THE HUMAN COST OF WEATHER RELATED DISASTERS

1995-2015

Centre for Research on the Epidemiology of Disasters
CRED

UNISDR
The United Nations Office for Disaster Risk Reduction

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Foreword

This publication provides a sober and revealing analysis of weather-related disaster trends over a twenty year time-frame which coincides with a period which has seen the UN Framework Convention on Climate Change Conference of the Parties become an established high- profile annual fixture on the development calendar. The contents of this report underline why it is so important that a new climate change agreement emerges from the COP21 in Paris in December.

This would be a satisfying conclusion to a year which started off strongly with the adoption in March of the Sendai Framework for Disaster Risk Reduction 2015-2030 which sets out priorities for action in order to achieve a substantial reduction in disaster losses. The Sendai Framework has since been followed by agreements on development financing and the ambition of the 17 Sustainable Development Goals adopted by UN Member States in September.

Climate change, climate variability and weather events pose a threat to the eradication of extreme poverty and should serve as a spur to hasten efforts not only to reduce greenhouse gas emissions but also to tackle other underlying risk drivers such as unplanned urban development, vulnerable livelihoods, environmental degradation and gaps in early warnings.

The report highlights many key shortcomings in understanding the nature and true extent of disaster losses, particularly from drought despite the fact that it accounts for more than 25% of all people affected by climate-related disasters.

There must be greater support to countries struggling to measure their losses so they can improve both risk reduction efforts and overall understanding of where the focus needs to be to reduce those very losses.

The more we understand the causes and consequences of risk generation and accumulation, the better we will be able to adapt, mitigate and prevent in the future, whatever that future may have in store for us.

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

Debarati Guha-Sapir
Professor
Centre for Research on the Epidemiology of Disasters
Institute of Health and Society
Université Catholique de Louvain (UCL), Belgium

Who we are

CRED

The Centre for Research on the Epidemiology of Disasters (CRED) is the world's foremost agency for the study of public health during mass emergencies, including the epidemiology of diseases, plus the structural and socio-economic impacts of natural and technological disasters and human conflicts. Based since 1973 at the School of Public Health of the Université Catholique de Louvain, Belgium, CRED became in 1980 a World Health Organization (WHO) collaboration centre. Since then, CRED has worked closely with United Nations agencies, inter-governmental and governmental institutions, non-governmental organizations (NGOs), research institutes and other universities. Disasters preparedness, mitigation and prevention for vulnerable populations have also gained a higher profile within CRED's activities in recent years.

www.cred.be

EM-DAT

CRED's Emergency Events Database (EM-DAT) contains the world's most comprehensive data on the occurrence and effects of more than 21,000 technological and natural disasters from 1900 to the present day. 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 decision-making in disaster preparedness, provide objective data for assessing communities' vulnerability to disasters and to help policy-makers set priorities. In 1999, a collaboration between the United States Agency for International Development's Office Foreign Disaster Assistance (USAID/OFDA) and CRED was initiated. Since 2014, EM-DAT also georeferences natural disasters, adding geographical values to numeric data which is essential for deeper analysis.

Details of EM-DAT's methodology and partner organizations can be found on our website **www.emdat.be**

UNISDR

The UN Office for Disaster Risk Reduction was established in 1999 and serves as the focal point in the United Nations System for the coordination of disaster risk reduction. It supports the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 which maps out a broad people-centered approach towards achieving a substantial reduction in disaster losses from man-made and natural hazards and a shift in emphasis from disaster management to disaster risk management. UNISDR and partners produce the biennial Global Assessment Report on Disaster Risk Reduction which provides evidence for the integration of disaster risk reduction into private investment decision-making and public policy in urban, environmental, social and economic sectors. UNISDR also coordinates the Making Cities Resilient Campaign and Worldwide Initiative for Safe Schools and engages with governments in developing national disaster loss databases.

www.unisdr.org

Executive Summary

Over the last twenty years, the overwhelming majority (90%) of disasters have been caused by floods, storms, heatwaves and other weather-related events. In total, 6,457 weather-related disasters were recorded worldwide by EM-DAT, the foremost international database of such events. Over this period, weather-related disasters claimed 606,000 lives, an average of some 30,000 per annum, with an additional 4.1 billion people injured, left homeless or in need of emergency assistance.

Weather-related disasters are becoming increasingly frequent, due largely to a sustained rise in the numbers of floods and storms. Flooding alone accounted for 47% of all weather-related disasters (1995-2015), affecting 2.3 billion people, the majority of whom (95%) live in Asia. While less frequent than flooding, storms were the most deadly type of weather-related disaster, killing more than 242,000 people in the past 21 years; that is 40% of the global total for all weather-related disasters. The vast majority of these deaths (89%) occurred in lower-income countries, even though they experienced just 26% of all storms.

Heatwaves and extreme cold were particularly deadly in terms of the numbers of lives lost in each event (405 deaths per disaster on average). High-income countries reported that 76% of weather-related disaster deaths were due to extreme temperatures, mainly heatwaves. Overall, mortality from heatwaves helped push the average toll from weather-related disasters up to 99 per event in high-income countries. This is second only to lower-middle-income countries in terms of the average number killed per disaster. While this ranking is subject to reporting bias (due in part to under-recording in low-income countries) the data still demonstrate the widespread impact of weather-related disasters on rich and poor alike.

In total, EM-DAT recorded an average of 335 weather-related disasters per year between 2005 and 2014, an increase of 14% from 1995-2004 and almost twice the level recorded during 1985-1994. While scientists cannot calculate what percentage of this rise is due to climate change, predictions of more extreme weather in future almost certainly mean that we will witness a continued upward trend in weather-related disasters in the decades ahead.

In order to plan for future risk reduction, two critical factors must be kept in mind: population growth will continue to put more and more people in harm's way, while uncontrolled building on flood plains and storm-prone coastal zones will increase human vulnerabilities to extreme weather events. The cost of such vulnerability is already evident from mounting death tolls since 1995, which have risen on average despite an overall decline in the absolute and relative numbers of people affected by weather-related disasters.

The true economic cost of weather related disasters is also bleaker than EM-DAT data suggest (US$ 1,891 billion), since only 35% of records include information about economic losses; in Africa the figure is as low as 16.7%. Overall, annual economic losses from disasters are estimated by UNISDR at between US$ 250 billion and US$ 300 billion extrapolating from a study of nationally-reported disaster losses.

The reporting gaps underline the need for UNISDR and partners to continue working with governments to establish robust and well-maintained national disaster loss databases to improve record-keeping and accountability. Universally acceptable loss indicators are currently under development to measure progress in reducing disaster losses as set out in the Sendai Framework for Disaster Risk Reduction 2015-2030.

BOX 1
Natural disasters

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
- 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.

For details about the definitions used in this report, please see: **http://www.emdat.be/explanatory-notes**

BOX 2
Hazards versus disasters

In this report, the term hazard refers to a severe or extreme event such as a flood, storm, cold spell or heatwave etc. which occurs naturally anywhere in the world. Hazards only become disasters when human lives are lost and livelihoods damaged or destroyed. Rises in the global population increase the risk of disasters because more people live in harm's way.

These statistics and others in this report point to several major conclusions:

- While better data are required to count the full human cost, EM-DAT records already demonstrate that weather-related disasters impact heavily on rich and poor alike.
- Economic losses from weather- and climate-related disasters have been heavily influenced by increasing exposure of people and economic assets.
- Better management, mitigation and deployment of early warnings could save more lives in future.
- Better flood control for poorer communities at high risk of recurrent flooding would be another step forward. Effective low-cost solutions exist, including afforestation, reforestation, floodplain zoning, embankments, better warnings and restoration of wetlands.
- Reducing the size of drought-vulnerable populations should be a global priority given the effectiveness of early warnings and the fact that one billion people have been affected over the last twenty years.
- There is a requirement for strengthening disaster risk governance to manage disaster risk with clear vision, competence, plans, guidelines and coordination across sectors.
- Public and private investment in disaster risk prevention and reduction through structural and non-structural measures needs to be stepped up to create disaster-resilient societies.

Chapter | 1

Weather-related disasters 1995-2015[1]

Introduction

Between 1995 and 2015, EM-DAT recorded 6,457 weather-related disasters, which claimed a total of 606,000 lives and affected more than 4 billion people. On average, 205 million people were affected by such disasters each year.

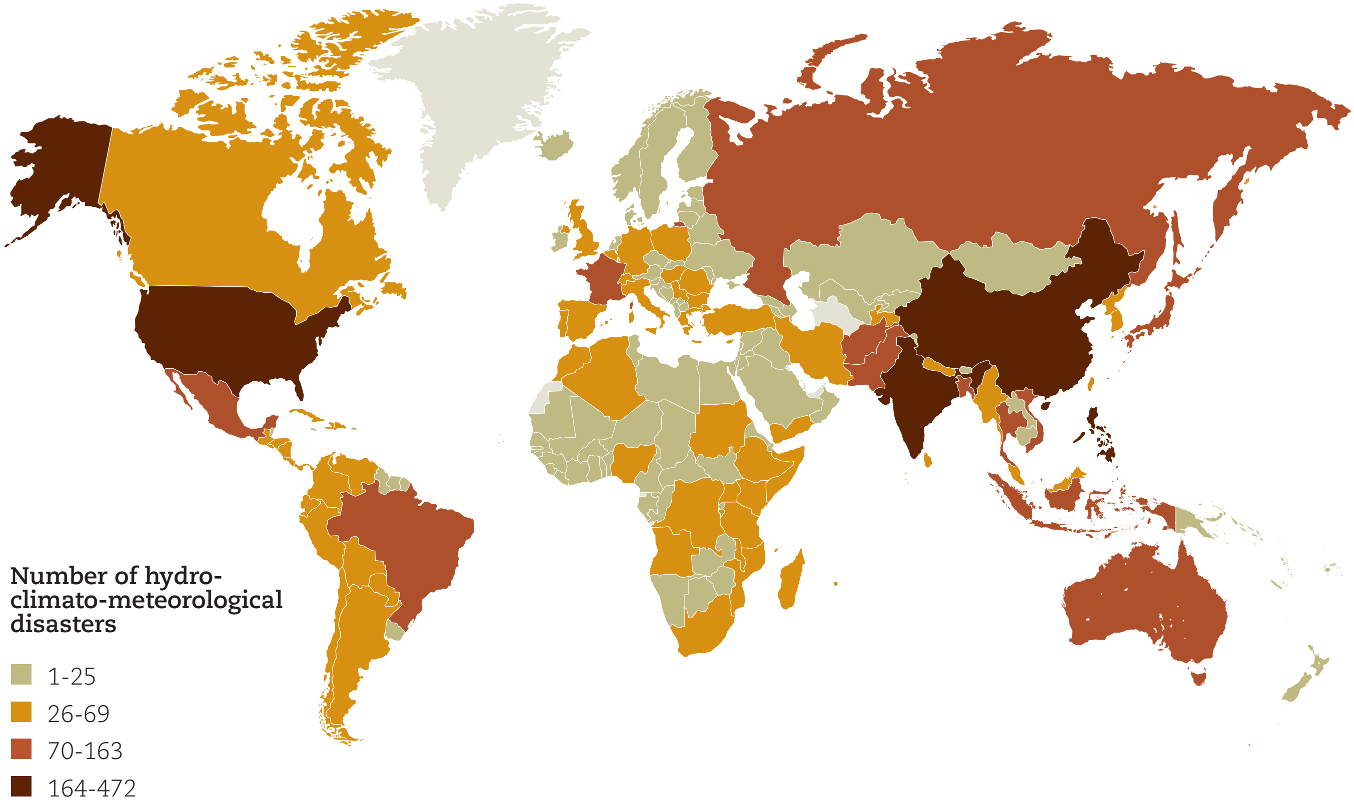
Asia bore the brunt of weather-related disasters, with more frequent events and greater numbers of people killed and affected than any other continent **(Figure 1)**. This is due mainly to Asia's large and varied landmass, including multiple river basins, flood plains and other zones at high risk from natural hazards, plus high population densities in disaster-prone regions. In total, 2,495 weather-related disasters struck Asia between 1995 and 2015, affecting 3.7 billion people and killing a further 332,000 individuals.

In terms of countries, USA and China reported the highest numbers of weather-related disasters during this period **(Figure 1)**. Again, this can be attributed to their large and heterogeneous landmasses and population concentrations.

[1] Data for 2015 are only until August 2015.

Figure 1

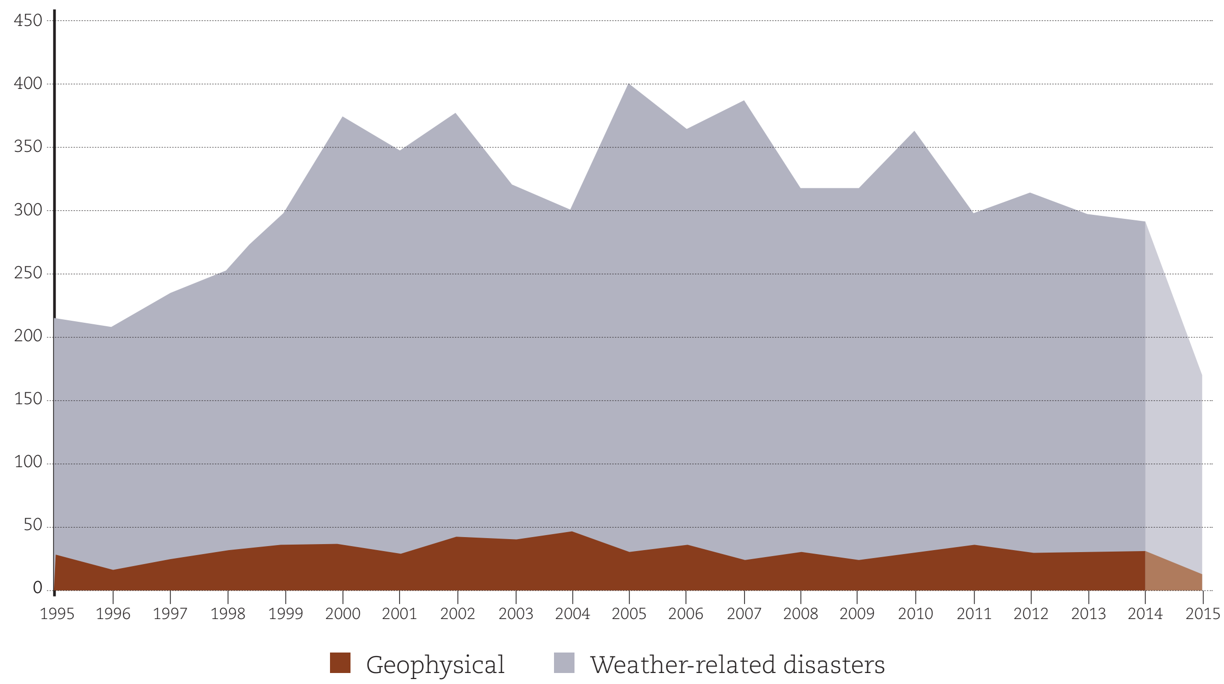
Number of weather-related disasters reported per country (1995-2015)



Weather-related disasters became increasingly frequent in the late 1990s, peaking at 401 events in 2005 **(Figure 2)**. Despite a decline in frequency since then, a sustained rise in the number of floods and storms pushed the average annual total up to 335 disasters per year after 2005, 14% higher than in the previous decade and more than twice the level recorded in 1980-1989.

Figure 2

Trends in the number of disasters by major category (weather-related & geophysical) (1995-2015)



The number of people affected by weather-related disasters has also fallen from its peak, reached in 2002 when drought in India hit 300 million people and a sandstorm in China affected 100 million (**Figure 3**). On average, 165 million people were affected each year between 2005 and 2014, down from 245 million in the period 1995-2004. Preliminary EM-DAT data for 2015 indicate this decline continued to just 14 million people this year (i.e. until end-August, the cut-off date for this report).

The proportion of the global population affected by weather-related disasters also fell over the past two decades from an average of one in every 25 people on the planet in 1995-2004 to one in 41 during 2005-2014, in part reflecting the rising numbers of people on the planet.

ACTION POINT

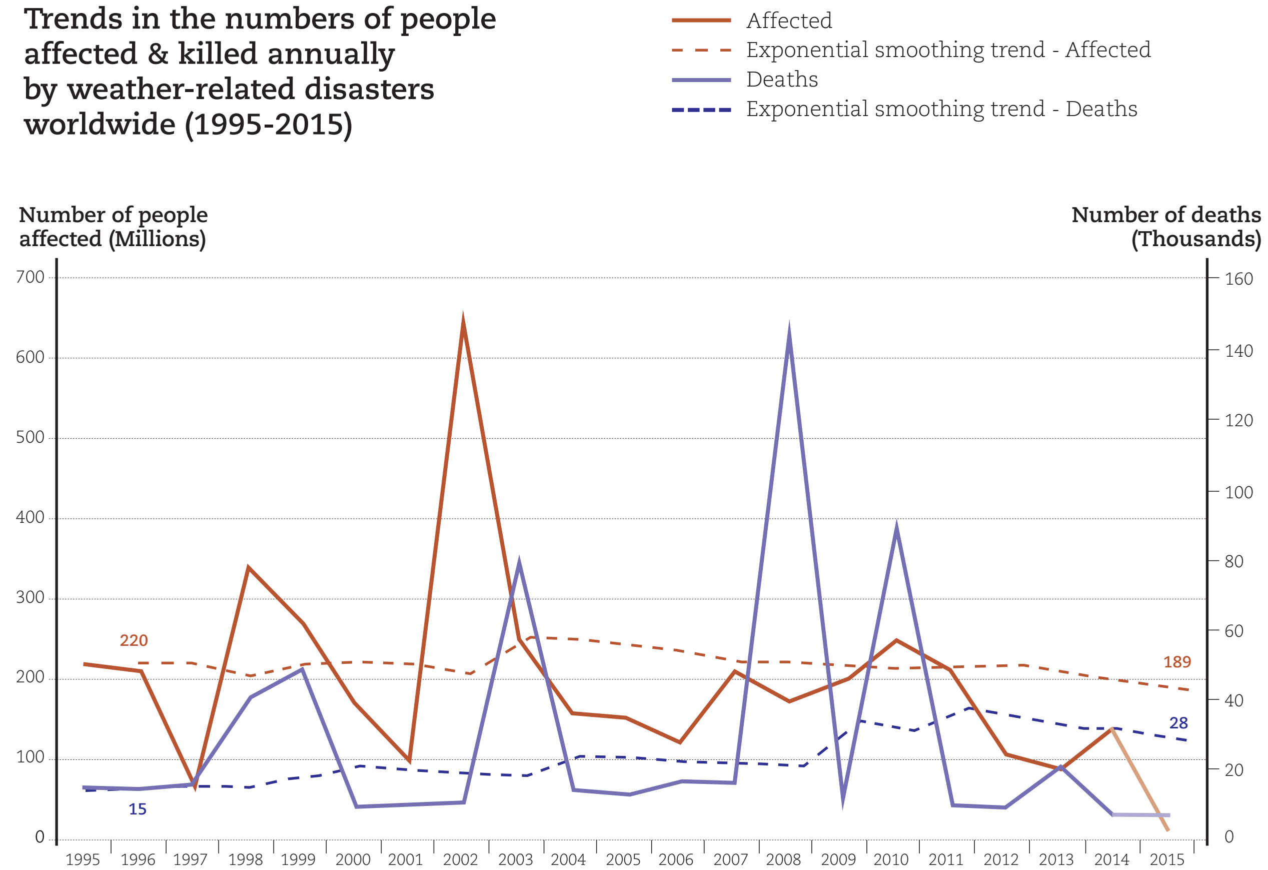
More focused studies to understand exactly how residents interpret disaster warnings (such as why they do not evacuate in time) will help reorient communication strategies for early warnings and make them more effective in future.

Average death rates, on the other hand, increased during the same 20-year period, climbing to more than 34,000 deaths per year between 2005 and 2014, up from an average of 26,000 deaths in 1995-2004. This average was pushed higher by the massive toll from Cyclone Nargis, which claimed 138,000 lives in Myanmar in 2008. Excluding this one megadisaster, average death rates fell to 20,000 a year during 2005-2014. Preliminary data for 2015 show this decline continued, with around 7,200 deaths from weather-related disasters.

While recent declines in the numbers of people dying and affected by weather-related disasters is clearly good news, the upward trend in average deaths over the 1995-2015 period demonstrates the continued vulnerability of communities to climate hazards. Given the deployment of early warning systems, and the accuracy of modern weather forecasting, EM-DAT data suggest that more work should be undertaken to evaluate the real outcomes on human lives and livelihoods of DRR interventions.

Figure 3

Trends in the numbers of people affected & killed annually by weather-related disasters worldwide (1995-2015)



BOX | 3

The Sendai Framework: A United Nations Office for Disaster Risk Reduction Perspective

A major stocktaking exercise took place on the learning from implementation of the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (HFA) starting in 2012. This was based on governments' own self-assessments of their performance and extensive consultations with civil society, including NGOs, the private sector, the scientific community, local governments and other stakeholders. Since the HFA was adopted, there has been a spread of a culture of disaster risk reduction across the globe manifesting itself in increased institutional and legislative arrangements, improved preparedness and early warning systems, and better response. It was also found that though the HFA gave detailed guidance on managing underlying risk drivers, in practice, most countries have understood and practiced disaster risk reduction as the management of disasters. Its replacement, adopted at the Third UN World Conference on Disaster Risk Reduction held in March, 2015, the Sendai Framework for Disaster Risk Reduction, clearly recognizes that disaster risk management needs to be about managing the risk inherent in social and economic activity, rather than simply mainstreaming disaster risk management to protect against external threats like natural hazards.

The Sendai Framework is a 15-year, voluntary, non-binding agreement which recognizes that the state has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders, including local governments, the private sector, the scientific community and NGOs. It aims for a substantial reduction in disaster losses resulting from both man-made and natural hazards. It lists priority areas for action such as understanding disaster risk, strengthening disaster risk governance to manage disaster risk, investing in disaster risk reduction for resilience and enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

The Sendai Framework's seven targets focus on substantial reductions in (1) disaster mortality, (2) number of affected people, (3) direct economic losses and (4) reducing damage to critical infrastructure and disruption of basic services. The Sendai Framework also seeks a substantial increase in (5) national and local disaster risk reduction strategies by 2020, (6) enhanced cooperation to developing countries, and (7) a substantial increase in multi-hazard early warning systems, disaster risk information and assessments.

Classifying natural hazards by disaster type[2]

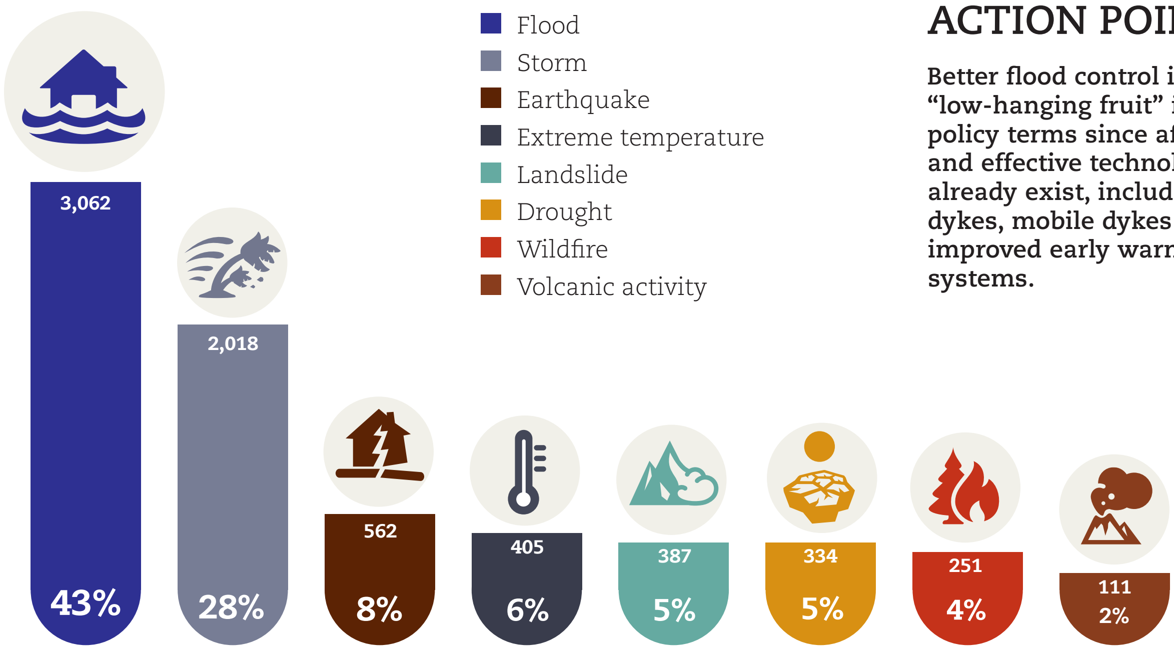
EM-DAT classifies disasters according to the type of hazard that provokes them. This report focuses on hydrological, meteorological and climatological disasters, which are collectively known as weather-related disasters.

[2] For information on the classification, see **http://www.emdat.be/new-classification**

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 4

Percentage of occurrences of natural disasters by disaster type (1995-2015)



ACTION POINT

Better flood control is one "low-hanging fruit" in DRR policy terms since affordable and effective technologies already exist, including dams, dykes, mobile dykes and improved early warning systems.

Chapter 2

Human costs of weather-related disasters

Introduction

The human cost of weather-related disasters depends on multiple factors, including the type of hazard, its location, duration and the size and vulnerability of the population in harm's way. EM-DAT also records basic economic impacts, including homes and infrastructure damaged and destroyed. 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 disasters.

Floods

Since 1995, floods have accounted for 47% of all weather-related disasters **(Figure 4)**, affecting 2.3 billion people **(Figure 5)**. The number of floods per year rose to an average of 171 in the period 2005-2014, up from an annual average of 127 in the previous decade.

Floods strike in Asia and Africa more than other continents, but pose an increasing danger elsewhere. In South America, for example, 560,000 people were affected by floods on average each year between 1995 and 2004. By the following decade (2005-2014) that number had risen to 2.2 million people, nearly a four-fold increase. In the first eight months of this year, another 820,000 people were affected by floods in the region.

Death tolls from flooding have also risen in many parts of the world. In 2007, floods killed 3,300 people in India and Bangladesh alone. In 2010, flooding killed 2,100 people in Pakistan and another 1,900 in China, while in 2013 some 6,500 people died due to floods in India.

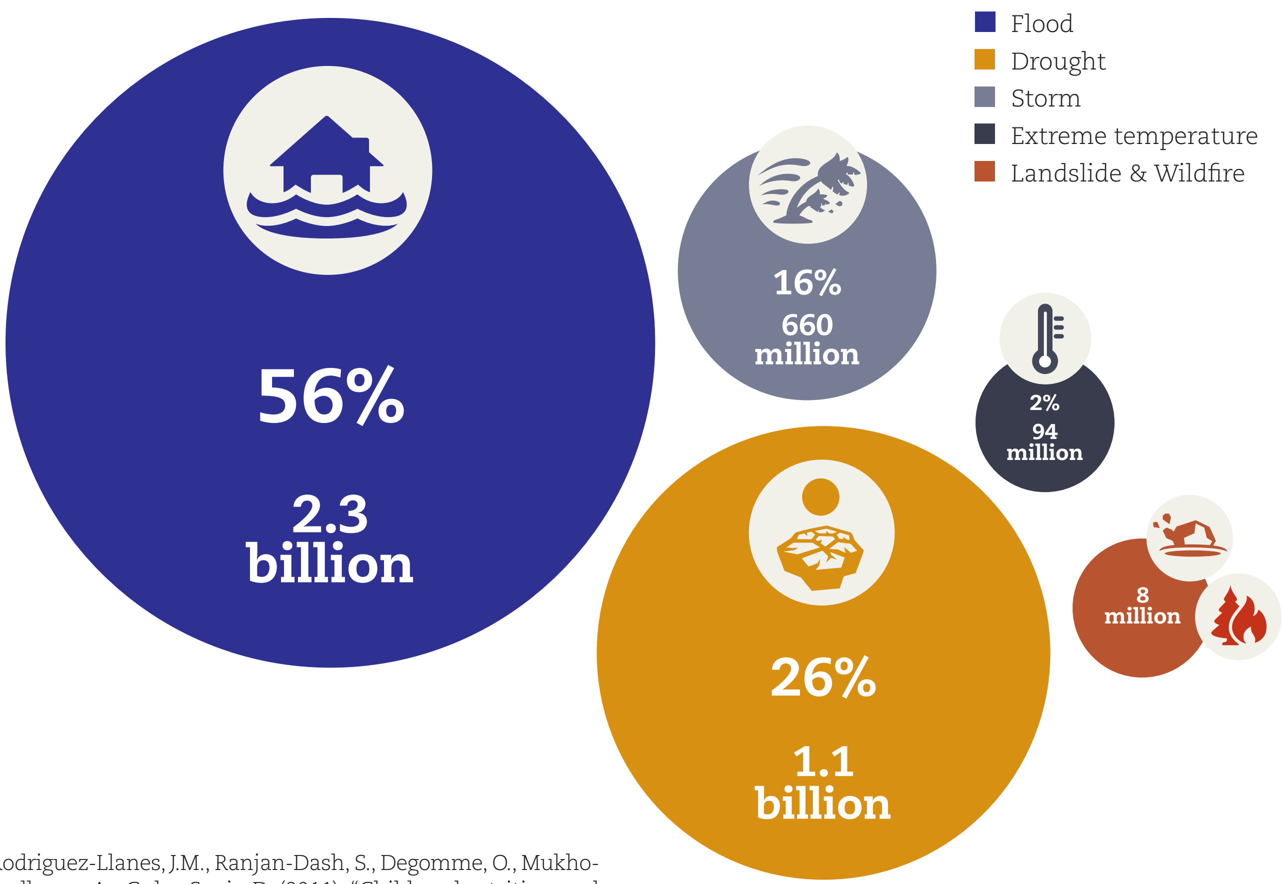
The nature of disastrous floods has also changed in recent years, with flash floods, acute riverine and coastal flooding increasingly frequent. In addition, urbanization has significantly increased flood run-offs, while recurrent flooding of agricultural land, particularly in Asia, has taken a heavy toll in terms of lost production, food shortages and rural under-nutrition. 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[3]. Many of these impacts are preventable since flooding - unlike most types of weather-related disasters - lends itself to primary prevention through affordable technologies such as dams and dykes, while measures such as 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 and UNISDR believe that flood control should be regarded as a development issue as well as 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 5

Numbers of people affected by weather-related disasters (1995-2015)
(NB: deaths are excluded from the total affected.)



[3] 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

Storms, including hurricanes, cyclones and storm surges, killed more than 242,000 people between 1995 and 2015 **(Figure 6)**, making storms the most deadly type of weather-related disaster in the past 21 years. The 2,018 storms recorded by EM-DAT during this period also make these events the second most frequent natural hazards after floods **(Figure 4)**.

While cyclones typically cut through wide swathes of densely populated regions, many small island states are also acutely vulnerable to storms. In March this year, for example, when Tropical Cyclone Pam hit Vanuatu Island, some 166,000 islanders were affected out of the total population of 258,000; at the time, the people were still recovering from Cyclone Lusi which tore through the island in the previous year. In total, between 1995 and 2015, storms accounted for 62% of all weather-related disasters in small states, 38% of disaster deaths and 92% of recorded economic losses.

EM-DAT records that overall, storms affected higher-income countries more often than lower-income nations, with 93% of all reported storm damage recorded in high- and upper-middle-income nations. (In total, storms caused US$ 1,011 billion in recorded damage.) In terms of lives lost, however, the brunt of storms is borne by lower-middle-income countries, where 89% of all storm deaths occurred between 1995 and 2014, even though these countries experienced just 26% of these events **(Figure 7)**.

Asia is particularly affected by storms, especially in the South and South-Eastern regions, which account for 21% of the total number of storms and more than 80% of storm mortality. Again, this toll is inflated by the impact of Cyclone Nargis, which claimed more lives than any cyclone 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 be expected to increase at the same rate as population growth in disaster-prone regions. On the positive side, weather forecasting has made extraordinary progress in recent years, with predictions now highly reliable within a 48-hour period. In the face of climate change, we may not be able to stem the increased frequency of storms, but better risk management and mitigation could reduce deaths tolls and other heavy losses from these predictable hazards.

ACTION POINT

More effective deployment of storm early warning systems could save many more lives in future, particularly in poor rural communities at higher risk. Proven life-saving measures, such as cyclone shelters and wind-resistant buildings, are also options which (according to resources available) could help protect vulnerable populations.

Figure 6

Numbers of people killed by disaster type (1995-2015)

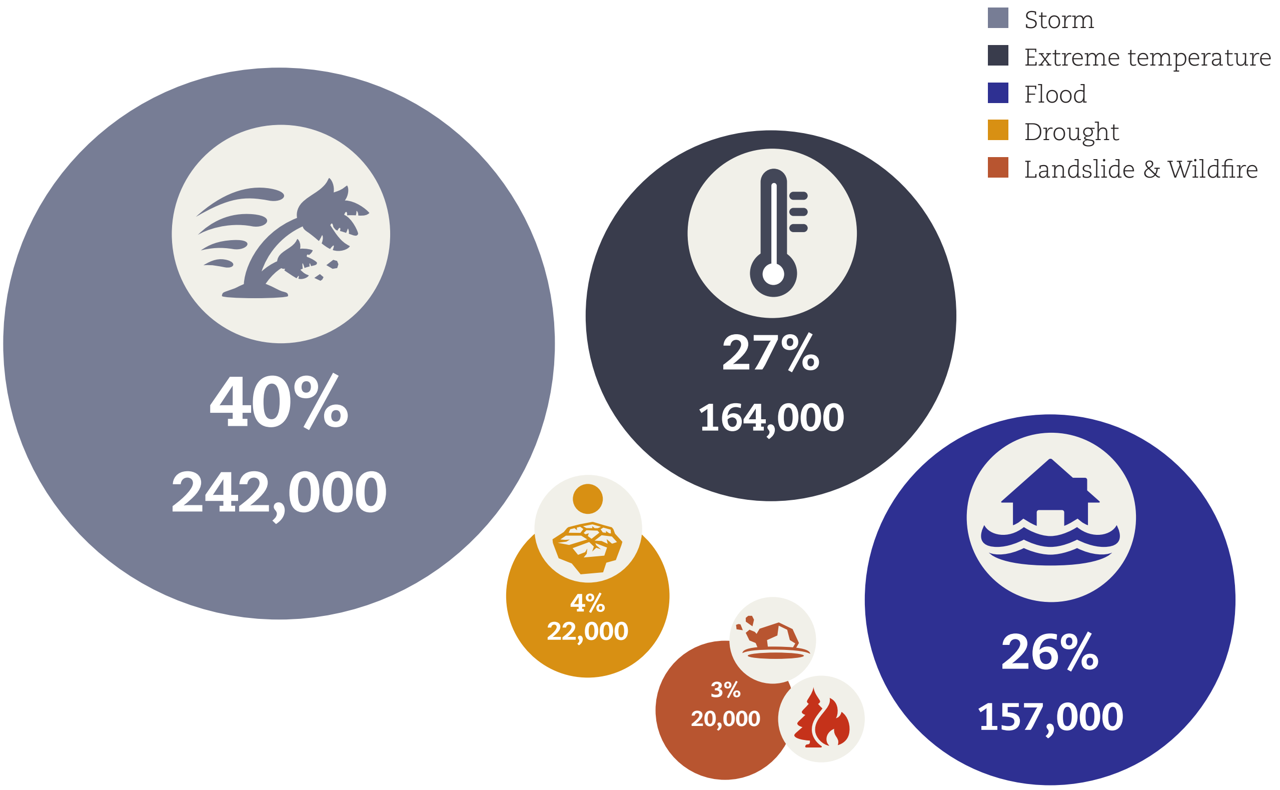
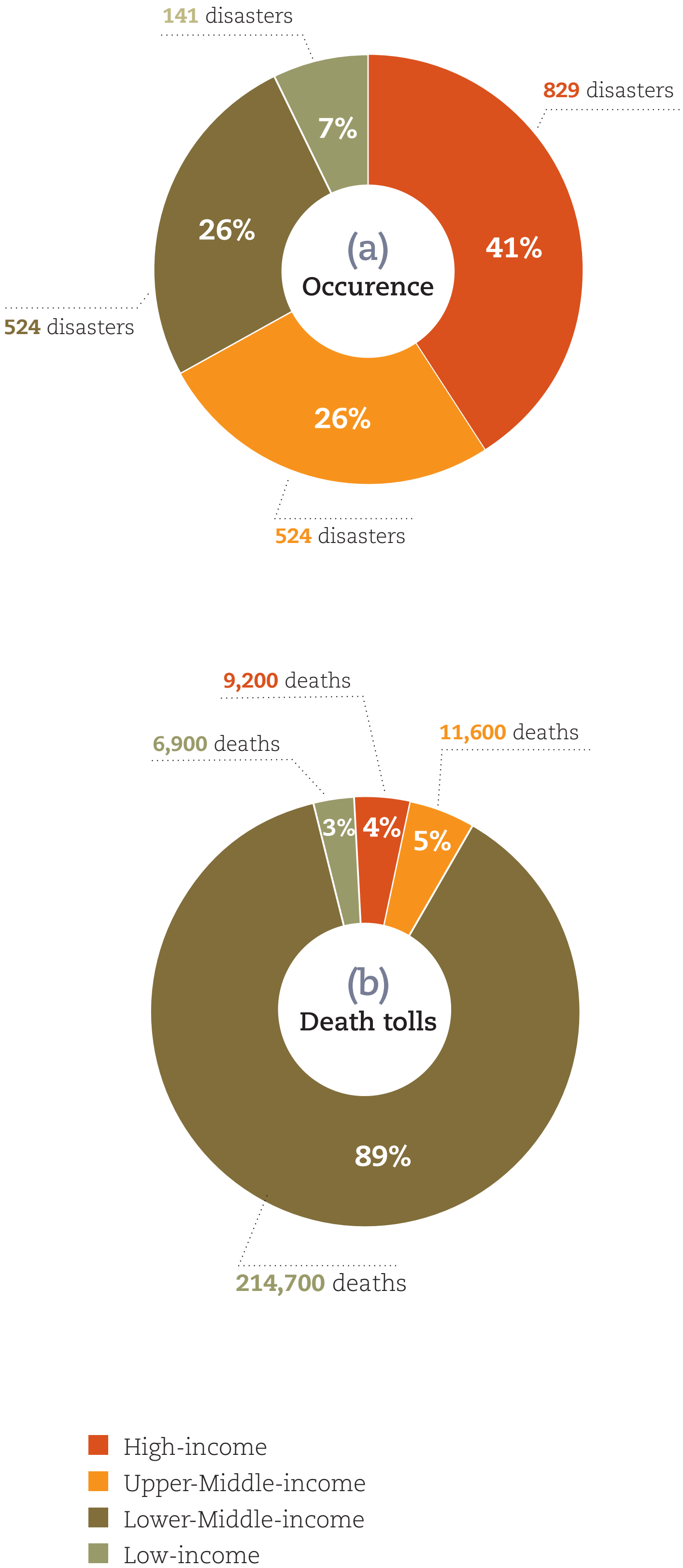


Figure 7

Occurrence (a) and death tolls (b) for storms (1995-2015) broken down by national income bracket



BOX | 4

Small states and Small Island Developing States (SIDS)[4]

Increasing numbers of storms due to climate change are likely to accentuate the particular economic challenges faced by many small states and SIDS. These challenges arise from their small domestic markets, narrow resource bases, limited diversification in terms of produce and exports, and diseconomies of scale.

Many isolated small states also pay high transport costs, while others with open economies are especially vulnerable to external shocks from global markets. Small population sizes add to these difficulties: when a high percentage of the national population is affected or killed by a cyclone, for example, just one single event can devastate economic activity and have long-term impacts on development.

While it is perhaps well known that the very existence of some SIDS is under threat from rising sea levels due to climate change, others face less publicized risks, including damage to commercial and subsistence farming and fishing when frequent storms change local vegetation and water salinity. Meanwhile, the cost of recovering from weather-related disasters overwhelms public finances in some small states, even high-income ones. In 2004, for example, Tropical Cyclone Ivan caused economic losses equivalent to almost three times Grenada's annual GDP. While in August 2015, heavy rains associated with Tropical Storm Erika triggered loss of life and economic losses and recovery costs estimated at 120% of the GDP of the small Caribbean island of Dominica (IMF estimates).

[4] For more information on small states, see technical notes on **www.emdat.be**

Drought

Drought affects Africa more than any other continent, with EM-DAT recording 136 events there between 1995 and 2015 (some 41% of the global total), including 77 droughts in East Africa alone. Droughts take a high human toll in terms of hunger, poverty and the perpetuation of under-development[5]. They are associated with widespread agricultural failures, loss of livestock, water shortages and outbreaks of epidemic diseases. Some droughts last for years, causing extensive and long-term economic impacts, as well as displacing large sections of the population. Consecutive failures of seasonal rains in East Africa in 2005, for example, led to food insecurity for at least 11 million people[6].

In total, EM-DAT recorded more than one billion people affected by droughts in the period 1995-2015; that is more than a quarter of all people affected by all types of weather-related disasters worldwide **(Figure 5)** even though drought accounted for less than 5% of all natural hazards **(Figure 4)**.

While EM-DAT data also show that just 4% of weather-related disaster deaths were due to drought **(Figure 6)**, this figure is rather misleading as it excludes indirect deaths from malnutrition, disease and displacement. Such indirect deaths largely occur after the emergency phase of a disaster is over and are often poorly documented or not counted at all.

Both the disproportionate numbers of people affected by drought and the scarcity of data about deaths are particularly disturbing at a time when effective early warning systems for drought have long been in place.

ACTION POINT

Reducing the size of drought-vulnerable populations should be a global priority over the next decade; better accounting systems for indirect deaths from drought are also required; these should be linked to early warning systems and response mechanisms in order to monitor the impacts of drought more comprehensively.

Heatwaves, extreme cold & wildfires

Between 1995 and 2015, extreme temperatures caused 27% of all deaths attributed to weather-related disasters, with the overwhelming majority (148,000 out of 164,000 lives lost) being the result of heatwaves.

Overall, 92% of deaths from heatwaves were recorded in high-income countries, with Europe reporting the lion's share at 90%. More than 55,000 people died during a heatwave in Russia during the summer of 2010, while Western and Southern Europe experienced major heatwaves in 2003 and 2006 which killed more than 72,000 and 3,400 people respectively. Europe witnessed a heatwave in summer 2015 as well but impacts still need to be evaluated. Elsewhere, India recorded 2,500 lives lost in just one month between May and June this year, and Pakistan recorded 1,230 deaths from the same heatwave.

Extreme cold has taken a high toll in the Americas in recent years, with cold waves increasingly frequent in Central and South America. Peru, for example, was hit by ten successive cold waves and severe winter conditions from 2003 to 2015, which cumulatively affected 5.4 million people. In the USA, 21 people died in a cold wave in January 2014, which also caused property damage valued at US$ 2.5 billion.

While deaths from extreme heat and cold are under-reported in some countries, EM-DAT data indicate that high-income countries rank second only to lower-middle-income countries in terms of the average number of deaths per weather-related disaster **(Figure 12 below)**. This is a very different pattern to the numbers killed by earthquakes, including tsunamis, which overwhelmingly affect people in low-income countries[7].

Wildfires are another major climatological threat in the USA, with 38 forest fires classified as disasters since 1995. These events affected 108,000 Americans and cost almost US$ 11 billion in recorded damage. These totals will almost certainly rise when full figures for 2015 are available, given that wildfires continued to rage in the USA after the August 2015 cut-off point for data in this report.

It is likely that extreme wildfires will become more and more frequent as a result of climate change as unusually high temperatures and droughts contribute to the increasing numbers of outbreaks[8].

ACTION POINT

Standardized methodologies are needed to collect comprehensive national data on deaths from all natural hazards. Following the adoption of the Sendai Framework, work is underway through the open-ended intergovernmental expert working group on indicators and terminology in relation to disaster risk reduction which should support making this action point a reality.

[5] Below, R., Grover-kopec, E. & Dilley, M. (2007). Documenting Drought-Related Disasters: A Global Reassessment. The Journal of Environment Development, 16 (3): 328-344.doi: 10.1177/1070496507306222

[6] Dilley, M., Chen, R.S., Deichmann, U., Lerner-Lam, A.L., Arthur, L., Arnold, M., Agwe, J., Buys, P., Kjevstad, O., Lyon, B. & Yetman, G. (2005). "Natural Disaster Hotspots: a global risk analysis". The World Bank, Disaster risk management series, 5.

[7] Centre For Research On The Epidemiology Of Disasters – CRED (2015) "The human cost of natural disasters" – 2015: A global perspective. CRED: Brussels.

[8] W. John Calder, Dusty Parker, Cody J. Stopka, Gonzalo Jiménez-Moreno, and Bryan N. Shuman. "Medieval warming initiated exceptionally large wildfire outbreaks in the Rocky Mountains" www.pnas.org/cgi/doi/10.1073/pnas.1500796112

Chapter | 3

Impacts of weather-related disasters by country[9]

Introduction

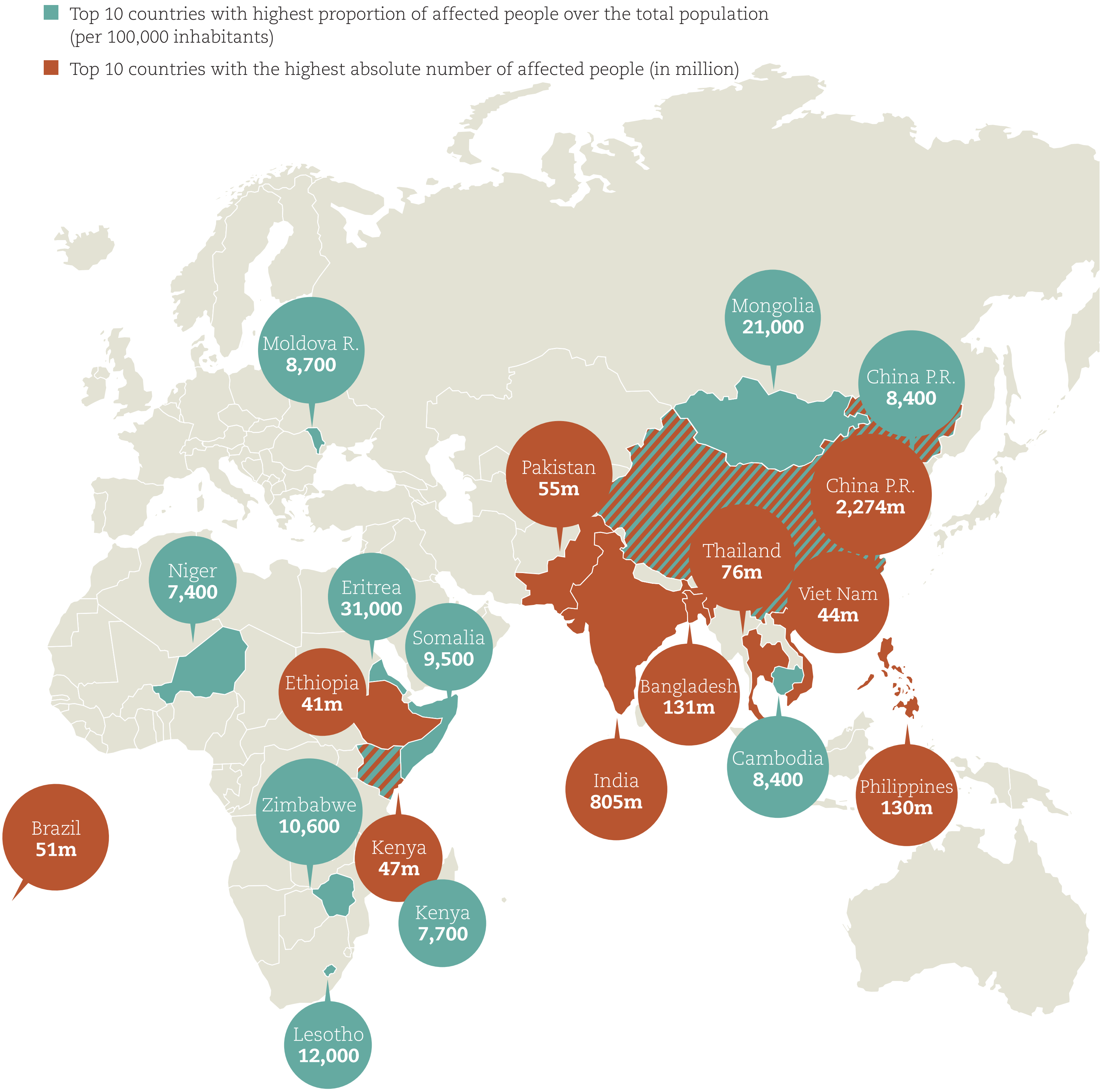
Asian population giants, China and India, dominate the league table of countries most affected by weather-related disasters. Together these two nations account for more than 3 billion disaster-affected people between 1995 and 2015. That is 75% of the global total of 4.1 billion people. Brazil is the only country from the Americas appearing in the top 10 list, and Kenya and Ethiopia are the only African nations.

When the data is standardized to reflect the numbers of people affected per 100,000 head of population (or the percentage of the affected population), the global picture looks very different, however, with six of the most-affected countries now in Africa, and just three in Asia. Moldova is the only European country appearing on either list, ranking sixth in the standardized league table due mainly to a storm in 2000 that affected 2.6 million people out of a total population of 3.6 million **(Figure 8)**.

[9] Small states excluded from this chapter

Figure 8

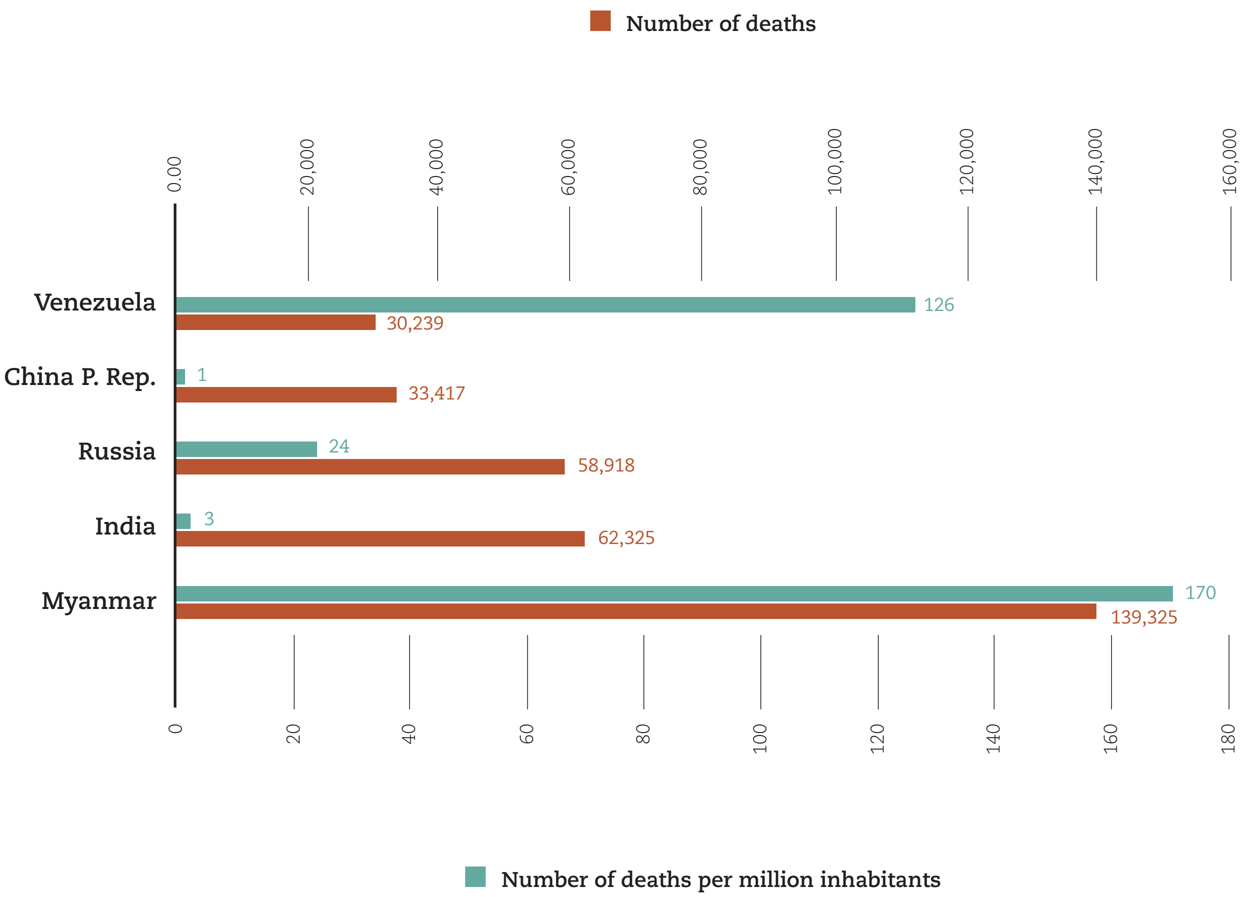
Top ten countries by total population affected by weather-related disasters (1995-2015) compared with the top ten countries most affected per 100,000 inhabitants.



Country ranking by death tolls also varies significantly when mortality is standardized by population size **(Figure 9)**. India and China, for example, experienced low death rates as a ratio of their overall population, despite very high absolute numbers. By contrast, Venezuela had a high death ratio because of a flash flood in 1999 which killed 30,000 persons out of a population of 24 million.

Figure 9

Number of deaths and Top 5 of relative mortality (deaths per million inhabitants) (1995-2015)



Chapter 4

Weather-related disasters & national income[10]

Introduction

In recent years, national preparedness and more efficient responses to disasters have significantly reduced the numbers of people dying from weather-related hazards in some countries. India, China, Indonesia, Bangladesh, Thailand and Myanmar, for example, have each made major commitments to reduce disaster losses by acting on the priorities of the Hyogo Framework for Action (HFA). In Indonesia, DRR became a pillar of national development immediately after the catastrophe of the Indian Ocean tsunami of 2004. 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 meanwhile reported that it has succeeded in keeping economic losses within a target of 1.5% of GDP[11].

EM-DAT data show that when countries are grouped together by income, the highest numbers of weather-related disasters occurred in lower-middle-income countries. These nations suffered 1,935 of all recorded events or 30% of the global total **(Figure 10)** at a cost of 305,000 lives lost, i.e. half of all deaths reported between 1995 and 2015 **(Figure 11)**. The heavy loss of life in lower-middle-income countries is also reflected in the high average number of deaths per disaster (157) **(Figure 12)**. Once again, the heavy toll of Cyclone Nargis on Myanmar (a lower-middle-income nation) had a major impact on these mortality statistics.

[10] Small states excluded from this chapter

[11] McClean D. (2014). "China celebrates the Hyogo Framework for Action". United Nations Office for Disaster Risk Reduction - Regional Office for Asia and Pacific (UNISDR AP). **http://www.unisdr.org/archive/38302**

The high number of deaths in high-income countries (31% of the global total) mainly reflects the impact of heatwaves (**Figure 11**) as noted above, while the relatively low numbers of occurrences and deaths in low-income countries (**Figures 10 & 11**) is indicative of under-reporting from these nations.

Figure 10

Number of weather-related disasters per income group (1995-2015)

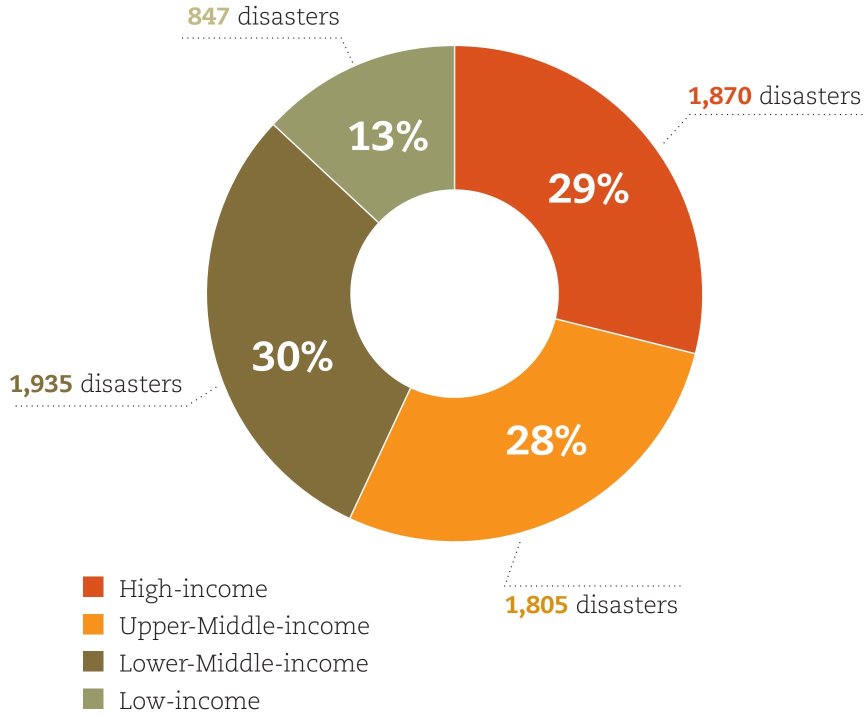
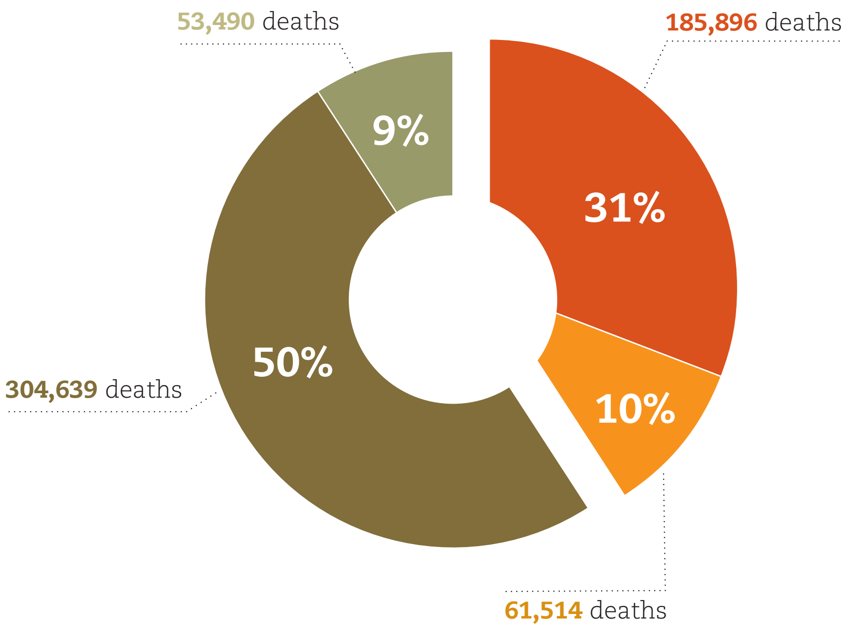


Figure 11

Number of deaths per income group for weather-related disasters (1995-2015)



BOX 5

Disaster damage to housing & infrastructure[12]

EM-DAT recorded 87 million homes damaged or destroyed by weather-related disasters since 1995, plus 130,000 damaged or destroyed schools, clinics, hospitals and other critical health and education facilities. Floods and storms together accounted for around 98% of houses damaged and 99.9% of education health and education facilities.

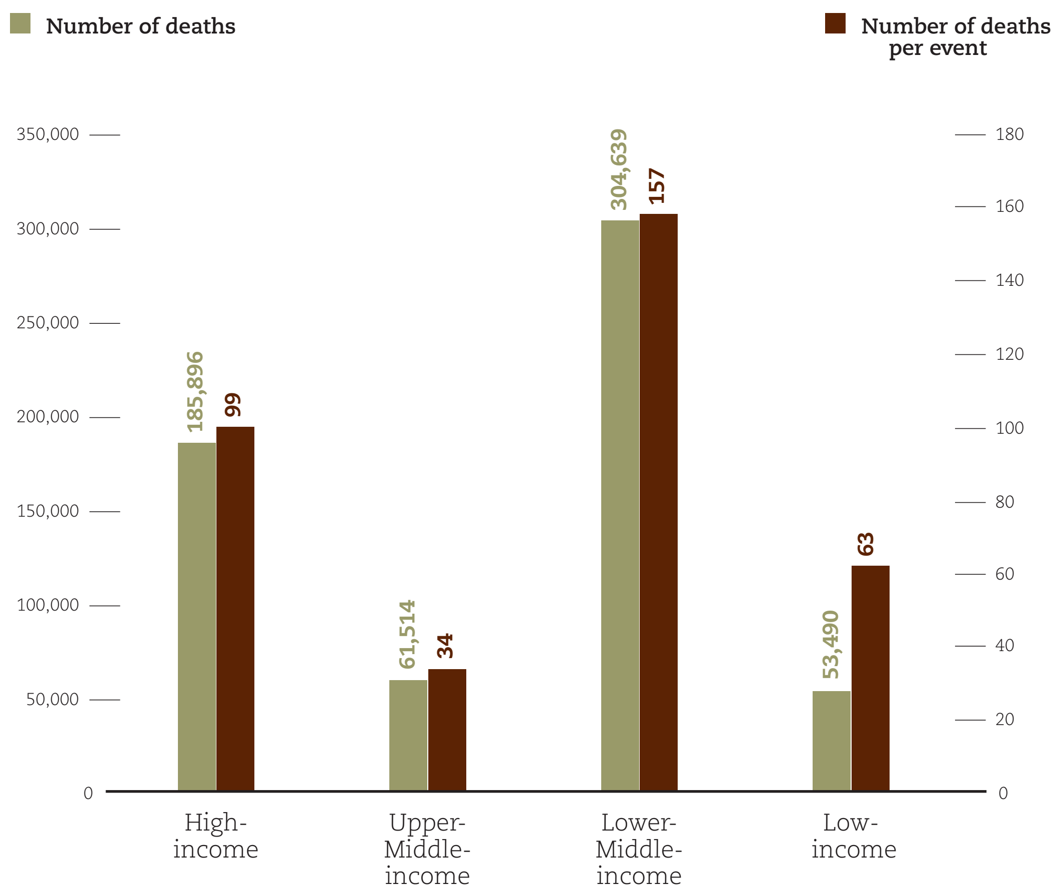
Often, one single event had devastating impacts on buildings, with Cyclone Sidr destroying more than 4,000 schools in Bangladesh in 2007; Peru lost 600 health facilities in one cyclone in 1997, while a tropical cyclone in 1999 devastated 11,000 schools in India. More recently in April 2015, a flood in Peru damaged 614 schools and more than 17,000 houses. In 2015, Bangladesh was hit by two storms in April and June that respectively destroyed 29,000 and 33,000 homes.

Given the importance of health and education for future development, high priority should be given to national and international efforts to protect these facilities from disaster damage, especially in lower-income countries. Preparedness and response planning would also be helped by a better understanding of the impact of poor building practices on disaster mortality figures. DRR managers could then compare this quantified data with the effectiveness of evacuation procedures, and allocate resources to the response measures most likely to save lives.

[12] Damaged includes partially damaged and fully destroyed in this report. EM-DAT records about the physical impacts of disasters are partial: 1,850 events (of 6,457) report houses damaged, 83 events report health facilities damaged and 198 report education infrastructures damaged.

Figure 12

Total numbers of deaths compared to the average number of deaths per disaster by income group for weather-related disasters (1995-2015)



ACTION POINT

Better data collection about disaster 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. In the meantime, initiatives such as the UNISDR's Worldwide Initiative on Safe Schools campaign should be fully supported.

Chapter 5

Counting the economic costs of disasters

Introduction

EM-DAT recorded losses totaling US$ 1,891 billion[13] from weather-related disasters between 1995 and 2015, equivalent to 71% of all losses attributed to natural hazards **(Figure 13)**. This figure is a minimum given widespread under-reporting of losses around the globe. With this caveat, EM-DAT data show that storms cost more than any other type of weather-related disaster in terms of recorded lost assets (US$ 1,011 billion), followed by floods (US$ 662 billion).

According to UNISDR's 2015 Global Assessment Report on Disaster Risk Reduction[14], expected annual average losses (AAL) from earthquakes, tsunamis, tropical cyclones and river flooding are now estimated at US$ 314 billion in the built environment alone. AAL is the amount that countries should be setting aside each year to cover future disaster losses; it represents an accumulating contingent liability. The report, based on a review of national disaster loss databases, estimates that economic losses from disasters are now reaching an average of US$ 250 billion to US$ 300 billion each year.

[13] All economic losses and GDP in this report are adjusted at 2014US$ value

[14] UNISDR (2015). Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction. Geneva, Switzerland: United Nations Office for Disaster Risk Reduction (UNISDR).

At the regional level, recorded losses in the Americas accounted for 46% of the total, followed by Asia at 37% **(Figure 14)**. A major contrast can be seen between low- and lower-middle-income countries, which reported just 12% of economic losses, against 88% for high- and upper-middle-income nations **(Figure 15)**.

Figure 13

Breakdown of recorded economic damage (US$) by disaster type (1995-2015)

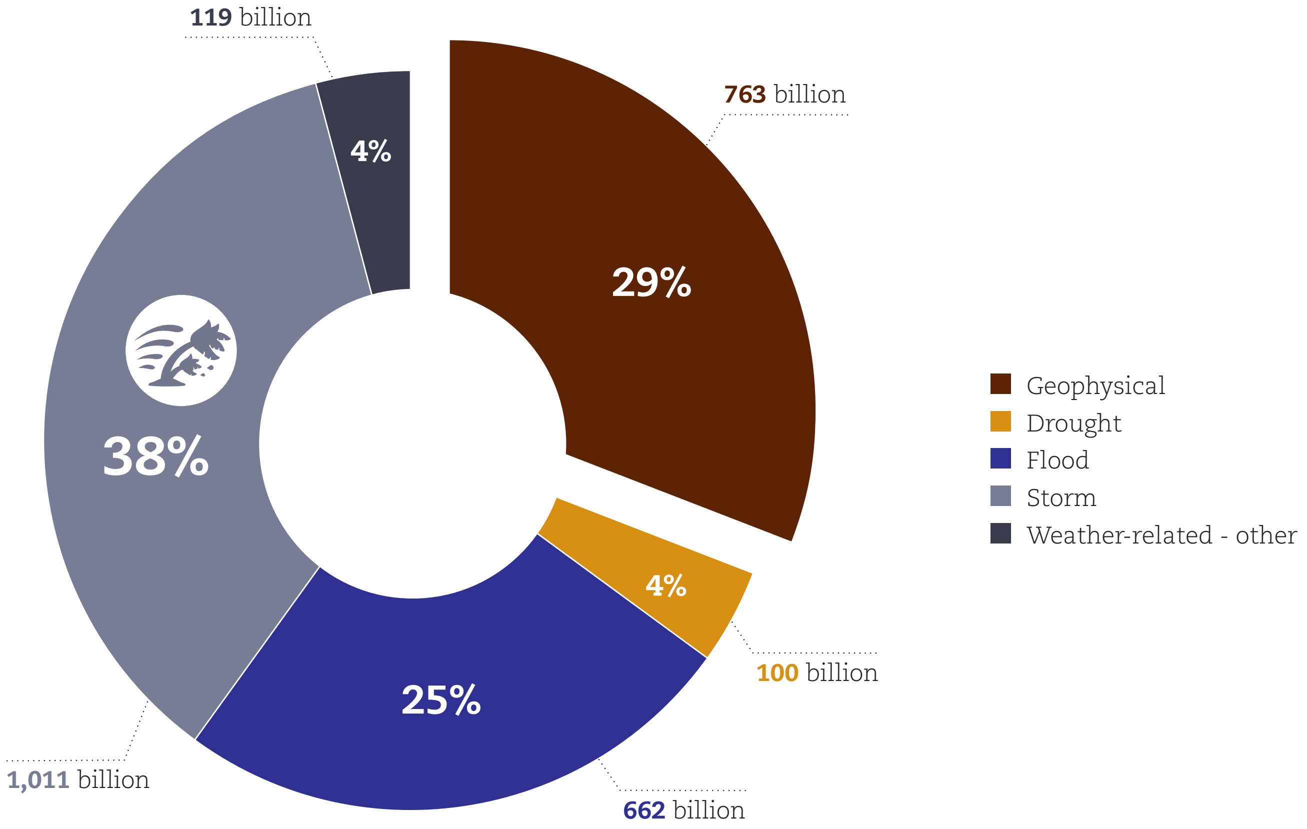


Figure 14

Absolute losses by continent (US$) (1994-2015)

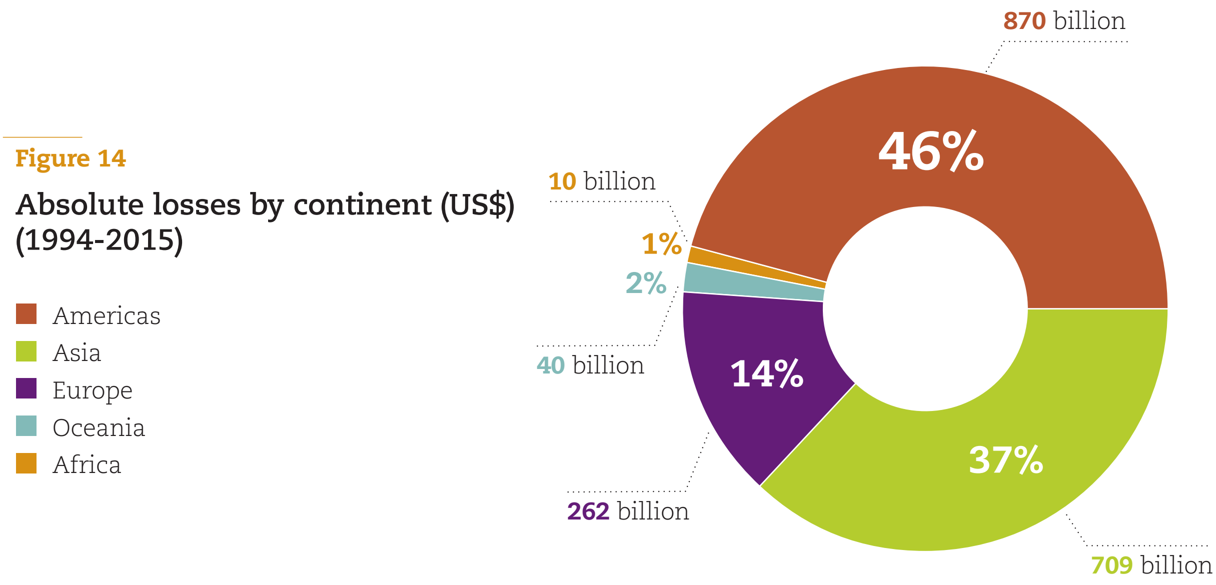
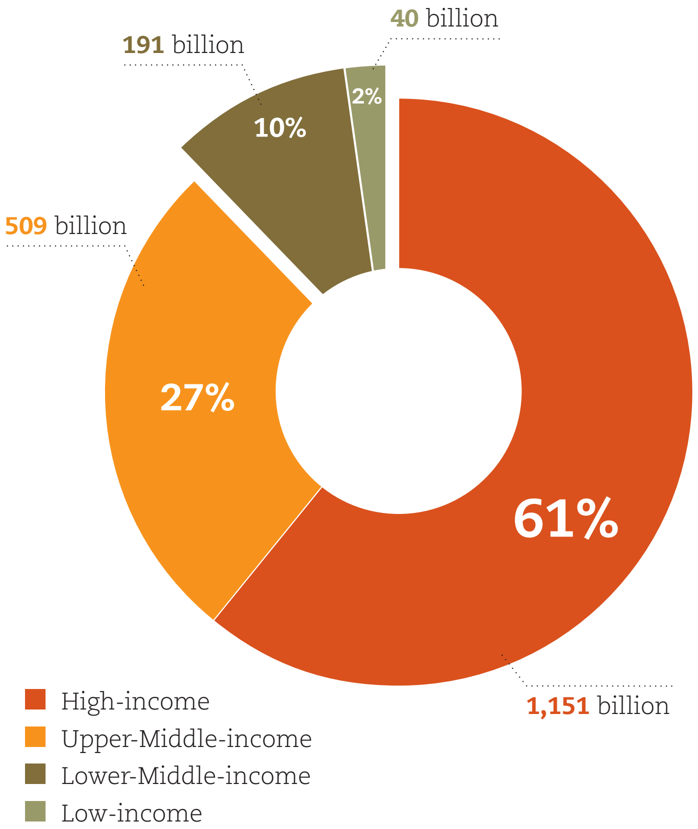


Figure 15

Income group analysis of economic damage (US$) (1995-2015)



Economic losses as a percentage of GDP

The global pattern of losses as a percentage of Gross Domestic Product (GDP) varies starkly from the pattern of losses in absolute terms, reflecting the much smaller economies of lower-income countries (and consequently the relatively greater economic impact of weather-related disasters on them). **Figure 16** illustrates how high asset values in high-income countries pushed up their recorded losses in the period 1995-2015, yet this remained a modest 0.2% of GDP. Much lower absolute losses in low-income countries (US$ 40 billion in total) amounted to a high 5% of GDP. These GDP figures understate the real disparity between rich and poor nations due to the under-reporting of losses in low-income countries[15].

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.

BOX 6

Under-reporting of economic losses[15]

Data on economic losses from natural disasters is available for just 36% of disasters recorded from 1995 to 2015. Records are particularly partial from Africa, where losses were reported from just 12.6% of events. Such gaps in our knowledge should be of international concern at a time of limited financial resources and competing priorities.

With weather-related disasters set to increase due to climate change, 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 evidence-based and 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.

[15] For further discussion: Centre For Research On The Epidemiology Of Disasters – CRED (2015) "The human cost of natural disasters" – 2015: A global perspective. CRED: Brussels.

BOX | 7

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

In the most disaster-affected countries, just one type of disaster causes the overwhelming majority of the recorded economic damage. For example, in DPR of Korea, 77% of recorded losses were due to floods between 1995 and 2015. These losses correspond to 33% of the country's GDP on average **(Figure 17)**. 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.

Figure 16

Economic losses in absolute values and as a percentage of GDP from weather-related disasters (1995-2015)

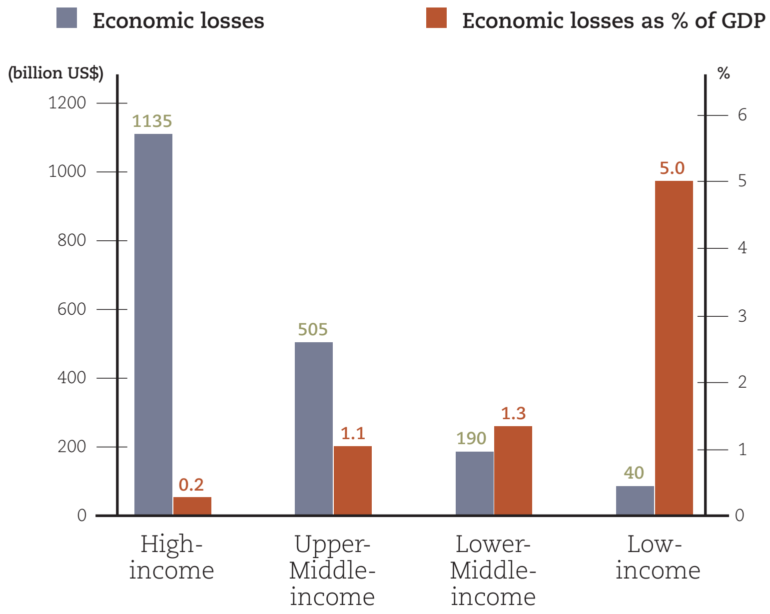
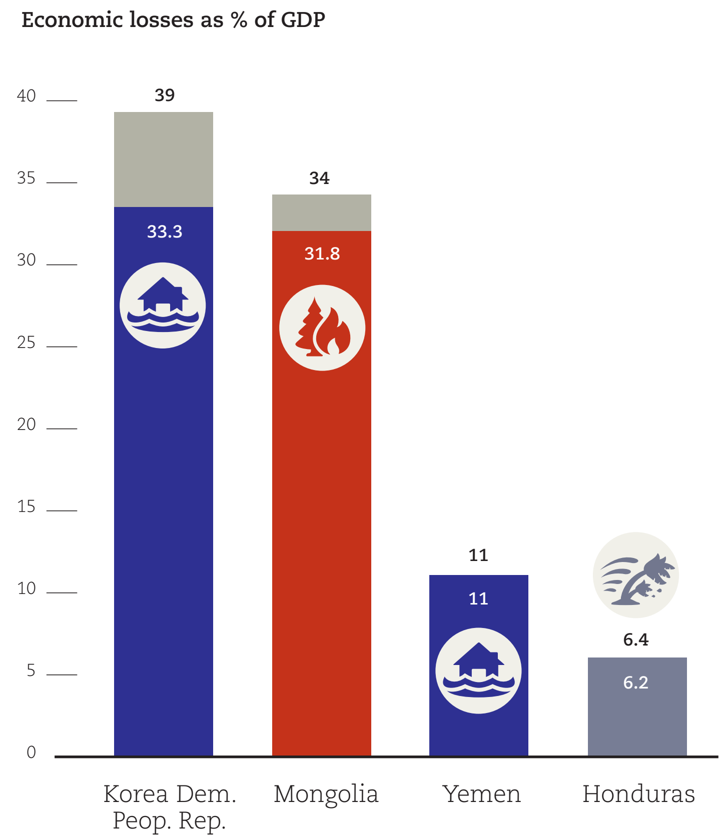


Figure 17

Top five countries ranked by losses as a percentage of GDP showing the impact of one disaster type (1995-2015)



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Contact

CRED

- **Mail:**
  Pascaline Wallemacq:
  pascaline.wallemacq@uclouvain.be
  Regina Below:
  regina.below@uclouvain.be

- **Phone:**
  +32 2 764 3327

- **Postal Address:**
  School of Public Health
  Institute of Health and Society (IRSS)
  Université catholique de Louvain
  Clos Chapelle-aux-Champs, Bte B1.30.15
  1200 Brussels, BELGIUM

UNISDR

- **Mail:**
  Denis McClean:
  mccleand@un.org

- **Phone:**
  +41 22 917 8897

- **Postal Address:**
  9-11 Rue de Varembé
  CH 1202, Geneva
  SWITZERLAND

design : www.mardi.be

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The contents of this report remain the responsibility of the authors alone.