example, tropical cyclone Ivan caused economic losses equivalent to almost three times annual GDP in 2004. In view of the extreme vulnerability of small island states to natural disasters, some 40 of the 60 small states analyzed in this chapter are part of the SIDS network.

Figure 31

Number of small states in PAND sample by income group (1994-2013)



Disaster occurrence and impacts on small states

Storms are by far the most frequent natural hazard to affect small states, accounting for 54% of all recorded disasters in these nations between 1994 and 2013 **(Figure 32)**.

Predictions of **increasing numbers of storms** due to climate change is of particular concern to SIDS, not only because of the likely impacts on local people but also because storms can alter vegetation and water salinity, affecting agriculture and fisheries in the longer-term.

Figure 32

Disaster occurrence by type in small states (1994-2013)

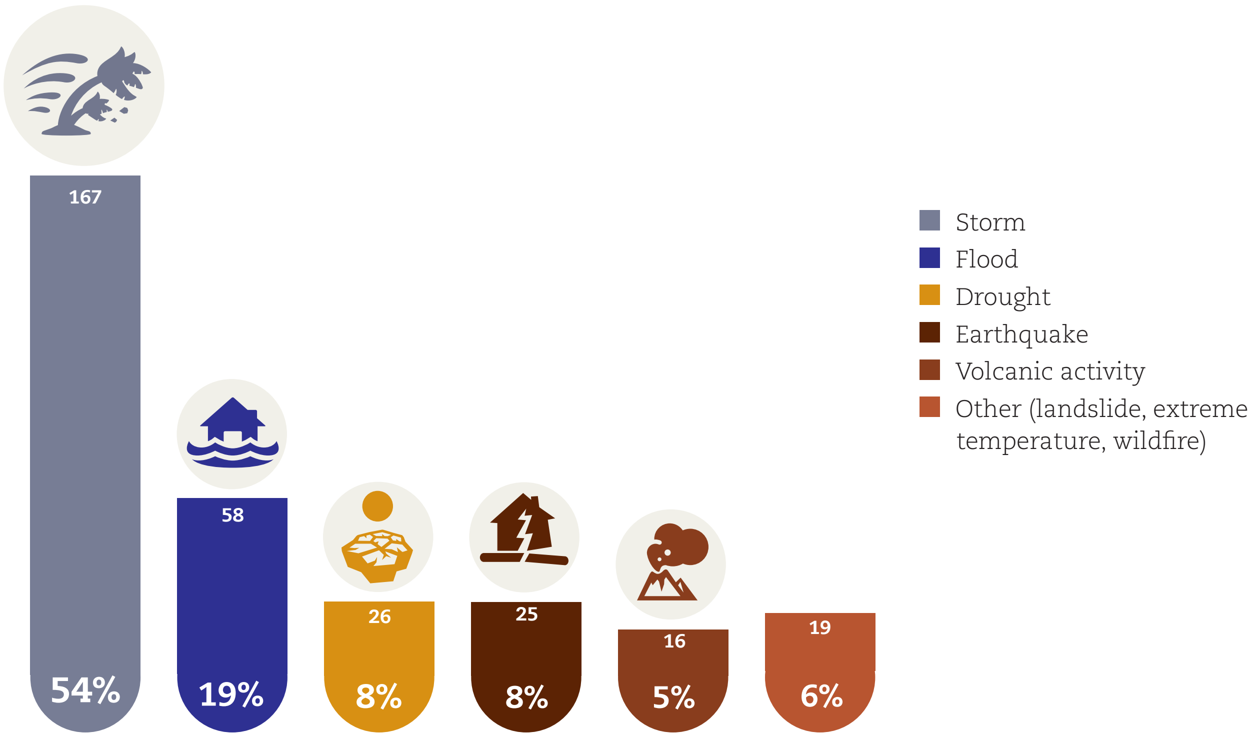


Figure 33 shows that the African nations of Swaziland and Djibouti experienced the highest number of people affected by natural disasters in the period 1994-2013, followed by three SIDS: Guyana, Fiji and St Lucia. Disaster death rates were highest in Bhutan, Djibouti, Luxembourg, Samoa and Vanuatu **(Figure 34)**.

In terms of the percentage of the total population affected by disasters, four out of the top five small states were **SIDS:** Kiribati, St Lucia, Monserrat and Niue **(Figure 35)**. **Figure 36** shows that economic impacts were severe for small states. In the Caribbean, natural disasters caused losses equivalent to 79.4% of the GDP in St Kitts and St Nevis, and 74.8% in Grenada. Dominica, the Cayman Islands and the Maldives suffered broadly similar (and very high) disaster-related losses as a percentage of GDP. These figures highlight the extreme economic vulnerability of SIDS and other small island states to natural disasters.

Figure 33

Top five small states with populations most affected by natural disasters (1994-2013)

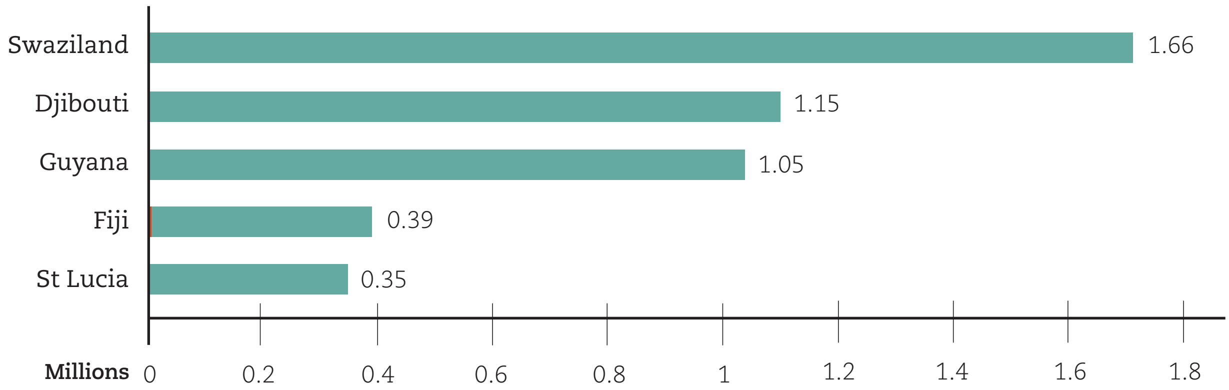


Figure 34

Top five small states ranked by natural disaster death tolls (1994-2013)

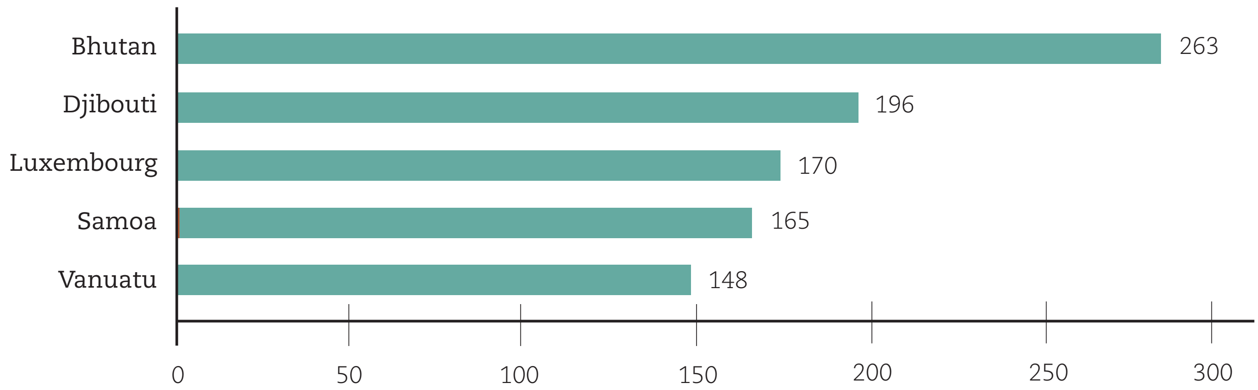


Figure 35

Top five small states per proportion of total population affected by natural disasters (1994-2013).

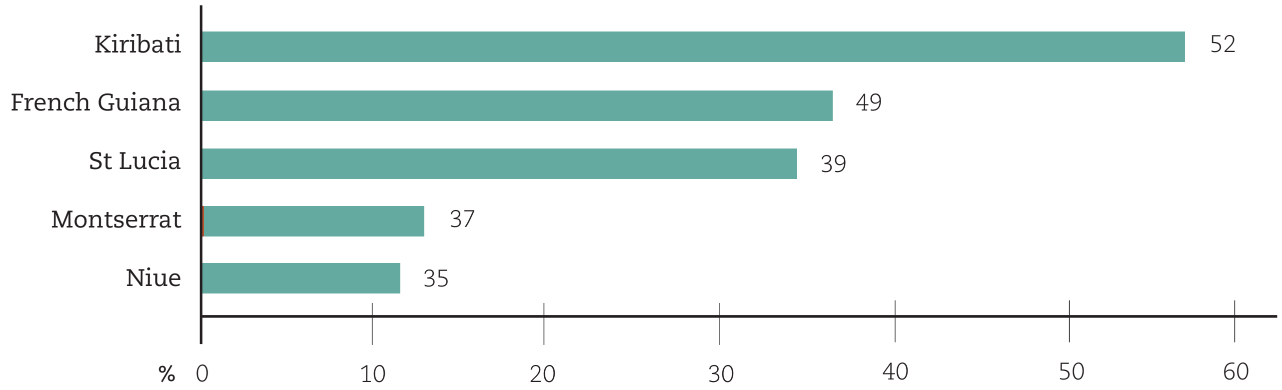
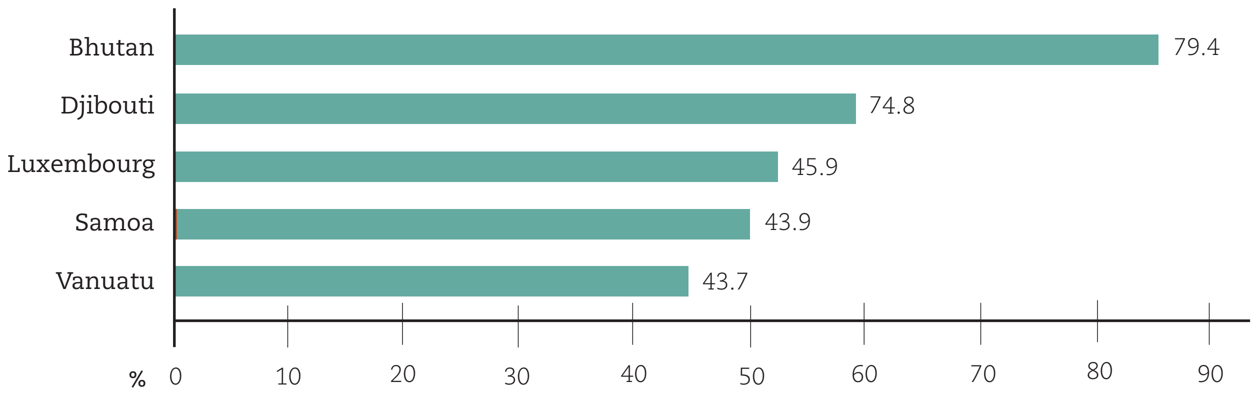


Figure 36

Top five small states ranked by disaster-related economic losses as percentage of GDP (1994-2013)



Chapter 6

The power of maps: georeferencing EM-DAT data

Introduction

Since 2014, CRED has been taking the first steps towards integrating EM-DAT data into a **Geographic Information System (GIS).** Termed "georeferencing", the aim of this project is to identify and map the impacts of disasters as precisely as possible. By presenting this data in map form, the project also will make the "footprint" of disasters more **visual** and therefore more **accessible** to disaster planners and policy-makers, as well as the general public.

Georeferencing will also aid disaster **research** since it will allow EM-DAT data to be merged with other standardized or georeferenced datasets (about population or income within disaster-affected areas, for example). This will move studies into risk and vulnerability from the macro- to the micro-level, which in turn will help planners to refine disaster mitigation and response measures.

Existing EM-DAT data is already being georeferenced; future data will be incorporated into the new recording system. Increasingly, therefore, information about disasters will be recorded in terms of administrative units where natural hazards have affected people and/or damaged infrastructure, rather than listing events.

For this project, CRED is using the **standardized** FAO Global Administrative Unit Layers (GAUL) dataset combined with the reported affected administrative units present in EM-DAT. Each GAUL administrative unit is labelled with a unique identifier and is already geocoded.

Each EM-DAT disaster record will contain the unique GAUL codes of the **administrative units affected,** together with the **coordinates** of their centroids (or geometric centres) **(Table 4)** plus a map representing the area affected **(Figure 37).**

Table 1

Example of the results of geocoding two disasters in Angola: codes of the affected administrative units (Level 1 or Level 2) and coordinates of their centroids

Year	Seq	Country name	Location	Adm1 code	Adm2 code	Lat centroid	Long centroid
2000	2	Angola	**Dombre-Grande** (Baia Farta-BenguelaProvince), **Massangano** (Cambambe-Kwanza Norte Province)		4214/4291	-13.1/-9.5	13.1/14.5
2001	146	Angola	**Namibie city, Macala, Lucira** (Namibie), **Bibala, Camacuio** (Namibie province), **Luacho, Senje, Muhaningo, Seco, Dombre-Grande, Canto** (Baia Farta-Benguela province), **Lubango, Quipongo, Caluquembe** (Huila province), **Namacunde, Xangongo** (Ombadja), **Onjiva** (Cuanhama) (Cunene province), **Luanda city, Bengo province**	408/398	4339/4337 4338/4214 4284/4287 4276/4261 4262/4258 -/-	-14.7/-14.6 -14.0/-13.1 -14.9/-15.0 -14.0/-17.0 -16.7/-16.4 -8.9/-8.9	12.4/13.1 13.0/13.1 13.6/14.5 14.5/16.6 14.9/16.3 13.3/13.9

Figure 37

Map of two georeferenced earthquakes (El Salvador 2001)

Uses for georeferenced EM-DAT data

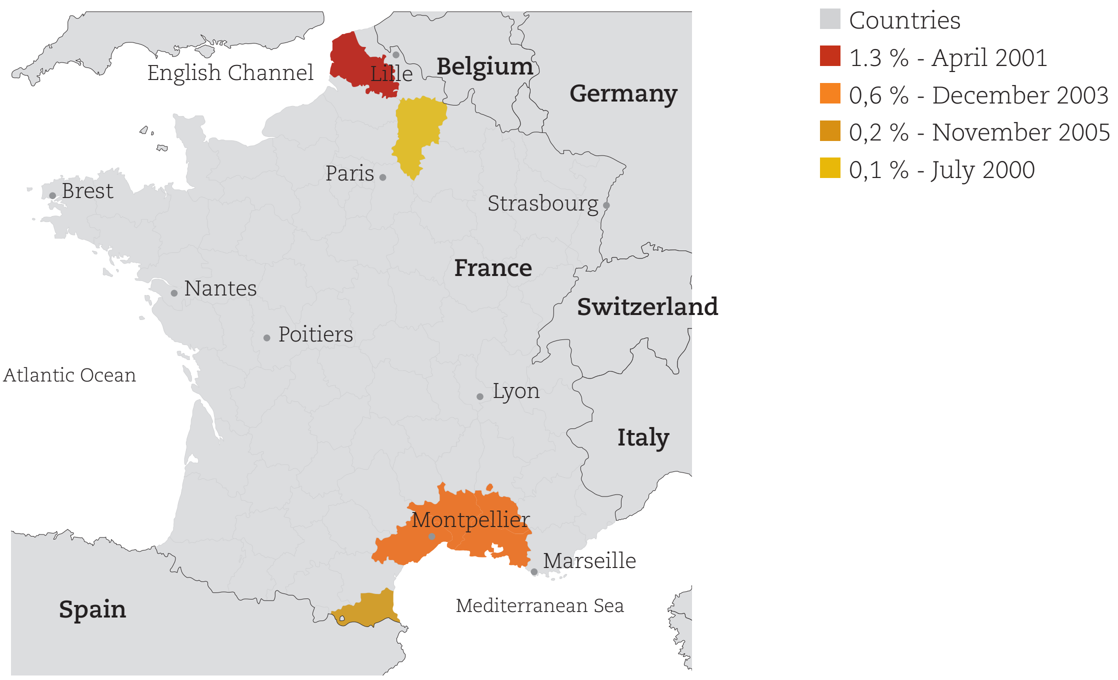
The **potential uses** of georeferenced EM-DAT data are **multiple**. When crossed with other georeferenced datasets, researchers will be able to study the relative effectiveness of different mitigation measures, or the **relationship** between certain events: whether a famine is occurring in the same place as a drought, for example. **Mapping** the footprint of a disaster will also help to answer questions about the full extent of its impacts, and the relationships between its extent and its consequences. **Spatial analyses** also could highlight the different impacts of natural disasters on urban and rural regions, for instance.

Then, by presenting data in the form of a map, georeferencing can help identify information gaps more readily than, say, tabulated figures. For instance, if all the surrounding districts have recorded disaster impacts, but one district in the middle has not, it is reasonable to assume that this is due to a lack of communications from that one district, rather than a genuine absence of impacts there.

Georeferencing will also allow maps to be built up that show disaster deaths (or the number of people affected) as a **proportion** of the total Population Potentially Exposed (PPE). PPE is the sum of all people situated in the disaster-affected area. **Figure 38**, for example, maps the proportion of the affected population to the PPE during four floods in France between 2000 and 2005. Studies into the **vulnerability** of a population could then be conducted by comparing the PPE to actual deaths or numbers of people affected during past events, while future vulnerability could be simulated by merging population growth forecasts with georeferenced EM-DAT data. Clearly, analyses based on PPE will be more accurate than ones based on national population, since not all of a country's population is exposed to a disaster. With the help of georeferencing, it will be possible to **refine** PPE, going from macro- to micro-level analyses.

Figure 38

Proportion of population affected to Population Potentially Exposed (PPE) to four floods in France



Hitherto, impact modelling has carried a high level of uncertainty and is often based on assumptions, rather than hard data. Observed impacts are more reliable indicators of the likely consequences of future events. Thus by incorporating past EM-DAT records into this new recording system, georeferencing will help researchers to identify the most disaster-prone locations and populations at highest risk. Georeferencing can also be applied to economic damage, relating impacts to GDP or other economic indices such as mean income, for example, or household consumption. EM-DAT data can therefore be used to **localize areas where natural hazards pose significant risks to livelihoods as well as to lives.**

Technical Notes

Chapter | 1

Classification used for Figure 2

The classification was made with the *Jenks natural breaks method*. For more information: “PAND: Technical notes” on **www.emdat.be**

EM-DAT classification of natural disasters

EM-DAT’s classification of natural disasters aligns with the IRDR’s “Peril Classification and Hazard Glossary” which in turn is based on pre-existing work by Munich RE and CRED.
The IRDR’s classification is available online: **http://www.irdrinternational.org/2014/03/28/irdr-peril-classification-and-hazard-glossary/**

The natural disaster category is divided into 5 sub-groups, which in turn cover 15 disaster types and more than 30 sub-types. The EM-DAT classification is available on this page : **http://www.emdat.be/new-classification**

Chapter | 2

Calculation of population affected and number of deaths related to the population

To calculate this proportion, only population data for the year and country where a value for number of affected/deaths was available were taken into account. Thus if for certain years the number of people affected/deaths are nil or unknown, population for this country is not taken into account.

The percentage calculated is equal to the sum of number of people affected/deaths for a year ‘j’ multiply by 100,000 for the rate related to affected and by 1 million for the rate related to deaths, and divided by the population for the year ‘j’ for each country. The final rate for the country for the period 1994-2013 will be the average of the previous calculated rates.

$$\text{Number of people affected per 100,000 inhabitants for i} = \textit{average}\left(\frac{xij * 100{,}000}{\text{Population } ij}\right)$$

$$\text{Number of deaths per 1million inhabitants for i} = \textit{average}\left(\frac{xij * 1{,}000{,}000}{\text{Population } ij}\right)$$

X = population affected (x > 0)
i = country
j = year (from 1994 to 2013)

GNI vs. GDP

In this report, GNI was used to differentiate the countries into the 4 different categories, from high to low-income countries. The GDP was used to assess the burden of disaster on the development of the country while the economic losses were related to it.

GDP gives information about the value produced within a country’s borders. Whereas the GNI reveals the value produced by all the citizens within the country and overseas. In other words the GDP shows the strength of a country’s local income. The GNI focusses on the economic strength of the citizens of a country.

Chapter 4

Calculation of economic losses related to GDP

To calculate this proportion, only GDP data for the year and country where a value for economic losses was available were taken into account. Thus if for certain years the economic losses are nil or unknown, GDP for this country is not taken into account.

The percentage calculated is equal to the sum of economic losses for a year ‘j’, multiply by 100, and divided by the GDP for the same year ‘j’ for each country. The final percentage for the country for the period 1994-2013 is the average of the previous calculated percentages.

$$\text{Economic losses as \% of GDP for i} = \textit{average}\left(\frac{xij * 100}{GDP\ ij}\right)$$

X = economic losses (x > 0)
i = country
j = year (from 1994 to 2013)

Chapter 5

List of small states

The small states in PAND are 60 countries where the population is less than 1.5 million. 40 of those are SIDS. For more information: “PAND: Technical notes” on **www.emdat.be**

Annexes

Annex A: List of country per income group (World Bank, 2014)

For this report, CRED has adopted the World Bank (http://data.worldbank.org/) revised classification of the world's economies based on estimates of GNI per capita for 2013:

- Low-income: $1,045 or less
- Lower-middle-income: $1,046 to $4,125
- Upper-middle-income: $4,126 to $12,745
- High-income: $12,746 or more

High income	Upper Middle income	Lower Middle income	Low income
Australia	Albania	Armenia	Afghanistan
Austria	Algeria	Bolivia	Bangladesh
Belgium	Angola	Cameroon	Benin
Canada	Argentina	Congo Rep.	Burkina Faso
Canary Is.	Azerbaijan	Cote d'Ivoire	Burundi
Chile	Belarus	Egypt	Cambodia
Croatia	Bosnia-Herzegovina	El Salvador	Central African Rep.
Czech Rep.	Botswana	Georgia	Chad
Denmark	Brazil	Ghana	Eritrea
Finland	Bulgaria	Guatemala	Ethiopia
France	China Peop. Rep.	Honduras	Gambia
Germany	Colombia	India	Guinea
Greece	Costa Rica	Indonesia	Guinea Bissau
Hong Kong (China)	Cuba	Kyrgyzstan	Haiti
Ireland	Dominican Rep.	Lao Peop. Dem. Rep.	Kenya
Israel	Ecuador	Lesotho	Korea Dem. Peop. Rep.
Italy	Gabon	Mauritania	Liberia
Japan	Hungary	Moldova Rep.	Madagascar
Korea Rep.	Iran Islam Rep.	Mongolia	Malawi
Kuwait	Iraq	Morocco	Mali
Latvia	Jamaica	Nicaragua	Mozambique
Lithuania	Jordan	Nigeria	Myanmar
Netherlands	Kazakhstan	Pakistan	Nepal
New Zeland	Lebanon	Palestine (West Bank)	Niger
Norway	Libyan Arab Jamah	Papua New Guinea	Rwanda
Oman	Macedonia FRY	Paraguay	Sierra Leone
Poland	Malaysia	Philippines	Somalia
Portugal	Mexico	Senegal	Tajikistan
Puerto Rico	Montenegro Rep.	South Sudan	Tanzania Uni. Rep.
Russia	Namibia	Sri Lanka	Togo
Saudi Arabia	Panama	Sudan	Uganda
Slovakia	Peru	Syrian Arab Rep.	Zaire / Congo Dem. Rep.
Slovenia	Romania	Ukraine	Zimbabwe
Spain	Serbia	Uzbekistan	
Sweden	South Africa	Vietnam	
Switzerland	Taiwan (China)	Yemen	
United Kingdom	Thailand	Zambia	
United States	Tunisia		
Uruguay	Turkey		
	Turkmenistan		
	Venezuela		

Annex B: list of acronyms

CRED: Centre for Research on the Epidemiology of Disasters

DRR: Disaster Risk Reduction

EM-DAT: Emergency Events Database, the International Disaster Database

FAO: Food and Agriculture Organization of the United Nations

GAUL: Global Administrative Unit Layers

GDP: Gross Domestic Product

GNI: Gross National Income

HFA: Hyogo Framework for Action

IDMC: The International Displacement Monitoring Centre

IFRC: International Federation of Red Cross and Red Crescent Societies

IRDR: Integrated Research on the Disaster Risk

OFDA: Office of US Foreign Disaster Assistance

PPE: Population Potentially Exposed

SIDS: Small Island Developing States

UN: United Nations

UNISDR: United Nations International Strategy for Disaster Reduction

WHO: World Health Organization

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