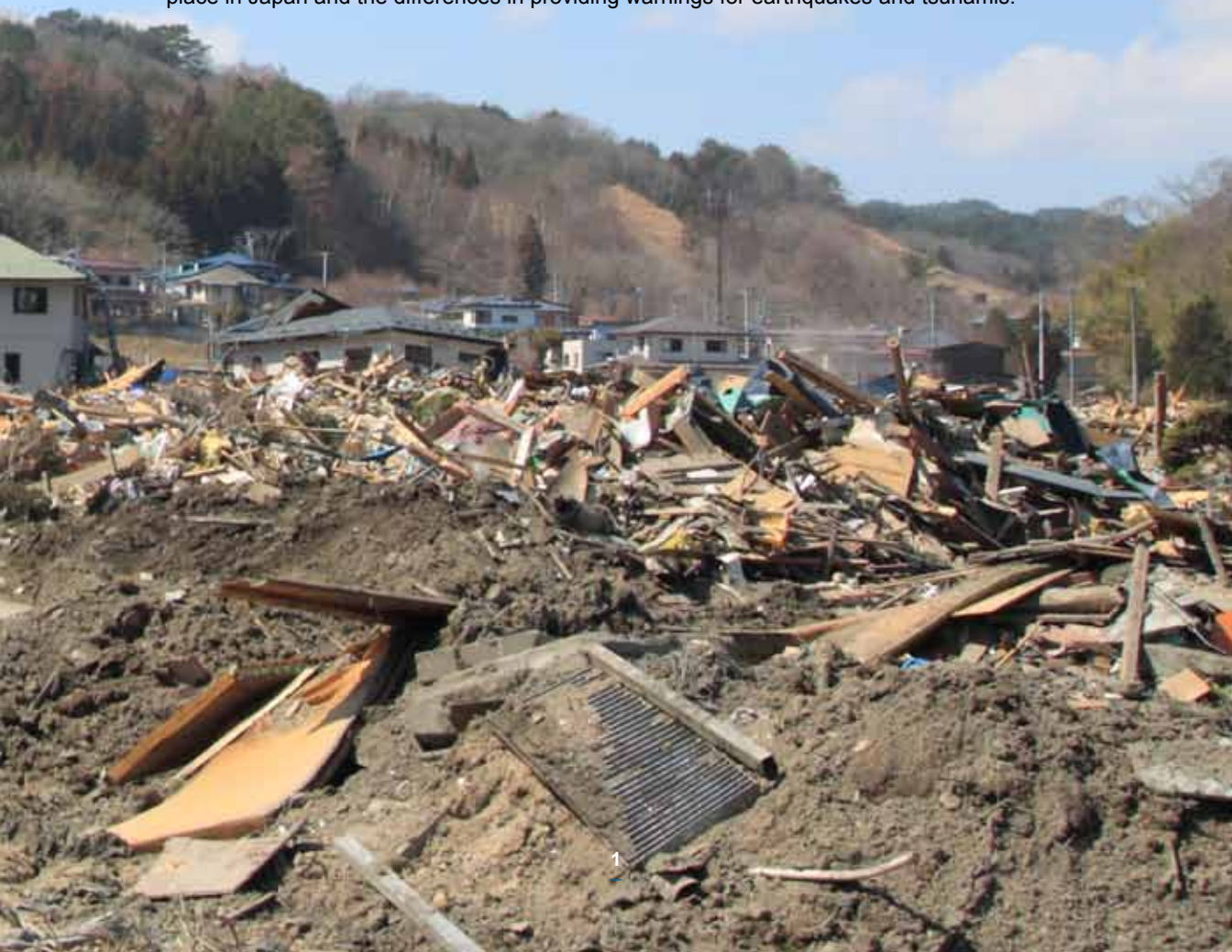
CHAPTER 1

THE YEAR THAT SHOOK THE RICH

2011 was the costliest year in history in terms of natural disaster damage, in large part due to major disasters which occurred in some developed countries. The earthquake and tsunami in Japan alone were estimated to have caused over $200 billion in damages.

This chapter looks in more detail at the disasters that shook developed countries in 2011, beginning with the Japanese earthquake/tsunami/nuclear accident – the most expensive disaster in history. While the earthquake occurred with a bit over a minute's warning, the consequences of that disaster will be felt for years, perhaps decades, to come.[22] In particular the nuclear accident at the Fukushima Daiichi plant not only raised troubling questions about the way the Japanese government handled this aspect of the disaster, but also generates disturbing concerns about the intersection of future natural hazards and technology.

[22] Technology Review, "80 Seconds of Warning for Tokyo," 11 March 2011, http://www.technologyreview.com/computing/35090/?p1=A3. This article gives an account of the early warning system in place in Japan and the differences in providing warnings for earthquakes and tsunamis.



Discussion then turns to the United States which experienced a string of costly and varied disasters in 2011. Unlike in Japan where energy and attention focused on a single mega-disaster, in the United States, different kinds of disasters occurred in succession, none of which caused more than 500 deaths. But after the snow, the tornadoes, the floods, the drought, the wildfires and the hurricane the country was wondering what could possibly come next. While residents of New York prepared for torrential flooding caused by Hurricane Irene, Texans and their neighbors battled record drought and devastating wildfires.

The flooding experienced by residents of Queensland in Australia in the early part of 2011 (though the waters actually began rising late the previous year) was on a physical scale greater than that of all other disasters occurring in 2011. And the earthquake that occurred very close to the center of Christchurch, New Zealand in February (itself one of 7,000 aftershocks to the September 2010 quake) caused major damage to half of the city center's buildings, leaving many of them beyond repair.

Although some of our analysis focuses on the economic costs of the disasters in developed countries, for too many people, economic losses paled in comparison with the loss of family members and homes and the disruption to their lives and livelihoods. For all of those affected by disasters – whether in rich or poor countries – it is hard to overstate the experience of personal loss. People died, were injured, lost family members and homes, lost jobs and/or faced a drop in income. Many were displaced to temporary shelters and faced the uncertainty of not knowing when or if they could return. Some chose to move elsewhere permanently to escape the potential dangers of future hazards.

People living in developed countries generally have better access to insurance and social safety nets than those living in developing countries; they expect their governments to respond when disasters occur. National disaster management agencies are, to varying degrees, well-staffed, well-trained and well-prepared. They have planned for contingencies, pre-positioned supplies and are usually able to respond effectively and promptly. Protocols are generally in place for mobilizing additional resources, such as military and police forces, when the needs so merit. This was generally the case in the four countries experiencing natural disasters considered here – Australia, New Zealand, Japan and the US. But responses in developed countries are not immune to problems of discrimination as sometimes evidenced, for example, in more robust programs of assistance to homeowners than to renters.[23] Disturbingly, in both developed and developing countries, the incidence of personal violence, such as domestic violence and child abuse, tends to increase in the aftermath of disasters.[24]

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[23] Elizabeth Ferris and Daniel Petz, *A Year of Living Dangerously, A Review of Natural Disasters in 2010*, Brookings-LSE Project on Internal Displacement, 2011, p. 67 ff.

[24] See: Canadian Red Cross, International Federation of Red Cross and Red Crescent Societies, *Predictable, Preventable: Best Practices for Addressing Interpersonal and Self-Directed Violence During and After Disasters*, 2012; See also: Elizabeth Ferris, "When disaster strikes: women's particular vulnerabilities and amazing strengths," *Keynote presentation, Women's Leadership Lunch, National Council of Churches Assembly*,10 November 2010, New Orleans, Louisiana,

As examined in more detail below, 2011 was the most expensive year in history for natural disasters – primarily because of the disasters in the rich world. Globally, economic losses attributed to natural disasters in 2011 reached $380 billion – of which the Japanese disaster alone accounted for more than 55 percent of the total (not even including nuclear-related damage).[25] Munich Re estimates the economic costs of the Japan earthquake and tsunami at $210 billion, with insured losses accounting for only $35-40 billion – about 18 percent of the total.[26] In contrast, damages from New Zealand's earthquake totaled $16 billion of which over 80 percent were covered by insurance. The difference in coverage between those two countries is explained by the fact that every house or contents insurance holder in New Zealand is automatically covered by the countries Earthquake Commission's insurance scheme, which insures up to NZD100,000 +GST (approximately US$83,000) for dwellings and up to NZD20,000 +GST for personal effects.[27] The Earthquake Commission's insurance not only covers earthquakes but all major disasters, such as tsunamis, floods, storms, etc. including fire damages caused by any of those.[28] Meanwhile, in Japan earthquake insurance is costly and therefore people and companies either opt not to take out insurance policies or select ones that do not cover the entire damage.[29]

Still, while many parts of the rich world were affected heavily by disasters in 2011, Europe was the outlier on all three of the major indicators of loss from natural disasters. As a region, it recorded the lowest numbers of fatalities, affected persons and the lowest economic damages since 1990.[30] But then, Europe had major problems of a different – economic and financial – kind in 2011. And while 2011 was relatively benign for Europe in terms of natural disasters, 2012 hit the region hard with a major cold wave.

p. 4. There is no evidence yet about higher rates of domestic violence after the 2011 Japan earthquake and tsunami.

25 Munich Re, "The five largest natural catastrophes of 2011," Geo Risks Research, NatCatSERVICE, January 2012, http://www.munichre.com/en/media_relations/press_releases/2012/2012_01_04_press_release.aspx

26 Note that the Japanese government initially estimated material damage at $190-300 billion but later revised it to $210 billion.

27 Goods and service tax (GST).

28 Earthquake Commission, "EQC Insurance," http://www.eqc.govt.nz/insurance.aspx

29 David Zeiler, "Japan May Prove an Overall Boon for Insurers," Seeking Alpha, 21 March 2011, http://seekingalpha.com/article/259287-japan-may-prove-an-overall-boon-for-insurers

30 AlertNet, "Richer nations hit hard by disasters in 2011," 19 January 2012, http://www.trust.org/alertnet/news/richer-nations-hit-hard-by-disasters-in-2011/

A group of people evacuates from the flooded area at Sapan Mai district during the massive flood crisis on November 13, 2011 in Bangkok. Photo: © Cowardlion | Dreamstime.com

Section 1

Disasters in the "Rich" World, Some Numbers

Defining the "rich world" is not as easy a task as it appears. The most common indicator to measure a country's wealth is the Gross Domestic Product (GDP), but while the GDP is a good indicator to capture a nation's overall material wealth, it says little about broader categories such as income inequality, societal mobility, gender equality or the state of a country's environment. There have therefore been several attempts to develop broader benchmarks of human wealth and well-being, one of the major ones being UNDP's Human Development Index. To not get tangled up in this debate, we simply decided in this study to focus on those "rich" countries that are members of the Organization for Economic Co-operation and Development (OECD), which currently has 34 member states and includes all major large developed economies.[31] The 31 OECD members in 2010 (Estonia, Israel and Slovenia were only admitted in the second half of 2010 and so are not included in these figures) had a share of 51 percent of the global economy in 2010, a number illustrating the major economic power of OECD countries.[32] Within the OECD there are obviously also large differences in wealth, with Luxembourg having a GDP per capita of $81,466 while the corresponding figure for Mexico is only $14,406.[33] However, basing our analysis on OECD members excludes a number of rich states. For example, our analysis does not include oil-rich Middle Eastern countries such as Qatar, which leads the 2010 global GDP per capita in purchasing power parity (PPP) list with $88,222 per capita, and smaller highly developed countries such as Singapore which with a GDP per capita of $56,694 is the third most affluent country in the world.[34] Still, as it includes 22 out of 30 of the richest countries in the world in terms of GDP, focusing on the OECD member states allows us to get a strong sense of how wealthy countries have been affected by natural disasters over the last decade.

While wealthy countries generally have more resources to devote to disaster risk reduction and response, the poor and marginalized in those countries can be exposed to many of

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31 The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, see: OECD, "List of OECD Member countries - Ratification of the Convention on the OECD," accessed 15 January 2012, http://www.oecd.org/document/58/0,3746,en_2649_201185_1889402_1_1_1_1,00.html

32 OECD, "Economy : Developing countries set to account for nearly 60% of world GDP by 2030, according to new estimates," 16 June 2010, http://www.oecd.org/document/12/0,3343, en_2649_33959_45467980_1_1_1_1,00.html

33 IMF, "World Economic Outlook Database, September 2011, Gross domestic product based on purchasing-power-parity (PPP) per capita GDP," www.imf.org

34 *Ibid.*

the same vulnerabilities encountered in developing countries. Those who were unable to evacuate New Orleans before Hurricane Katrina struck, for example, tended to be poorer than those who escaped. It's also important to recognize that wealthy people in poor countries also tend to fare better, both in terms of their vulnerability to natural hazards and their access to resources in disaster recovery.

OECD disaster data 2001-2010

In the decade from 2001 to 2010, around 37.3 million persons were affected by natural disasters in OECD countries, accounting for 1.61 percent of the total number of disaster affected persons in that decade. In other words, 98 percent of those affected by disasters in this period were from non-OECD countries. When we look at fatalities, the difference is not as stark, with OECD countries having around 8.12 percent of global disaster fatalities during that period (see Table 2). Interestingly, almost 83 percent or 71,422 fatalities come from one single disaster, the 2003 European heat wave.

Table 2 Disaster Affected, Fatalities and Damage – Comparing OECD and Global Totals 2001-2010[35]

	OECD countries	World	OECD countries as percentage of World total
Total disaster affected 2001-10	37,322,039	2,323,319,858	1.61%
Total disaster fatalities 2001-10	86,385	1,064,295	8.12%
Total disaster damage 2001-10	$607 bn.	$978 bn.	62.01%
Population 2009	1,221,410,000[36]	8,629,400,000[37]	14.15%

As also evident in Table 2, while a lower percentage than the global average of the population of OECD countries are either affected by or killed by disasters, roughly 62 percent of the cost of all global disaster damages was registered in OECD countries during the 2001-10 period. These damage numbers are closely comparable to data from the United Nations International Strategy for Disaster Risk Reduction (UNISDR) which showed that from 1991-2005 around 60 percent of costs due to disasters were incurred in OECD countries.[38] Although historic disaster damage figures have to be considered with a certain degree of caution (for a more detailed discussion see Chapter 2 of this review), it seems logical that the higher asset base in more

[35] EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, accessed 25 January 2012, www.emdat.be

[36] OECD, "OECD StatsExtracts," accessed 5 January 2012, http://stats.oecd.org/Index.aspx?DatasetCode=MIG

[37] UNFPA, *State of World Population 2009 – Facing a Changing World: Women, Population and Climate*.

[38] UNISDR, CRED, "Disaster Statistics, Total amount of reported economic damages by level of development and type of disaster (2005 US$ billion): 1991-2005", 2005.

developed countries is likely to account for higher damage numbers.[39]

While we still lack comprehensive data for 2011 at this point, the currently available data clearly show that OECD countries were especially hard-hit in 2011. In terms of fatalities the three deadliest disasters in OECD countries (Japan earthquake and tsunami, Turkey earthquake, US April tornadoes) killed over 20,000 persons and caused almost 70 percent of global disaster fatalities in 2011, compared to a 10-year average of around 8 percent of global disaster fatalities in OECD countries (for more details see Chapter 2 of this review).[40] Even if we include casualty estimates from the Horn of Arica famine (approximately 50,000-100,000 victims) the percentage of fatalities in 2011 which occurred in the rich world is well above the average for the preceding decade.

As noted, 2011 was the most expensive year for losses from natural disasters in history, in large part because of disasters in OECD countries. Four out of the five most costly disasters in 2011 occurred in OECD countries; the earthquake and tsunami in Japan alone made up 55 percent of global disaster damage in 2011.[41] According to Munich Re, the New Zealand earthquake, the April tornadoes in the US and Hurricane Irene each caused damages of more than $15 billion dollars and as discussed in Section 3 of this chapter, the US alone faced 14 disasters in 2011, each of which resulted in more than $1 billion in damage.[42] These numbers indicate that disaster damage in the OECD countries in 2011 might be higher than the already substantial 62 percent they were in the 10-year average since 2001. (The thorny issue of measuring economic damage from disaster is addressed in Chapter 2 of this review).

Statistics are not yet available on the percentage of the 206 million persons globally affected by natural disasters in 2011 that lived in OECD countries, but the floods in Australia in late 2010 and early 2011 and the earthquakes in Christchurch in September 2010 and February 2011 were the biggest disasters in both countries in terms of affected persons for over a decade. The same is true for the earthquake and tsunami in Japan.

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39 Disaster damage datasets are often incomplete and estimates often vary widely. For example, for Hurricane Katrina, disaster damage estimates varied from US$82 billion to US$125 billion (see Neumayer et al., *The Political Economy of Natural Disaster Damage,* September 2011). As an example for the limit of datasets, EM-DAT provided disaster damage estimates in 2010 for fewer than 70 out of 373 natural disasters, therefore we can assume that the real cost of natural disasters in 2010 was much higher than the $108.5 billion reported (See: Elizabeth Ferris and Daniel Petz, *A Year of Living Dangerously, A Review of Natural Disasters in 2010*, Brookings-LSE Project on Internal Displacement, 2011).

40 The majority of fatalities from those three disasters were recorded for the Japanese Tohoku earthquake and tsunami, which according to EM-DAT left 19,846 persons dead or missing. Source: Debarati Guha-Sapir, "Disasters in Numbers 2011," CRED-UNISDR Press Conference, Geneva, 18 January 2012, CRED Université catholique de Louvain - Brussels – Belgium, www.emdat.be

41 For more detail see Chapter 2, Section 1 of this review.

42 Munich Re, "The five largest natural catastrophes of 2011," Geo Risks Research, NatCatSERVICE, January 2012, http://www.munichre.com/en/media_relations/press_releases/2012/2012_01_04_press_release.aspx

A factory facility burns following an earthquake and tsunami in Sendai, northeastern Japan, March 11, 2011. Photo: © Mainichi/AFLO/Nippon News/Corbis

Section 2

Japan: The Most Expensive Disaster in History, the Tohoku Earthquake and Tsunami

The facts of the Great East Japan or Tohoku earthquake are well-known: a powerful 9.0 earthquake on 11 March 2011 was followed minutes later by a tsunami with waves reaching as high as 30 meters, destroying or damaging some 138,000 buildings and causing $210 billion in economic damages. 19,846 people are known to have died or are still missing.[43] It is a testament to Japan's pioneering work in developing earthquake-resistant construction techniques that only an estimated 100 people were killed in the earthquake itself.[44] Many of the 5.6 million residents of the three prefectures worst hit by the disaster lost their homes and the number of evacuees peaked at more than 475,000 a few days after the quake. A notable feature of members of the affected communities was their age. The population in the hard hit northeastern part of the country was older on average than the Japanese population as a whole, with over a quarter of the population over the age of 65. The specific needs of older people in disasters are considered in Chapter 4 of this review.

Table 3 Top 10 Natural Disasters in Japan by Fatalities since 1900[45]

Disaster	Date	Fatalities
Earthquake	1/9/1923	143,000
Earthquake, tsunami	11/3/2011	19,846
Earthquake	17/01/1995	5,297
Earthquake	28/06/1948	5,131
Storm	26/09/1959	5,098
Storm	09/1917	4,000
Storm	18/09/1945	3,746
Earthquake, tsunami	2/3/1933	3,064
Storm	21/09/1934	3,006
Storm	09/1923	3,000

While Japan has a long history of earthquakes, this was the most powerful earthquake the country ever experienced although it was not the deadliest. The 1923 Great Kantō earthquake resulted in far higher casualties, with over 140,000 dead. In 2011, the combination of the powerful earthquake and the tsunami – whose scale had not been predicted – caused

[43] EM-DAT: The OFDA/CRED International Disaster Database, accessed 13 January 2012, www.emdat.be

[44] Interviews conducted by Elizabeth Ferris, Tokyo, May 2011.

[45] EM-DAT: The OFDA/CRED International Disaster Database, accessed 24 January 2012, www.emdat.be; The number of casualties for the 2011 earthquake and tsunami is adjusted to the number presented by CRED on 18 January 2012: "Disasters in Numbers 2011."

massive destruction. The devastation to infrastructure – roads, trains, ports, and communications systems – was widespread as was the destruction of factories, homes, schools, and other buildings, particularly in the prefectures of Iwate, Myagi and Fukushima. Dams ruptured, electricity went off, about 11 percent of Japan's ports were closed and 2.6 percent of Japan's farms were washed away or submerged.[46]

Over 1,000 aftershocks hit the region in the period immediately following the earthquake, at least three of which measured over 7.0 on the Richter scale, increasing fear and uncertainty among the population. But it was the tsunami which was triggered by the earthquake which caused by far the most damage. In fact, at least 100 tsunami evacuation sites were destroyed, indicating that the scale of the waves of this tsunami had not been anticipated.[47] The Pacific Tsunami Warning Center issued a tsunami warning for the entire Pacific region shortly after the earthquake but while some waves were reported as far away as the Philippines, Hawaii and Oregon, casualties were few and economic damages were minor.[48]

The nuclear risk

While the earthquake and tsunami were responsible for the large-scale loss of life and damage to infrastructure, it was the threat posed by damage to nuclear reactors that caused the greatest fear – and the greatest criticism of the Japanese government's response. The earthquake and tsunami created the worst global nuclear crisis since the 1986 Chernobyl disaster. The three active reactor units, reactors 1, 2 and 3 at the Fukushima Daiichi Nuclear Power Station suffered meltdowns after the quake knocked out the plant's power and the tsunami disabled the backup generators meant to keep the cooling systems working. (Reactor units 4-6 were shut down for planned maintenance when the disaster happened.)[49]

The day after the earthquake/tsunami, the Japanese government evacuated nearly 80,000 residents living near the plant. Under a special nuclear emergency law, people entering the zone were subject to fines of up to 100,000 yen ($1,200) or possible detention of up to 30 days.[50] There were immediately questions about the scale of the evacuation area, particularly as some foreign governments warned their residents to leave areas much further away than the Japanese-declared evacuation zone. In the months following the accident, some people were resettled elsewhere and some returned to their communities, while

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46 AlertNet, "Japan rebuilding effort in numbers," 22 August 2011, http://www.trust.org/alertnet/news/factbox-japan-rebuilding-effort-in-numbers/

47 Japan Times, "Tsunami hit more than 100 designated evacuation sites," 14 April 2011, http://www.japantimes.co.jp/text/nn20110414a4.html

48 New York Times, "Away From Japan, Tsunami's Effect Is Diffuse," 11 March 2011, http://www.nytimes.com/2011/03/12/world/asia/12tsunami.html?partner=rss&emc=rss

49 Richard Black, "Reactor breach worsens prospects," BBC News, 15 March 2011.

50 The Washington Times, "Japan declares no-go zone around nuclear plant," 21 April 2011, http://www.washingtontimes.com/news/2011/apr/21/japan-declares-no-go-zone-around-nuclear-plant/?page=all

others never left the evacuation zone. By the end of the year 160,000 people remained displaced, many of them in evacuation centers.[51]

Having very limited fossil fuel reserves, Japan has for decades invested in nuclear energy to minimize dependency on fossil fuels, most of which it needs to import. In an age of climate change, nuclear power was also seen as a low-carbon alternative energy source. Before the accident, nuclear energy from the country's 54 reactors provided almost 30 percent of Japan's electricity, with plans underway to increase that to 40 percent by 2017.[52] The Fukushima accident led the government to shut down many of the reactors for testing and with other reactors undergoing regular maintenance, by the summer of 2011 only 19 of the country's 54 reactors were running, causing electricity shortages in many parts of the country and leading to a government campaign urging Japanese to save energy. While the campaign was quite successful, the lack of electricity also had negative consequence. With people and companies cutting down on the use of air conditioning, the government reported that around 6,880 people suffering heatstroke were taken to hospitals by ambulance in June, more than three times the number a year earlier. Fifteen of them died after reaching a hospital. People aged 65 or older accounted for 52 percent of the total.[53]

One of the problems linked to the nuclear accident was widespread uncertainty among the population about whether the government was accurately reporting the scale of the damage and the potential harm to human life. In April, Japan raised its assessment of the accident from 5 to 7, the worst rating on the International Atomic Energy Agency's (IAEA) International Nuclear and Radiological Event Scale (INES), putting the accident on a par with the 1986 Chernobyl explosion. However, it also reported that the amount of radiation released was less than 10 percent of that released from Chernobyl. In early June, reports that the amount of radiation released in the first days of the crisis might have been more than twice the original estimate strained the credibility of the government and the nuclear industry.[54] In late November, new analyses of the accident indicated more extensive melting probably occurred at the Unit 1 reactor than previously thought.[55]

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51 New York Times, "Japan — Earthquake, Tsunami and Nuclear Crisis (2011)," Updated: 10 February 2012, http://topics.nytimes.com/top/news/international/countriesandterritories/japan/index.html

52 Bloomberg, "Tokyo Electric Tries to Cool Unstable Atomic Reactor; Thousands Evacuated," 12 March 2011, http://www.bloomberg.com/news/2011-03-12/explosion-destroys-walls-of-japan-reactor-building-nhk-reports.html

53 Japan Times, "Heatstroke surge feared as people save power," 10 July 2011, http://www.japantimes.co.jp/text/nn20110710a3.html

54 New York Times, "2011 Japan Nuclear Crisis: Overview," updated: 31 January 2012, http://topics.nytimes.com/top/news/business/energy-environment/atomic-energy/index.html

55 World Nuclear News, "Fukushima units enter decommissioning phase," 21 December 2011, http://www.world-nuclear-news.org/WR-Fukushima_units_enter_decommissioning_phase-2112114.html

In mid-December, Japanese Prime Minister Yoshihiko Noda declared that the nuclear crisis was over as technicians gained control of the reactors at the Fukushima Daiichi Nuclear Power Plant. The government announced it would now focus on removing the fuel stored at the site and eventually dismantling the plant – a process that is expected to take at least four decades.

More than 160,000 people remain displaced because of the nuclear accident and many of the evacuees are refusing to return to their homes even though the government has declared some of the areas to be safe.[56] Unlike the case of Chernobyl, where affected communities were relocated to other areas, the Japanese government announced that it planned to clean up the area contaminated by radiation, but given the scale of the task and the long timeframe, it remains to be seen how many of the affected people will be able or willing to return.[57]

The Japanese government initially delayed giving information to the public about the state of affairs at Fukushima's nuclear plant – perhaps because it didn't have the information, or

[56] New York Times, "Japan's Prime Minister Declares Fukushima Plant Stable," 16 December 2011, www.nytimes.com/2011/12/17/world/asia/japans-prime-minister-declares-fukushima-plant-stable.html

[57] New York Times, "2011 Japan Nuclear Crisis: Overview," *op. cit.*

The giant wave tossed cars and boats like toys, transforming thriving towns into waterlogged wastelands. Japan, March 11, 2011. Photo: © Dreamstime.com

because it was waiting to get more information before passing it on, or because it wanted to avoid panic. For whatever reason, it was slow to acknowledge publicly the scale – or potential scale – of the nuclear crisis. The report of an internal investigation released on 26 December 2011 found that authorities had grossly underestimated tsunami risks, delayed giving information to the public, and that workers at Tokyo Electric Power Company (TEPCO) were untrained to handle emergencies such as the powerful shutdown that struck when the tsunami destroyed backup generators. The study found that a better response might have reduced core damage, radiation leaks and the hydrogen explosions that followed at two reactors and disseminated plumes of radiation. The report further criticized officials' use of the term "*soteigai*," meaning unforeseeable. The internal investigators said the term implied that authorities were shirking responsibility for what had happened.[58]

In January 2012, Japan said it would set new 40-year age limits on the legal lifespan of nuclear reactors, which could be a step toward fulfilling a government promise to eventually phase out nuclear power in the country.[59] However, as discussed below, at this stage Japan's future use of nuclear energy is uncertain.

The disaster response

Most observers give the Japanese government and Japanese civil society high marks for its rapid and efficient response to communities affected by the earthquake and tsunami – but decidedly lower marks for its response to the nuclear meltdown. Within weeks, most of the key infrastructure such as highways and airports had been restored.[60] Within six months of the earthquake about half of the estimated 23 million tons of rubble had been moved, although the disposal of all of the rubble is expected to take until early 2014. The government enacted a $50 billion emergency budget in May 2011, followed by an additional emergency budget of $25 billion in July, and in November the Japanese parliament passed a set of bills hiking taxes and generating other funds for rebuilding from the quake, bringing the supplementary budget for reconstruction up to $157 billion.[61] Total spending of 19 trillion yen (almost $250 billion) is planned over the next five years to rebuild northeastern coastal areas devastated by the disaster.[62]

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58 The Guardian, "Fukushima investigation reveals failings," 26 December 2011, http://www.guardian.co.uk/world/2011/dec/26/fukushima-investigation-reveals-failings?INTCMP=SRCH

59 Washington Post, "Japan plans to scrap nuclear plants after 40 years to beef up safety after Fukushima disaster'," 7 January 2012, http://www.washingtonpost.com/world/asia-pacific/japan-plans-to-shut-down-nuclear-reactors-after-40-years-of-use-to-beef-up-safety/2012/01/07/gIQAcqpKgP_story.html

60 OCHA, "Japan Earthquake and Tsunami, Humanitarian Situation Report No. 16," 1 April 2011, https://community.apan.org/hadr/japan_earthquake/m/sitreps/63918.aspx

61 AlertNet, "Japan rebuilding effort in numbers," 22 August 2011, http://www.trust.org/alertnet/news/factbox-japan-rebuilding-effort-in-numbers/

62 CNBC, "Japan Lower House Passes Reconstruction Funding Bills," 24 November 2011, http://www.cnbc.com/id/45425687/Japan_Lower_House_Passes_Reconstruction_Funding_Bills

The outpouring of response from Japanese civil society and NGOs was impressive. The Japanese Red Cross alone deployed over 600 teams to affected areas in the initial weeks. More than 119,000 emergency service personnel responded within eight days. In the week following the earthquake, 102 governments and 14 international organizations offered their assistance to Japan.[63] OCHA deployed a team to work with Japanese authorities in coordinating international assistance. Twenty international search and rescue teams from 15 countries responded. Over time the scale of international solidarity increased to 163 countries and regions and 43 international organizations offering assistance.[64]

The rapid engagement of the Japanese military in the days following the disaster was widely appreciated. This was the first time that Japan's Self Defense Forces were used on such a large scale and could in the longer term lead to broader public support for defense spending and to increased Japanese military assistance to disasters outside its territory. Shortly after the earthquake, the Japanese government dispatched 107,000 of its 230,000 troops for disaster relief and for the first time established a joint command of its ground forces, marines and air force. The Japanese military coordinated its efforts well with roughly 20,000 US service members who were called in to respond to the earthquake. This experience contrasts with that of the 1995 Kobe earthquake where the local government and prime minister were reluctant to summon the Self Defense Forces for help.[65]

In November, the Japanese government approved the creation of a reconstruction agency to speed up the rebuilding of areas hit by the disaster. The agency will be headed by the prime minister, who will be supported by a minister in charge. The agency, headquartered in Tokyo, will have branch offices in the three disaster-stricken prefectures of Iwate, Miyagi and Fukushima and will be active for 10 years through March 2021.[66] While there will be a reconstruction agency, the main administrative actors in the reconstruction will be the municipalities. The basic guidelines for the region's reconstruction published in July focus on rebuilding in a way that meets the challenges of a declining population and aging society. The plan promises to support community-led efforts to enable a new model of community building in the Tohoku area, giving due consideration to the elderly, children, women, persons with disabilities, public transportation, renewable energy, etc. The plan also places a strong emphasis on full implementation of both physical and social disaster risk reduction measures.[67]

As of November 2011, there were a total of 330,000 internally displaced persons from the disaster, with only 780 remaining in evacuation centers. Over 310,000 were accommo-

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63 Ministry of Foreign Affairs of Japan, 15 March 2011.

64 Government of Japan, "Road to Recovery," December 2011.

65 Chico Harlan, "A pacifist nation comes to depend on the service of its troops," Washington Post, 3 April 2011, p. A12.

66 NHK World, "Govt approves reconstruction agency bill," 1 November 2011, http://www3.nhk.or.jp/daily/english/01_16.html

67 Reconstruction Headquarters in response to the Great East Japan Earthquake, *Basic Concept for Reconstruction,* decided by the Reconstruction Headquarters on 29 July 2011, revised 11 August 2011, http://www.reconstruction.go.jp/english/topics/2011/12/000355.html

dated in public housing, emergency temporary housing, rental housing, and hospitals, with approximately 17,000 staying with relatives or friends.[68] Reconstruction of infrastructure and debris removal were well underway towards the end of the year, with 96 percent of electricity supply in the affected areas restored, 98 percent of water supply restored, major national roads and expressways and major rail connections almost completely rebuilt, as well as 68 percent of damaged ports restored.[69]

Longer term consequences

It is still early to evaluate the full array of consequences of the earthquake/tsunami/nuclear accident in Japan, but there are concerns about the long-term economic, political and energy impacts on the country.

Most economists do not expect the economic costs of the disaster to be long-term, especially given that the disaster did not hit Japan's industrial heartland and Japan has a strong institutional framework, which is usually seen as important for the long-term success of recovery from disasters.[70] The tsunami-hit area accounts for about six to seven percent of Japan's economic output. While the immediate impact of the disaster led to a further shrinking of the Japanese economy, which had been in recession, in the third quarter of 2011 the Japanese economy started to grow again.[71] In the case of the 1995 Kobe earthquake, Japan's trade slowed for only a few quarters, imports recovered fully and exports rebounded to 85 percent of pre-quake levels within a year.[72] In fact, policy-makers and economists are counting on the reconstruction effort to give the economy a jolt to keep it from sliding back into recession. But while the overall economic prognosis seems positive, the affected sub-region faces serious challenges. More than 38,000 residents left the area between March and August. Of those that remain, 180,000 have reportedly filed jobless claims – 70 percent more than the corresponding figures for 2010.[73] As in developing countries, solutions for IDPs and evacuees depend on restoration of livelihoods.

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68 Government of Japan, "Current situations of evacuees in the aftermath of the Earthquake," 17 November 2011.

69 Secretariat of the Reconstruction Headquarters, "Recovery Status of Major Infrastructures," 30 November 2011. Only 111,000 households from 2,558,000 affected in March remained without electricity most of those because their houses had been completely destroyed or they remained in the restricted area after the nuclear accident.

70 For studies on the long-term effects of natural disaster see for example: Aaron Popp, "The Effects of Natural Disasters on Long Run Growth," *Major Themes in Economics*, Vol. 8, Spring 2006; see also: Chul-Kyu Kim, *The Effects of Natural Disasters On Long-Run Economic Growth*, 2010.

71 New York Times, "Economy in Japan Shows Signs of Strength," 13 November 2011.

72 The World Bank, "Impact of quake on Japan's growth likely to be 'temporary'; 'Limited impact' on strong regional economy, says World Bank East Asia and Pacific Economic Update," 21 March 2011, http://www.worldbank.org/en/news/2011/03/21/impact-of-quake-on-japan-growth-likely-to-be-temporary-limited-impact-on-strong-regional-economy

73 AlertNet, "Japan's post-tsunami revival plan reaches tipping point," 14 December 2011, www.trust.org/alertnet/news/analysis-japans-post-tsunami-revival-plan-reaches-tipping-point/

There has been considerable discussion about the political consequences of the disaster. Naoto Kan, Japan's prime minister since June 2010, resigned in August 2011 after just 15 months in office. He was replaced by Yoshihiko Noda, Japan's finance minister, reportedly in part because of Kan's failure to galvanize the country after the earthquake and the nuclear accident. In the immediate aftermath of the earthquake, political bickering seemed to give way to unity, but it didn't last long.[74] There were particular concerns around the way the government handled the nuclear issue and about the future of nuclear energy in the country. While Mr. Kan called for ending Japan's dependence on nuclear power, Mr. Noda followed the business community in saying that Japan needs nuclear power to prevent electrical shortages.

TEPCO, as the company responsible for managing the nuclear power plant, has come under particular criticism and heavy economic pressure. In December 2011 the Japanese government told TEPCO to consider accepting temporary state control in return for a much-needed injection of public funds – both to pay compensation and to clean up and decommission the reactors. Japan's nuclear crisis minister, Goshi Hosono, acknowledged that no country has ever had to clean up three destroyed reactors at the same time. And there are lingering doubts about whether the plant has in fact undergone a cold shutdown.[75]

More broadly, the accident at Fukushima raises concerns about the future of nuclear energy in a country which depends on nuclear reactors for at least a third of its electricity. In its current Strategic Energy Plan, launched in March 2010, Japan indicated its intention to increase its dependence on alternative energy sources to 70 percent of which 50 percent would be from nuclear energy.[76] The Fukushima accident shook confidence in the government-business alliance which has historically been responsible for nuclear policy and which has been criticized for its lack of transparency. But the crisis also led to an overhaul of nuclear energy governance to increase both oversight and transparency. However, Jamil notes that even with the changes, it is still "not totally clear who truly wields authority in the (nuclear governance) structure."[77] Nor is it clear whether Japan will continue its path towards greater reliance on nuclear energy in the future.

Internationally, the fallout of Fukushima for the future of nuclear energy has been mixed. While Germany decided to close all its nuclear reactors by 2022 and Switzerland decided to phase out nuclear energy by 2034, other countries that rely heavily on nuclear power such as the US, France, Russia and South Korea plan to continue their reliance on nuclear power as a major energy source (even though few reactors are under construction in these

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74 New York Times, "Naoto Kan," 29 August 2011, http://topics.nytimes.com/top/reference/timestopics/people/k/naoto_kan/index.html?scp=1

75 New York Times, "2011 Nuclear Crisis: Overview," *op. cit.*

76 Sofiah Jamil, "Falling from Grace: Nuclear Energy in Japan Post-Fukushima," *NTS Alert,* November 2011 (Issue 1), p. 1.

77 *Ibid.,* p. 3.

countries).[78] China, with by far the largest number of nuclear plants under construction in the world, announced after the Fukushima accident that it would temporarily suspend construction of nuclear power plants, but by late 2011 construction work at some plants had resumed.[79] Table 4 gives a picture of operational nuclear plants as well as plants under construction in selected countries.

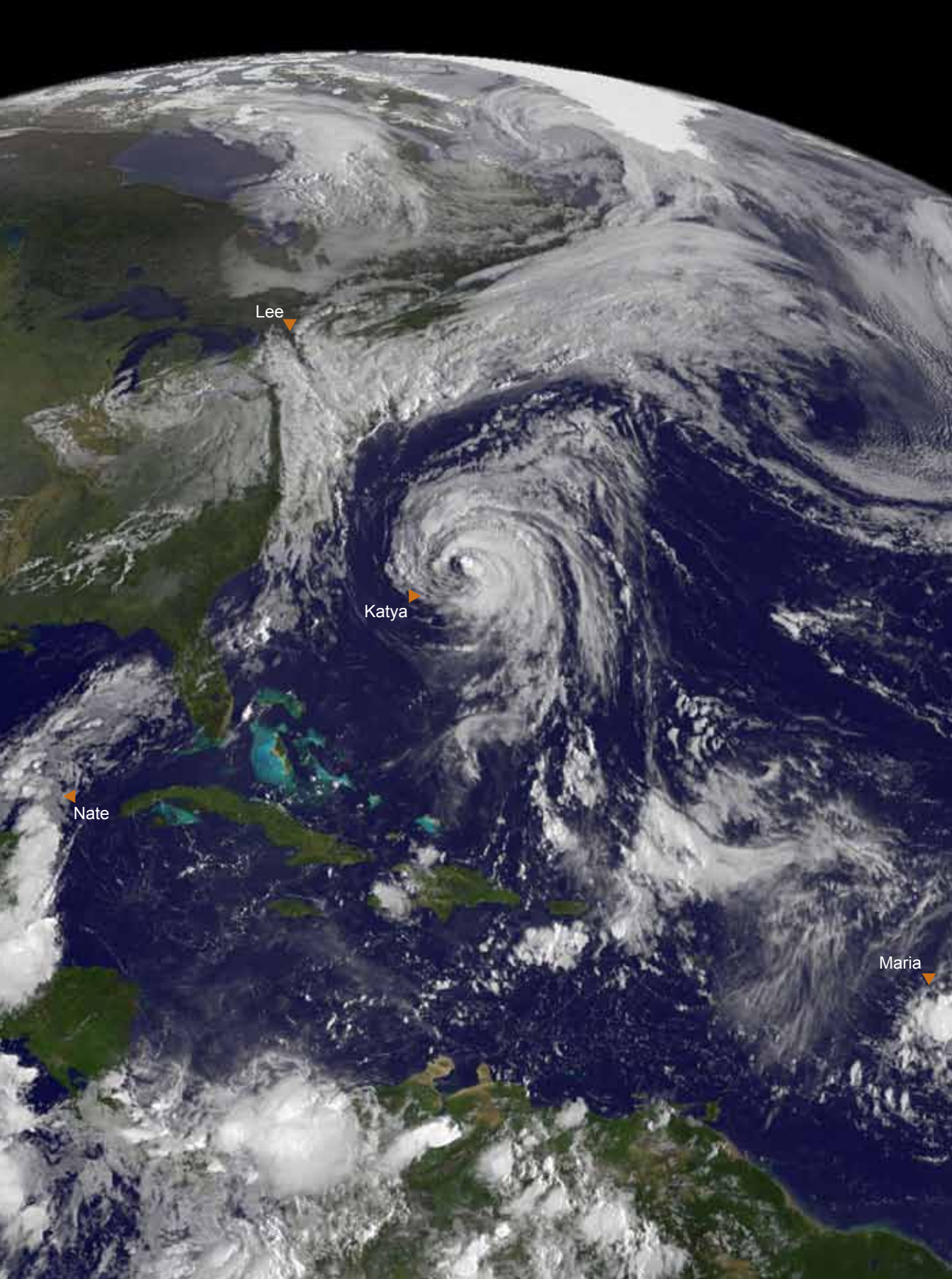
Table 4 Nuclear Plants in Selected Countries, 2011[80]

Country	Nuclear plants (in operation)	Nuclear plants (under construction)
USA	104	1
France	58	1
Japan	50	2
Russian Federation	33	10
Korea Rep.	21	5
India	20	6
China	16	26
Germany	9	0
Switzerland	5	0

78 See: Huffington Post, "Switzerland Nuclear Power Phaseout Approved By Lawmakers," 8 June 2011, see also: BBC News, "Germany: Nuclear power plants to close by 2022," 30 May 2011.

79 Kevin Voigt, Irene Chapple, "Analysis: Fukushima and the 'nuclear renaissance' that wasn't," CNN News, 1 June 2011, www.edition.cnn.com/2011/BUSINESS/04/11/japan.fukushima.nuclear.industry/index.html, see also Penn Energy, "China may restart suspended nuclear power plant construction by end of 2011," 18 November 2011, http://www.pennenergy.com/index/power/display/2566624541/articles/pennenergy/power/nuclear/2011/november/china-may_restart.html, see also: Business China, "China May Soon Resume Approvals for Nuclear Power Plants," 18 January 2012, http://en.21cbh.com/HTML/2012-1-18/3NMjY4XzIxMTU3NQ.html

80 European Nuclear Society, "Nuclear power plants, world-wide," 4 January 2012, http://www.euronuclear.org/info/encyclopedia/n/nuclear-power-plant-world-wide.htm



Tropical cyclones or remnants plaguing the Atlantic Ocean on Sept. 8, 2011, and one satellite has captured all four in one image: Katia, Lee, Maria and Nate. Photo: NASA/NOAA Project

Section 3

USA: Fourteen Billion Dollar Disasters

2011 was a devastating year for the US in terms of natural disasters, in spite of the fact that it was a fairly calm year for hurricanes. On 99 separate occasions, the federal government declared that a major disaster existed – breaking the previous record of 81, which was itself set in 2010. This figure of 99 declared disasters is nearly triple the average of 34 per year dating back to 1953.[81]

The frequency of severe weather-related events was striking, as was the variety of disasters. From snowstorms, floods and tornadoes to drought and wildfires, 2011 seemed to be the year of extremes. While the number of casualties for the 14 biggest US disasters was less than 600 (small in comparison with 2005, when Hurricane Katrina alone resulted in 1,833 deaths), economically it was an extremely costly year.[82] According to the National Climatic Data Center, the US has experienced 114 weather/climate disasters since 1980 in which overall damages reached or exceeded $1 billion. Fourteen of those disasters occurred in 2011. The previous record for billion dollar disasters was set in 2008 when nine disasters were recorded. To put the severity of the year's events in context, 2011 had more billion dollar disasters than the entire decade of the 1980s.[83]

Some observers have suggested that these figures actually understate the number of disasters. A Weather Underground meteorologist adds two events to this list: severe thunderstorm/tornado outbreaks 19-21 April (0 deaths, $1 billion) and the 29 October snowstorm (27 deaths and $3 billion in damages).[84] The costs of these disasters will be felt for years.

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81 Insurance and Financial Advisor Web News, "Insurers' lost $32B from natural disasters in first nine months of '11," 3 January 2012, http://ifawebnews.com/2012/01/03/insurers-lost-32b-from-natural-disasters-in-first-nine-months

82 EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, www.emdat.be

83 National Oceanic and Atmospheric Administration, "Extreme Weather 2011," 5 February 2012, http://www.noaa.gov/extreme2011/

84 See for example: Weather Underground, "Severe Weather Headlines," www.wunderground.com/resources/severe/severe.asp. Note too that there are differences in the number of deaths and estimates of the economic costs of the disasters.

Table 5 Billion Dollar Disasters in the US in 2011[85]

Disaster	Date	Fatalities	Economic costs ($ billions)
Groundhog Day Blizzard	29 Jan-3 Feb	36	1.8+
Midwest/Southeast tornadoes (46 tornadoes)	4-5 April	9	2.8+
Southeast/Midwest tornadoes (50 tornadoes)	8-11 April	0	2.2+
Midwest/Southeast tornadoes (177 tornadoes)	14-16 April	38	2.1+
Southeast/Ohio Valley/Midwest tornadoes (343 tornadoes)	25-28 April	321	10.1
Midwest/Southeast tornadoes (180 tornadoes)	22-27 May	177	9.1+
Midwest/Southeast tornadoes and severe weather (81 tornadoes)	18-22 June	3	1.3
Rockies and Midwest severe weather	10-14 July		1+
Southern Plains/Southwest drought and heat wave	spring-fall		10+
Mississippi River flooding	spring-summer	2-7	3-4
Upper Midwest flooding	summer	5	2[86]
Hurricane Irene	20-29 August	45	7.3+[87]
Tropical Storm Lee	early September	21	1+
Texas, New Mexico, Arizona wildfires	spring-fall	5	1+
Total			**54.7+**

Why so many weather-related disasters in the US?

While variability in weather is always to be expected, scientists make the case that 2011 was a particularly bad year because of two factors: La Niña and global warming. La Niña typically triggers certain extreme weather conditions, such as heavy precipitation in Australia and drought in Texas – but this year global warming has amplified them from bad to record levels.[88] And 2011 was a particularly bad year in terms of rising greenhouse gases, melting Arctic sea ice and global temperatures the tenth highest ever recorded. In July, the National Oceanic and Atmospheric Administration (NOAA) reported that the last 300 months had all been above average temperature and that the 13 warmest years had all occurred in the 15 years since 1997.[89] (We will discuss questions pertaining to La Niña and climate change in more detail in Chapter 2 of this report.)

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85 National Oceanic and Atmospheric Administration, "Extreme Weather 2011," 5 February 2012, http://www.noaa.gov/extreme2011/

86 The floods caused another billion dollars in damage in Canada.

87 Munich Re estimates the damage of Hurricane Irene in the US and Caribbean to be $15 billion (See Chapter 2, Section 3 of this Review.)

88 Huffington Post, "U.S. Natural Disasters: 2011 An Extreme And Exhausting Year," 3 September 2011, http://www.huffingtonpost.com/2011/09/03/diasters-in-us-an-extrem_n_947750.html

89 The Guardian, "Environment world review of the year: '2011 rewrote the record books'," 22 December 2011, http://www.guardian.co.uk/environment/2011/dec/22/environment-2011-year-review

Floods and a hurricane

The US has a long history of flooding of the Mississippi River and an elaborate system of dykes or levees has been constructed over the years along the river.[90] But particularly heavy rains in the US Midwest in April led to large-scale flooding downstream. For the first time since 1973, the Morganza Spillway in Louisiana was opened, deliberately flooding part of the state in order to protect the urban center of New Orleans. The New Madrid Floodway was activated by detonating portions of a Mississippi River levee for the first time since 1937. Shortly after the country finished dealing with the massive flooding along the Mississippi River basin, another billion dollar flood unfolded in the upper Midwest, due to a heavy snow season, the melting of a late May snowpack in the northern Rockies and the wettest May on record in the north-central states. Flooding along the Missouri and Souris Rivers led to the evacuation of 11,000 residents from Minot, North Dakota while the floods breached or overtopped levees in parts of Missouri, Iowa and Nebraska.

Although 2011 was a light year for hurricanes in the US, the damage caused by Hurricane Irene was substantial. The hurricane battered Puerto Rico and portions of the Bahamas before making landfall in North Carolina on 27 August. It then weakened into a tropical storm before landing in New York City on 28 August, where authorities had ordered the unprecedented evacuation of about 370,000 residents in low-lying areas as well as for the first time in history shutting down the city's entire transit system because of a weather event.[91] But in spite of the storm's weakened state, torrential rainfall caused catastrophic flooding in the Northeastern US. Seven million people lost electric power, 45 people died and the economic costs were calculated at more than $7.3 billion.[92]

And then there were the tornadoes

The spate of tornadoes that hit the US in 2011 was unusual and accounted for half of the billion dollar disasters in 2011. Typically, some 800 tornadoes are reported nationally every year, in which an average of 80 people are killed.

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90 For a fascinating account of the impact of economic and political interests in developing this system, see John M. Barry, *Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America*, 1997.

91 New York Times, "With Hurricane Irene Near, 370,000 in New York City Get Evacuation Order," 26 August 2011, http://www.nytimes.com/2011/08/27/nyregion/new-york-city-begins-evacuations-before-hurricane.html?pagewanted=all

92 Chris Dolce, "2011 Billion-Dollar Disaster Tally Continues to Climb," *The Weather Channel*, 7 December 2011, http://www.weather.com/outlook/weather-news/news/articles/2011-year-of-billion-dollar-weather-disasters_2011-12-07

A word of background

A tornado is defined as a "violently rotating column of air extending from a thunderstorm to the ground." Thunderstorms develop in warm, moist air in advance of eastward-moving cold fronts. These thunderstorms often produce large hail, strong winds and tornadoes. In the winter and early spring, tornadoes are often associated with strong, frontal systems that form in the central states and move east. Tornadoes also occasionally accompany tropical storms and hurricanes that move over land. Almost 70 percent of all tornadoes are considered weak with winds less than 110 mph and lasting less than 10 minutes. Violent tornadoes account for only 2 percent of all tornadoes but 70 percent of all tornado deaths and can last for more than an hour. Tornadoes can occur at any time of the year although in the south, peak tornado occurrence is March-May while peak months in the northern states are during the summer.[93]

[93] National Severe Storm Laboratory, "Tornadoes…," accessed 17 January 2012, http://www.nssl.noaa.gov/edu/safety/tornadoguide.html

2011 was an exceptionally destructive and deadly year for tornadoes in the US. Photo: Thinkstock.com

The greatest tornado outbreak in world history hit the southeast US during a four-day period from 25-28 April 2011 when 334 tornadoes touched down. This more than doubles the previous record for most tornadoes in a four day period, which was 162. The prior record was set just two weeks earlier, during the 14-16 April 2011 Southeast US outbreak. Before 2011, the greatest tornado outbreak in history was the 3-4 April 1974 Super Outbreak which had 148 twisters and led to the deaths of 315 people.[94] The Joplin, Missouri tornado on 27 May was the costliest tornado in history with damages expected to reach $3 billion and 160 deaths recorded. Before 2011, the most damaging tornado was the 3 May 1999 Oklahoma City tornado, which did $1 billion in damage (1999 dollars).[95]

Overall, the number of deaths from tornadoes has decreased dramatically since 1875 as a result of the deployment of weather radar in the 1950s and 1960s. In fact, the warning system was "absolutely as good as it could be" according to Stan Gedzelman of the City College of New York. Joplin residents were given a 24 minute warning before the tornado touched down, but the force of the tornado and the destruction it caused were "beyond

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94 Weather Underground, "Severe Weather Headlines," accessed 17 January 2012, www.wunderground.com/resources/severe/severe.asp

95 *Ibid.*

belief."[96] Patrick Michaels suggests that one of the reasons the casualties were so high in both Joplin and north central Alabama is the fact that these areas are not traditionally tornado-prone and thus people are less aware of the tornados and drills – unlike in the Oklahoma-Texas "tornado alley."[97]

Writing before the 2011 outbreak, Sutter and Simmons analyzed fatalities from tornadoes in the US and found that only 347 of the almost 21,000 tornadoes in their data set resulted in one or more fatalities. In fact, 98 percent of tornadoes had no fatalities and 91 percent caused no injuries. They also looked at measures expected to reduce fatalities, including the question of lead time – the number of minutes between the time a warning is issued and the beginning of the tornado. They found that while warnings reduce injuries, greater lead time does not always translate into fewer deaths. In fact, lead times greater than 15 minutes increase fatalities relative to no warning. This may be because most tornado warnings turn out to be false alarms (three out of four cases) and it may be that when people have more warning, they are apt to take more risks, e.g. "run to the store before the tornado hits."[98]

Drought and wildfires

Beginning in December 2010, Texas and other parts of the southwest began to experience drought. That drought, coupled with the fact that it was one of the hottest summers on record across the southern plains, had devastating economic consequences. Total direct losses to crops, livestock and timber resulting from the drought were estimated at some $10 billion. In turn, the drought set the stage for some of the worst wildfires ever experienced in the United States.[99] The Bastrop fire in Texas was the most destructive fire in Texas history, destroying over 1,500 homes and 500 million trees, and burning three million acres. The Wallow Fire consumed over 500,000 acres, making it the largest on record in Arizona while the Las Conchas Fire in New Mexico was also the largest fire in that state's history, burning over 150,000 acres and threatening the Los Alamos National Laboratory.[100] Texas governor Rick Perry declared a state of disaster every month since December 2010;

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96 Anthony Mason, "Deadliest tornado season in 50 years – but why?" CBS News, 23 May 2011.

97 Patrick Michaels, "The Great Tornadoes of 2011 Put In Perspective," *Forbes,* 26 May 2011, http://www.forbes.com/sites/patrickmichaels/2011/05/26/the-great-tornadoes-of-2011-put-in-perspective/

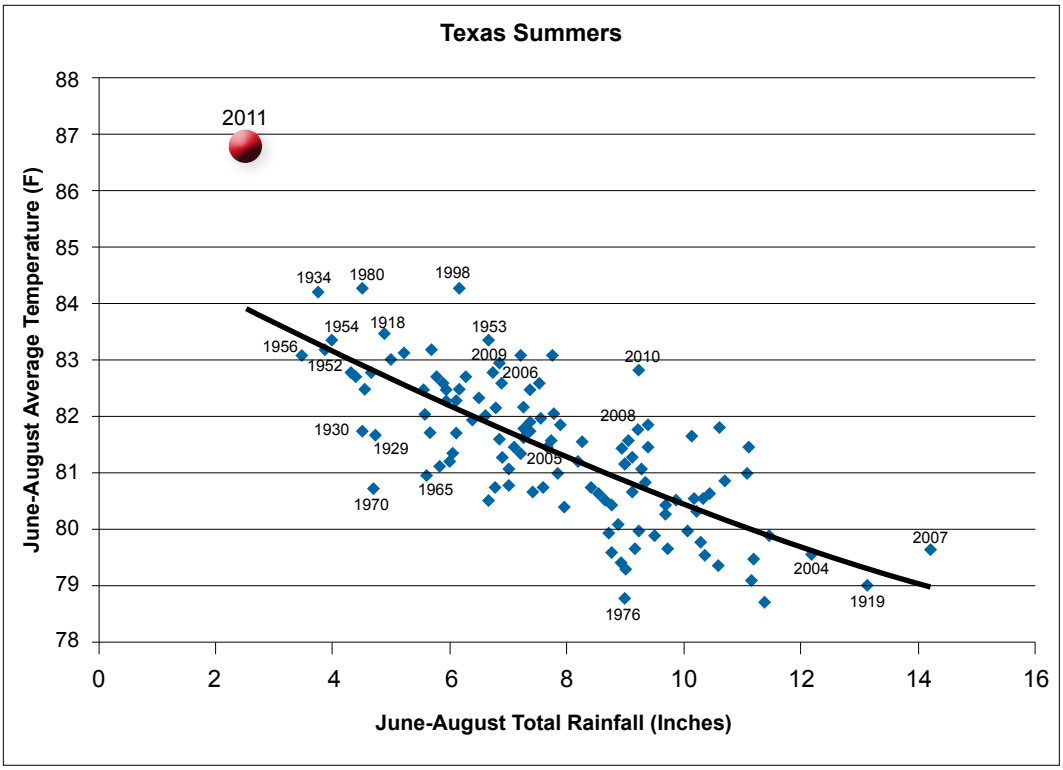
98 Daniel Sutter and Kevin M. Simmons, "The Socioeconomic impact of tornadoes," pp. 103-132, in William Kern, ed., *The Economics of Natural and Unnatural Disasters*, Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 2010. Note that they also suggest that it is not cost-effective to invest in tornado shelters as violent tornadoes occur too infrequently to justify the cost. According to their calculations, the cost of constructing such shelters per life saved in Oklahoma, in the heart of Tornado Alley would be over $50 million, p. 121.

99 For a discussion of the relationship between wildfires and climate change and for an overview of measures to prevent wildfires, see Johann Georg Goldammer and Brian J. Socks, "SR10: Specification for a state of science review – wildland fires," UK Government's Foresight Project, Migration and Global Environmental Change, 2011.

100 National Climatic Data Center, "Billion Dollar U.S. Weather/Climate Disasters," 7 December 2011, www.ncdc.noaa.gov/oa/reports/billionz.html

by 28 June 2011, over 90 percent of Texas was in extreme drought, with 47 percent of the state qualified as having exceptional drought, the most severe category.[101]

While rains fell in some parts of Texas in December 2011, almost 98 percent of the state continued to experience severe drought by the end of the year and projections are that the drought will continue well into 2012 and perhaps beyond.[102] The graph below illustrates the deadly combination of higher-than-average temperatures coupled with dramatically lower than average rainfall.[103]



[101] Weather Underground, "Severe Weather Headlines," accessed 17 January 2012, www.wunderground.com/resources/severe/severe.asp

[102] For a description of the Texas drought by the state climatologist, John Nielsen-Gammon, see: Houston Chronicle Blog, "Texas Drought: The Executive Summary," 4 November 2011, http://blog.chron.com/climateabyss/2011/11/texas-drought-the-executive-summary/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+houstonchronicle%2Fclimateabyss+%28reader+blog%3A+Climate+Abyss%29

[103] John Nielsen-Gammon, "Texas Drought: Spot the Outlier," *Houston Chronicle Blog*, 29 August 2011, http://blog.chron.com/climateabyss/2011/08/texas-drought-spot-the-outlier/

A man and child stand on a dry lakebed during the Texas drought of 2011.
Photo: © Enigmacypher | Dreamstime.com

It is hard to overstate the negative effects of the drought in Texas and other states. Over the course of the year, the number of cows in Texas dropped by about 600,000 – a 12 percent decrease from the five million cows in the state at the beginning of the year. This is a greater annual percentage decrease than at any time since the Great Depression of the 1930s. While some ranchers moved their cattle to greener pastures outside the state, about 200,000 more cows were slaughtered in 2011 than in 2010 – a 20 percent increase. This means that there will be fewer calves next year and overall, beef production nationally is expected to be down four percent and beef prices are expected to increase.[104]

But again, the costs of the drought and the wildfires go beyond the cattle losses. Texas lost half of its cotton crop which could affect the price of clothing assembled in Asia. The entire hay crop was lost which will make feeding the surviving cattle more expensive in the future. Texas and Oklahoma produce a third of the country's wheat; the fall 2011 planting season was affected as winter-wheat requires rain for the seeds to germinate.[105] There are concerns about the region's water supply as lakes and reservoirs fall below normal ranges and possible shortages of electricity may further limit economic growth. Businesses which rely on sales to farmers and ranchers are also affected. As one Texas car dealer commented "The bottom has fallen out of tractor sales. People just aren't buying farm equipment because there's nothing to farm."[106]

The variety and severity of weather-related disasters in the United States during the course of 2011 is striking. Given predictions that such disasters will increase in intensity in the future as a result of climate change gives rise to the disturbing possibility that the experiences of 2011 may in fact be the "new normal."

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[104] Betsy Blaney, "Texas drought takes cow numbers down by 600K," *Yahoo News*, 16 December 2011, http://news.yahoo.com/texas-drought-takes-cow-numbers-down-600k-082208305.html

[105] Time Magazine, "Forget Irene: The Drought in Texas Is the Catastrophe That Could Really Hurt," 31 August 2011, http://www.time.com/time/nation/article/0,8599,2091192-2,00.html

[106] David Self, interview, 24 December 2011.

Brisbane Flood 2011 Photo: © Thinkstock.com

Section 4

Australia: Submerged in Queensland

After years of prolonged drought, the northeastern state of Queensland, Australia in December 2010 and January 2011 experienced one of the largest floods in Australian history, affecting an area of about 850,000 square kilometers (an area larger than the size of Pakistan). Around 200,000 persons were affected, 16 people died and over 70 towns were evacuated. In terms of the number of people affected, it was the largest natural disaster in the decade. The floods were preceded and followed by three cyclones, Tasha (December), Anthony (January), and the strongest of the group, Category 5 Cyclone Yasi which made landfall on 2 February.[107] Both the floods and storms were very likely influenced by a particularly strong La Niña weather pattern, making 2010 the third wettest year on record for Australia. With estimates of up to US$15.9 billion in losses and damages, the floods and cyclones of 2010/11 were also one of the largest disasters in Australian history in terms of disaster damage. These disasters damaged more than 6,700 km of state roads and 4,700 km of rail network and damaged and disrupted the province's important coal industry. As of November 2011, 130,666 insurance claims were filed as results of the floods and Cyclone Yasi, for a value of AUD$3.73 billion of which 66 percent had been paid.[108]

Table 6 Number of Total Disaster Affected Populations in Australia 2001-2011[109]

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010[110]	2011	Total
Extreme temp.	0	0	0	0	0	0	0	0	2,000	0	0	2,000
Flood	4,001	0	470	3,620	3,000	1,100	5,000	8,400	9,200	211,000	217	246,008
Storm	207	129	2,070	645	1,200	9,030	820	12,000	15,400	0	7,300	48,801
Wildfire	4,400	244	2,650	0	220	141	0	0	9,954	0	0	17,609
Total	8,608	373	5,190	4,265	4,420	10,271	5,820	20,400	36,554	211,000	7,517	314,418

The Federal government and the Queensland state authorities responded swiftly with the help of Australia's Emergency Management system as well as the Australian Defence Force to effectively coordinate the evacuation, relief efforts and recovery support.

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107 BBC, "Flooding in Australia's Queensland 'to last weeks'," 3 January 2011, http://www.bbc.co.uk/news/world-asia-pacific-12107131

108 Queensland Reconstruction Authority, *Monthly Report,* December 2011.

109 EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, accessed 5 January 2012, www.emdat.be

110 To avoid double counting, EM-DAT registers a disaster at the onset of the hazard. Therefore the Queensland Floods are recorded as a 2010 disaster in the database.

In February 2011, the Queensland Reconstruction Authority was established to oversee and coordinate the recovery and reconstruction efforts. The Government of Australia indicated that it would invest AUD$5.6 billion (US$5.7 billion) in rebuilding flood-affected regions and the Government of Queensland pledged AUD$2.1 billion for recovery and reconstruction. Immediately after the flood, the Australian government initiated a "social safety net" emergency program, disbursing Australian Disaster Recovery Payments and Income Recovery Subsidies. The authorities used an advance payment mechanism to swiftly transfer funds to local governments which expedited disbursements. Financial support was provided immediately to the beneficiaries. By June more than 630,000 Australian Disaster Recovery Payments had been made, totaling AUD$725 million of which 60 percent were flood-related and the rest storm-related.[111] In addition, AUD$278 million were contributed by the Australian public to the Premier's Disaster Relief Appeal providing assistance to disaster-affected persons.[112] The Government of Australia also incentivized the inclusion of disaster mitigation measures in reconstruction by making full disbursal of reconstruction funding to state and local governments contingent upon the development and implementation of appropriate natural disaster mitigation strategies. The Queensland Reconstruction Authority also declared building resilience as an overarching goal for disaster reconstruction based on the framework provided by Australia's National Strategy for Resiliency of 2011, especially focusing on coastal management, integrated watershed management and flood risk reduction.[113]

The Reconstruction Authority has also put a strong focus on strategic communication with stakeholders by developing a user-friendly websites as well a "build back navigator" providing advice on insurance, getting damage assessments and building quotes, finding temporary accommodation, accessing disaster relief grants, other financial support avenues and information about what factors people need to consider when they are ready to start rebuilding.[114] Media reports around the one year anniversary of the floods generally see reconstruction as well on track, while noting that only ten percent of the billions of dollars set aside for natural disaster recovery had been paid out although authorities reported that projects worth AUD$3.6 billion were in the pipeline.[115]

Social media, including Twitter and Facebook, played an important role in the crisis communication during the flood crisis. More than 35,000 tweets containing the #qldfloods hashtag were sent during the height of the emergency, from 10-16 January 2011, sharing directly emergency information, relevant situational information, advice, news media and multimedia reports.[116]

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111 The World Bank and Queensland Reconstruction Authority, *Queensland Recovery and Reconstruction in the Aftermath of the 2010/2011 Flood Events and Cyclone Yasi,* June 2011, p. 7f.

112 Queensland Reconstruction Authority, *Monthly Report,* December 2011, p. 47.

113 The World Bank and Queensland Reconstruction Authority, *op. cit.*, p. 3.

114 *Ibid.,* p. 27f.

115 ABC News, "Flood reconstruction on track one year on," 1 January 2011, http://www.abc.net.au/news/2012-01-11/flood-reconstruction-on-track-one-year-on/3767310

116 Media Ecologies Project et al., "#qldfloods and @QPSMedia: Crisis Communication on Twitter in

Given Australia's vulnerability to climatological and hydrometeorological disasters the instigation of a climate tax in November 2011 by the Australian Government was an important step to foster climate change mitigation in one of the world's highest per capita CO_2 polluters (each Australian emitted 18.6 tons of CO_2 in 2008, which is higher than the per capita emissions in the US and most other major economies.)[117] The law sets a fixed carbon tax of AUD$23 per ton on the top 500 polluters from July 2012, then moves to an emissions trading scheme from July 2015.[118]

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the 2011 South East Queensland Floods," Research Report, January 2012.

[117] World Bank, "CO2 emissions (metric tons per capita)," accessed 12 January 2012, http://data.worldbank.org/indicator/EN.ATM.CO2E.PC?order=wbapi_data_value_2008+wbapi_data_value+wbapi_data_value-last&sort=asc

[118] Reuters, "Australia passes landmark carbon price laws," 8 November 2011, http://www.reuters.com/article/2011/11/08/us-australia-carbon-idUSTRE7A60PO20111108

2011, Flooding in Brisbane. Photo: © Thinkstock.com

Earthquake damage, Christchurch, New Zealand.
Photo: © Alexandra1977 | Dreamstime.com

Section 5

New Zealand: The Canterbury Quakes

New Zealand experienced one of its largest disasters in history, when an earthquake on 22 February 2011 struck the country's second largest town, Christchurch, which is located in the Canterbury Region on South Island.

Table 7 Number of Total Disaster Affected Populations in New Zealand 2001-2011[119]

	2001	2002	2003	2004	2005	2006	2007	2010	2011	Total
Earthquake	0	0	0	0	0	0	0	300,002	301,847	601,849
Flood	0	300	0	5,350	400	1,200	0	0	0	7,250
Storm	0	0	0	0	100	0	300	0	0	400
Total	0	300	0	5,350	500	1,200	300	300,002	301,847	609,499

The Canterbury region and Christchurch had previously been hit by a strong 7.1 magnitude quake in September 2010, with the epicenter about 40 km west of Christchurch City at a depth of 10 km, which caused severe damage to houses and infrastructure but resulted in no casualties. The 6.3 magnitude February aftershock centered 10 km outside of Christchurch at a depth of 5 km, causing many of the already-weakened building structures to crumble and collapse. The February earthquake, which struck four times closer to the city's center, was also much closer to ground level and it occurred at lunch time during the work week rather than during the middle of the night as the September earthquake did. This meant that 181 people died in the 22 February aftershock, even though it was much weaker than the original quake which hit on September 4.[120]

For New Zealand the February quake was the most deadly natural disaster since the 1931 Hawke's Bay earthquake. In terms of the number of persons affected, both the 2010 and 2011 earthquakes top the list of disasters since at least 1900.[121] For the first time in the country's history a state of national emergency was invoked for a civil defense emergency and the New Zealand Defence Forces mounted their largest ever operation on New Zealand territory.[122] Urban Search and Rescue (USAR) teams from New Zealand and Austra-

[119] EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, accessed 5 January 2012, www.emdat.be

[120] Guardian, "Christchurch Earthquake: At Least 65 dead and 100 Trapped in 'Darkest Day'," 22 February 2011, www.guardian.co.uk/world/2011/feb/22/christchurch-earthquake-65-dead-100-trapped

[121] EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, accessed 5 January 2012, www.emdat.be

[122] Earthquake Commission, *Annual Report 2010-2011*, 2011, p.9., available at: http://www.eqc.govt.nz/

lia, UK, USA, Japan, Taiwan, China and Singapore tried to rescue survivors in the days after the February quake, but as in most developed countries, the broader recovery efforts were almost exclusively covered by resources within New Zealand. And while there were certainly offers of international assistance, the UN's financial tracking service shows that only around $9.8 million in international disaster assistance was disbursed for the New Zealand earthquakes in 2011.

As in most earthquake areas, thousands of aftershocks hit the area. In Christchurch, over 7,000 aftershocks were recorded. Among them, the strong aftershocks on 13 June 2011 (5.8 and 6.3 magnitude) were particularly frightening as they injured 46 people and affected many structures that had already previously been damaged. The most recent series of aftershocks on December 23 (5.8 and 6.0 magnitude) led to the collapse of several unoccupied buildings as well to the evacuation of the city's airport.[123]

The September and February earthquakes damaged more than 100,000 homes in and around Christchurch – a city with a total population of 350,000. In addition to homes, the earthquake damaged sewer lines, water pipes, farms and roads and led to power outages. In addition to the collapse of structures, a main cause of damage was soil liquefaction,[124] especially in riverside areas, which means that many plots will have to be abandoned and people resettled elsewhere. More than 60 percent of the businesses in the central business district, which employed 50,000 people, needed to relocate because of the quake, although fortunately there was no significant rise in unemployment.[125] Most of the affected households and businesses were expected to file claims with their insurers and the Earthquake Commission (EQC) making it one of the highest-insured major disasters in history.[126] New Zealand possesses a unique disaster insurance scheme. The EQC, formed in 1944 as the "Earthquake and War Damage Commission" has since then collected a premium from all holders of domestic fire insurance. When a disaster strikes, these funds are disbursed to citizens who own private or government insurance for their buildings and/or personal effects and damages up to NZD100,000 (+GST) to buildings and NZD20,000 (+GST)

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123 GeoNet, "Dec 23 2011 - Christchurch hit again at Christmas," 24 December 2011, http://www.geonet.org.nz/, Guardian, "New Zealand's Christchurch hit by series of earthquakes," 22 December 2011, http://www.guardian.co.uk/world/2011/dec/23/new-zealand-earthquake-christchurch

124 Liquefaction is a physical process that takes place during some earthquakes that may lead to ground failure. As a consequence of liquefaction, clay-free soil deposits, primarily sands and silts, temporarily lose strength and behave as viscous fluids rather than as solids. Liquefaction takes place when seismic shear waves pass through a saturated granular soil layer, distort its granular structure, and cause some of the void spaces to collapse. USGS, "FAQs - Earthquake Effects & Experiences," http://earthquake.usgs.gov/learn/faq/?categoryID=8&faqID=100

125 Canterbury Earthquake Recovery Authority, *Draft Recovery Strategy for Greater Christchurch*, September 2011, p. 10.

126 Businessweek, "New Zealand's Key Pledges Subsidies on Visit to Earthquake Zone," 7 September 2010, www.businessweek.com/news/2010-09-07/new-zealand-s-key-pledges-subsidies-on-visit-to-earthquake-zone.html; BBC News, "New Zealand Earthquake Damaged 100,000 Homes," 6 September 2010, www.bbc.co.uk/news/world-asia-pacific-11191105

to personal effects are covered. Any further damage above that threshold will be covered by the policyholder's insurance company depending on their insurance policy. The disaster affected population was therefore one of the best insured in history, with estimated 80 percent of the entire disaster damage covered by the Earthquake Commission and private insurance companies.[127]

The September and February Canterbury earthquakes combined were the largest and most costly insurance events in New Zealand's history, generating more than 360,000 claims with the Earthquake Commission (consisting of over 550,000 individual contents, building and land exposures) as of 30 June 2011. In comparison, before 4 September 2010, the Inangahua earthquake of 1968 had generated the most claims from a single event with a comparatively tiny 10,500 claims.[128] By 26 January 2012 the EQC's insurance had paid out over NZD2.8 billion.[129]

Table 8 New Zealand Earthquake Insurance Claims for Christchurch Earthquakes 2010/11[130]

	Sep 4 + aftershocks	Feb 22 + aftershocks	June 13 + aftershocks	Other claims	All events
Building exposures	172,076	139,139	20,764	2,901	334,880
Contents exposures	59,942	82,940	10,143	442	153,467
Land exposures	28,176	40,990	6,038	2,473	77,677
Total claims	185,016	161,126	23,825	4,164	374,131

Following the 4 September earthquake, government legislation – the Canterbury Earthquake Recovery Act (CER Act) – was passed, which established the Canterbury Earthquake Recovery Authority (CERA) to lead and coordinate the ongoing recovery effort. The authority developed a draft recovery strategy for Greater Christchurch which was then broken down into more specific sectoral plans. Major tasks such as damage assessments (done by the Earthquake Commission), demolition of unsafe properties, and provision of temporary shelter for displaced persons were overseen by the Recovery Authority. The task of the authorities was multiplied by the massive destruction caused by the February aftershock, calling into question plans for reconstruction after the September quake and making it necessary to assess and reassess the safety of almost 200,000 buildings. By June 2011, 5,100 residential buildings were deemed to be in red zones (completely damaged) and the government offered to purchase insured buildings from the residents.

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127 Munich Re, "The five largest natural catastrophes of 2011," Geo Risks Research, NatCatSERVICE, January 2012, http://www.munichre.com/en/media_relations/press_releases/2012/2012_01_04_press_release.aspx

128 Earthquake Commission, *Annual Report 2010-2011*, *op. cit.*

129 Canterbury Earthquakes Recovery, "Statistics," http://canterbury.eqc.govt.nz/news/progress/statistics

130 A claim can consist of more than one exposure. Source: Earthquake Commission, Annual Report 2010-2011, 2011, p. 20., available at http://www.eqc.govt.nz/

Another 10,000 buildings had been deemed orange, meaning they needed further assessment.[131] By November around 6,500 buildings had been declared to be in red zones, while around 180,000 buildings were deemed to be in the green zone, indicating that they were safe for repair or reconstruction.[132]

Christchurch's Central City was especially hard hit by the earthquake. With more than 50 percent of all inner city buildings severely damaged, the task of long-term reconstruction is a major one. More than half of the listed heritage buildings within Christchurch (more than 250) were in the Central City, of which 113 had been demolished by November 2011 due to the amount of damage sustained.[133] A classification of residential homes into red houses (unsafe), yellow (restricted access) and green (safe) found that 800 of 2,000 residential properties in the inner city fell into the first two categories.

Given the enormous transformation the quake would bring to the city center, the authorities opted for a highly participatory planning process for the reconstruction. The reconstruction plan was inspired by 106,000 ideas received from the general public as part of the initial "Share an Idea" initiative and from key stakeholder feedback. It was further refined by almost 5,000 comments made in response to a request for more formal consultation on the draft plan.[134] Before planning could begin, the city undertook an extensive ground investigation to evaluate the nature and variability of the geotechnical conditions and the potential impact of future large earthquakes, assessments which will help inform decisions around land-use planning.[135] The draft city reconstruction plan envisions a wide-ranging transformation, modernization and greening of the city and has a planning horizon of 20 years, up to 2032.

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131 Stuff, "Crown to buy 5100 quake-hit Christchurch homes," 26 June 2011, http://www.stuff.co.nz/national/christchurch-earthquake/5179959/Crown-to-buy-5100-quake-hit-Christchurch-homes

132 New Zealand Herald, "Christchurch properties added to red zone," 17 November 2011, http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10766752

133 Christchurch City Council, *Draft Central City Recovery Plan, For Ministerial Approval*, December 2011, http://resources.ccc.govt.nz/files/CentralCityDecember2011/FinalDraftPlan/FinaldraftCentralCityPlan.pdf, p. 22.

134 *Ibid.*, p. 10.

135 *Ibid.*, p. 23.

Section 6

Learning from "The Year that Shook the Rich"

Based on this review of some of the major disasters affecting some rich countries in 2011, this section both reflects on some of the lessons learned and underscores some of the remaining open questions regarding disaster planning, response and reconstruction.

1. Low-probability high-impact disasters tend to surpass our imagination and preparations.

Low-probability high-impact events such as the 2004 Indian Ocean Tsunami and the 2011 Japanese Tohoku earthquake and tsunami in most cases catch states and societies by surprise. While Japan is probably the world leader when it comes to seismic disaster preparedness, scientists did not foresee an earthquake of that strength at that particular fault line.[136] While most buildings withstood the tremors, walls built to protect against tsunamis were simply not high enough to withstand the onslaught of waves much higher than predicted. As a report by Chatham House points out, known hazards such as floods, hurricanes and earthquakes can become "black swan" events, where the low likelihood of occurrence or the high costs of mitigation mean that societies remain unprepared or underprepared for them.[137]

In addition to the higher than expected tsunami waves, the nuclear accident caught both the government and humanitarian actors unprepared to mount relief operations in an environment where there was a possibility of radioactive contamination. Although this did not turn out to be a major factor affecting the disaster response in the case of Japan, it does raise the possibility that future relief operations may have to be carried out in an area contaminated by a nuclear, technological or even biological accident triggered by the disaster. Few humanitarian actors have seriously prepared for this eventuality; in fact it may be that specialized military forces are best equipped to operate when hazardous materials are involved.

From a cost-benefit perspective it is impossible for countries to prepare for every possible disaster. But given the potential impact of low-probability high-impact events, it would be prudent to prepare for them. These preparations should include stress-testing a country's response system to enable it to function well in case such an event occurs. 2011 has clearly shown that rich countries are not "immune" to major disasters and that disaster preparedness and emergency response systems can always be further improved.

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[136] The Star, "Size of Japan's quake surprises seismologists," 11 March 2011, http://www.thestar.com/news/world/article/952418-size-of-japan-s-quake-surprises-seismologists

[137] Bernice Lee et al., "Preparing for High-impact, Low-probability Events Lessons from Eyjafjallajökull," *A Chatham House Report*, January 2012, http://www.chathamhouse.org/publications/papers/view/181179

2. Disaster plans and defenses need to be adjusted to a new and shifting "normal."
While the total number of disasters in 2011 declined, many of the disasters that occurred were considered as "once-in-a-century" disasters. Predictions from climate scientists show that recurrence intervals of heavy precipitation and extreme temperatures will likely become more frequent.[138] In other words, what was formerly a "once-in-a-century" disaster might become a "once-in-a-generation" disaster. Furthermore, new "once-in-a-century" disasters may simply overwhelm the preparations undertaken thus far. With a disaster landscape where the past might no longer be indicative of the future, policy makers and mitigation specialists will need both foresight and guidance from ever more sophisticated climate models to take the necessary decisions to prevent and prepare for future disasters. This might require major investments in disaster mitigation measures and upgrading infrastructure as part of a climate change adaptation agenda for rich countries. Clearly, such investments should not distract from rich countries' obligations and commitments to assist less wealthy countries to deal with the negative effects of climate change.

3. Nuclear technology is not completely safe. We need a societal, global and intergenerational debate about the risks and benefits of nuclear technology.
The illusion that nuclear technology in the rich world is completely safe was spectacularly shattered by the collapsed reactor pressure vessels of the Fukushima Daiichi Nuclear Plant. Initial investigations into the accident have shown that disaster mitigation measures for the plant were insufficient; that the location itself was highly questionable; that possible tsunami risks were underestimated; and that neither TEPCO, the company running the plant, nor the government was prepared to deal with an accident of that scope.[139] As Mark Ramseyer argues in his thought-provoking paper "Why Power Companies Build Nuclear Reactors on Fault Lines: The Case of Japan," companies will never end up footing the entire bill for a nuclear disaster, as the costs would outstrip their entire assets. Therefore, energy companies have few disincentives to build plants in areas that might not be safe.[140] Close ties in many countries (as in Japan) between regulators and the nuclear industry might in addition lead regulators to overlook potential risk factors. In his paper, Ramseyer also makes the point that even government ownership of nuclear plants might lead to some of the same moral hazards because in democracies plants would more likely be built on "politically optimal" rather than "seismologically optimal" sites. While proponents of nuclear energy came out strongly after the disaster saying that new reactor models were much safer than the 1970s Fukushima model (just as Western reactors were much safer than Soviet ones after the 1986 Chernobyl meltdown),

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138 Clare M. Goodess, *SR1: How is the frequency, location and severity of extreme events likely to change up to 2060?,* UK Office for Science, Foresight, Migration and Global Environmental Change, October 2011.

139 BBC News, "Fukushima accident: disaster response failed – report," 26 December 2011, http://www.bbc.co.uk/news/world-asia-16334434

140 Mark Ramsayer, "Why Power Companies Build Nuclear Reactors on Fault Lines: The Case of Japan," *The Harvard John M. Olin Discussion Paper Series*, Discussion Paper No. 698, June 2011, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1874869&download=yes

there is a need for a broad debate at a societal level about what the acceptable risks of nuclear technology are and who will foot the costs when an accident happens.[141] As nuclear fallout isn't restrained by national borders, the debate needs to be held on a global scale and given that nuclear isotopes such as caesium 137 with its half-life of 30 years and plutonium 239 with a half-life of more than 24,000 years are produced in nuclear accidents such as the one in Fukushima, this debate also needs to have a strong intergenerational component.

4. Disaster risk reduction and preparedness work (up to a certain threshold).

This review of disasters that shook the rich world in 2011 leads to the conclusion that in many instances loss of life would have been much greater without disaster risk reduction and preparedness measures. This is a conclusion confirmed by the differences in casualty figures between disasters in the developed world and in developing countries (see Table 2). As noted before, casualties from the 9.0 earthquake in Japan were relatively low. While debates continue as to whether the tsunami defenses were sufficient given historical precedents, there is little doubt that tsunami warning systems, clear evacuation routes and disaster preparedness exercises saved many lives. It is very difficult and often not economically viable to provide safety from high-impact low-probability events, but a national culture of disaster

[141] Physorg, "Today's plants far safer than Fukushima: US expert," 15 September 2011.

Xingtai City, Hebei Province, China, March 28, 2011. Students participating in regular disaster preparedness exercises. Photo: © Jianbinglee | Dreamstime.com

preparedness can be extremely helpful when such disasters strike and save many lives. The striking difference between insurance coverage in the Japanese and New Zealand disasters also draws attention to the role of insurance and particularly mandatory government insurance schemes in protecting those at risk of disasters. The focus on disaster risk reduction in the reconstruction plans in many of the affected rich countries shows that states are taking to heart the need to be better prepared for when the next "big one" strikes.

5. Local disasters are getting rarer.

With economic globalization knitting an ever-tighter web of economic and social interconnections around the globe, disasters are becoming less and less local affairs. Disasters that once would have been local have become global issues. In addition to the Japanese tsunami, which disrupted global supply chains of products ranging from cars to smart phones, other disasters in 2011 caused major ripples in the global economic network. The floods in Thailand for example disrupted global production chains for computer hard drives and major carmakers had to slow down production in factories in several countries because they were missing car parts usually made in Thailand.[142] Disruption of coal production in Queensland, Australia, led to spiking coal prices in early 2011.[143] While the impacts of disasters on other countries' economies can be significant, they are rarely included in determining either the number of those affected by a disaster or in calculating economic damages caused by a disaster. Given the realities of globalization, we should consider broadening the net to include all of those affected in our tallies.

6. There seem to be few disincentives for people not to settle in disaster-prone areas such as coastal areas in the United States.

In many countries, a large proportion of the population lives in areas which are vulnerable to natural hazards. For example, many coastal areas face high disaster risks – risks which will be compounded by climate change through rising sea levels, stronger storms and changes in temperature and precipitation. Nonetheless, globally two-thirds of the world's cities with populations over five million are at least partially located in coastal zones.[144] In Australia, close to 90 percent of the population lives within 50 kilometers of the coast.[145] In the US, half the population lives within 50 miles of the coast, with population density much higher in coastal areas than in the rest of the country and density growing steadily in the recent decades.[146] The AIR Worldwide Corporation estimates that insured property

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142 The Hindu, "Thailand flooding affects global industries," 7 November 2011, http://www.thehindu.com/opinion/op-ed/article2607072.ece

143 The Australian, "Flood disruptions to push up world coal price, says Rio," 28 January 2011.

144 The Government Office for Science (London), *Foresight: Migration and Global Environmental Change, Final Project Report*, 2011.

145 Australian Bureau of Statistics, "How many people live in coastal areas?" 1301.0 - Year Book Australia, 2004, http://www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/1301.0Feature%20Article32004?opendocument&tabname=Summary&prodno=1301.0&issue=2004&num=&view=

146 NOAA, "Over half of the American population lives within 50 miles of the coast," revised 17 November 2011, http://oceanservice.noaa.gov/facts/population.html

value in the coastal US was $8,891 billion in 2007.[147] While major disasters like Hurricane Katrina have led to a decline in population in certain areas, such as New Orleans, overall population in coastal areas in the US has grown steadily; for example, the population along the Gulf of Mexico soared by 150 percent between 1960 and 2008, more than double the rate of increase of the overall population of the country.[148] A World Bank report notes that mispriced insurance (insurance premiums too low because of popular pressures on a regulated industry) is partly to blame for overbuilding along the hurricane-prone US coastline.[149] After a disaster strikes, there may be some talk about declaring certain areas unsafe for habitation or reconstruction, or constructing buffer zones, or more radically, even abandoning whole areas or cities. But such discussions rarely lead to any changes in either individual behavior or in incentives to support other settlement patterns.

7. Communication, communication, communication!

Japanese authorities have presented us with a Janus-faced approach to communication following disasters. On the one hand, earthquake and tsunami warning systems generally worked well and there was a sense that authorities' communication with earthquake and tsunami-affected populations functioned smoothly. On the other hand, the government's crisis communication and handling of the Fukushima nuclear accident has been heavily criticized. Both TEPCO and the government were criticized for informing people too slowly about the details and the scale of the disaster. There were too many different spokespersons issuing multiple statements. The statements themselves were often confusing, too general in tone and too short on substance.[150] No one questions the fact that in crisis situations communication is always difficult and that governments often have to take difficult decisions on the basis of imperfect information. And yet providing important information to the public in a crisis is a core function of government and if authorities fail on that front, they stand to lose credibility with the public. In the US meanwhile, some of the lessons from Hurricane Katrina have been heeded by government officials. Learning from the Bush Administration's abysmal crisis communication and disaster management, when Hurricane Irene looked ominous, President Obama cut his holidays short, governors and majors were seen at the forefront of the disaster response, warnings flooded the media and evacuations proceeded relatively smoothly.

Social media such as Twitter and Facebook or mapping tools such as Google maps and Ushahidi play an increasingly important role in crisis communication between govern-

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147 Jeffrey Pompe and Jennifer Haluska, *Estimating the Vulnerability of U.S. Coastal Areas to Hurricane Damage*, Francis Marion University, April 2011.

148 US Census Bureau, "Census Data & Emergency Preparedness," last revised 9 November 2011, http://www.census.gov/newsroom/emergencies/

149 Apurva Sanghi et al., *Natural Hazards UnNatural Disasters: The Economics of Effective Prevention*, World Bank, 2010, p. 3f.

150 The Asia Foundation, "In Face of Disaster, Japanese Citizens and Government Pull from Lessons Learned," 16 March 2011, http://asiafoundation.org/in-asia/2011/03/16/in-face-of-disaster-japanese-citizens-and-government-pull-from-lessons-learned/

ments, media and the affected population, a development that is particularly pronounced in developed countries as they have a large user community.

Decision-making about post-disaster reconstruction is rarely uncontroversial. However, it seems that the attempts by the recovery authorities in both Queensland and Christchurch to foster strategic communication with the affected communities are good examples of ways that governments can involve affected communities in the decisions that affect their lives. In particular, the participatory reconstruction approach used for the inner city in Christchurch demonstrates how information technology can be used in developing inclusive approaches to post-disaster reconstruction.

8. How much international solidarity do rich countries need and want?

Most rich countries have the resources and the capacity to manage emergency relief and recovery operations as well as post-disaster reconstruction and thus don't need to rely on major assistance from the international humanitarian system. Still, in the event of a major disaster, like the Tohoku earthquake and tsunami in Japan or Hurricane Katrina in the US, the compelling media coverage leads to expressions of solidarity by governments, organizations and citizens from countries throughout the world. It is not so clear, however, how that solidarity can best be used.

The deployment of highly-trained search and rescue teams is often the first and most visible offer of international assistance. Ironically, the Japanese search and rescue team was deployed in Christchurch, New Zealand when the earthquake and tsunami occurred in Japan. But in any event, there were few people to be rescued in the aftermath of the Japanese tsunami, as the waves had been so high. Rather the grim matter of retrieving and identifying the dead bodies was an urgent task. Over the years, international protocols for the use of search and rescue teams have provided useful guidance on their deployment.[151] This is not the case for the far larger number of NGOs and international agencies seeking to offer assistance in the aftermath of a disaster. As discussed in the next chapter, governments – including governments of developed countries – would be well-advised to develop procedures for accepting and facilitating international assistance before disasters occur.

The US, for example, was strongly criticized for declining many international offers of assistance after Hurricane Katrina struck. In fact, the US turned down 54 of 77 recorded aid offers from three of its staunchest allies: Canada, Britain, and Israel. By April 2007 the US had only claimed $40 million out of $854 million in cash and in oil that was to be sold for cash, offered by US allies to aid with post-Katrina relief and reconstruction.[152] Similarly, the Japanese authorities struggled with how to respond to the large outpouring of international solidarity, eventually accepting only those offers that corresponded to the list of needs iden-

[151] For more about INSARAG - International Search and Rescue Advisory Group see: OCHA, "INSARAG – International Search and Rescue Advisory Group," http://www.unocha.org/what-we-do/coordination-tools/insarag/overview

[152] Washington Post, "Most Katrina Aid From Overseas Went Unclaimed," 29 April 2007.

tified by the Japanese government. It is easier to decide on how such offers of assistance will be handled before a disaster occurs and governments should include this in their planning for disaster response.

Another question surrounding solidarity in disasters centers on financial contributions. As our overview in Chapter 2 of humanitarian disaster relief funding in 2011 shows, Japan received more than $700 million in aid – a large percentage of all the international humanitarian disaster funding in 2011. Given the massive scale of the disaster, this represents only one third of one percent of the total disaster damage and will obviously only make a small dent in the amount of money the Japanese government and its citizens will need to invest in reconstruction. Given that the Japanese economy is one of the three largest in the world, this raises the question of whether those funds could have been more effectively used in some of the underfunded emergencies in the developing world in 2011. (Taken together, 33 other disasters received about the same amount of international assistance as did Japan.) Some of these broader questions about humanitarian financing are further explored in the next chapter.

9. Building back better in the rich world.

While disasters cause terrible human suffering and significant strain on human societies, post-disaster reconstruction, especially after such major disasters as the Christchurch earthquake or the Japanese tsunami, gives communities a chance to develop and implement a collective vision of a different future. Rich countries usually possess the resources and institutions that can make the slogan of “build back better” possible and while national governments and parliaments play a major role in creating the overall institutional and financial framework for reconstruction, it is often local and provincial authorities which are the key to successful reconstruction. Building back better also means ensuring that demographic, ecological and technological trends are incorporated into the reconstruction plans and process. Looking at the reconstruction plans in Japan and New Zealand, for example, there are positive signs that authorities are considering how to rebuild cities in ways that reflect the needs of aging societies, incorporate ecologically sound principles and make communities safer from future natural hazards. The long mandates and planning horizons for reconstruction authorities and master-plans – from 10 to 20 years for Japan and New Zealand respectively – indicate that reconstruction can be the task of up to a generation, and should give pause to the impatience that Western media and donors often show towards reconstruction in developing countries which have much fewer resources at their disposal. Of course, the final verdict on the success of reconstruction efforts will only be evident years or decades down the road. But these efforts should be closely monitored by the public, media and researchers. Good practices and lessons learned should be drawn out and applied in post-disaster reconstruction efforts in countries other than those in the rich world.

In addition to a spate of disasters hitting developed countries, a range of major natural disasters occurred all over the world in 2011, including floods and landslides in Brazil, drought in the Horn of Africa, massive floods in Southeast Asia which left Bangkok under water for months, storms in the Philippines and a major earthquake in Eastern Turkey.

Bangkok, Thailand – Airport under water. Photo: Thinkstock.com