

FLOODS & LANDSLIDES



ESTIMATES GLOBAL CLIMATE IMPACT



2010 EFFECT TODAY



DEATHS
PER YEAR

2,750



USD LOSS
PER YEAR

10 BILLION

2030 EFFECT TOMORROW



DEATHS
PER YEAR

3,500

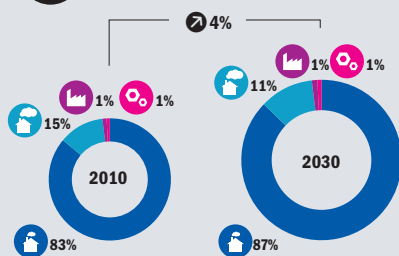


USD LOSS
PER YEAR

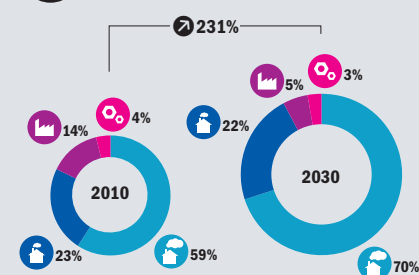
95 BILLION



MORTALITY IMPACT



ECONOMIC IMPACT



CONFIDENCE INDICATIVE



SEVERITY



AFFECTED



INJUSTICE



PRIORITY



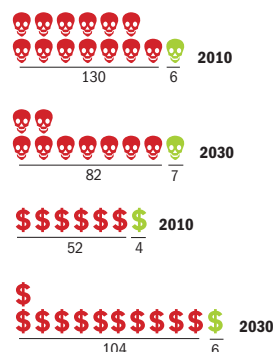
MDG EFFECT



- Heavy rainfall, the main trigger of flooding and landslides, is on the rise
- Spring comes earlier and releases more water from mountains and glaciers which adds further to flood risks
- Future increases in these effects may coincide, generating more mega disasters of the scale of the 2010 Pakistan floods
- Comprehensive risk reduction efforts in implementation of the Hyogo Framework for Action are helping to reduce vulnerabilities, even as world population and exposed infrastructure expand
- Parallel efforts are not being made to deliberately adjust humanitarian relief systems to growing flood danger



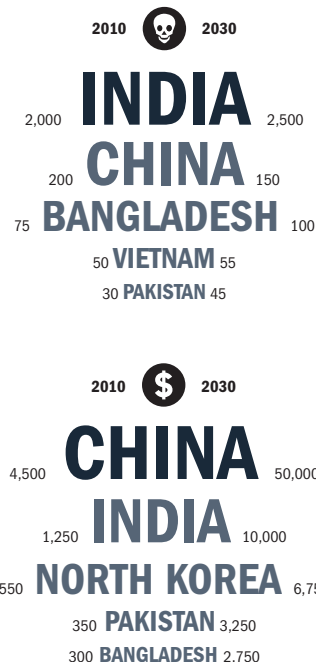
RELATIVE IMPACT



GEOPOLITICAL VULNERABILITY



HOTSPOTS



Deaths



Economic Cost (2010 PPP non-discounted)



Developing Country Low Emitters



Developed



Developing Country High Emitters



Other Industrialized



Deaths per 100 million



Losses per 100,000 USD of GDP



Change in relation to overall global population and/or GDP



Millions of USD (2010 PPP non-discounted)

Flooding is a common natural hazard from increases in rainfall due to climate change. Floods are expected to worsen practically everywhere, even in areas facing declining annual rainfall, as heavy downpours become more common (IPCC, 2007). More floods mean more deaths and injuries, more damaged property and infrastructure, and growing disruption of economic activities. Where large countries like China, Pakistan, or the US are affected, the lives of millions of people may be disrupted and billions of dollars of economic damage inflicted (CRED/EM-DAT, 2012). However, the risk of death due to flooding is heavily concentrated in low-income countries, which face significant risks of setbacks in development gains, with women particularly vulnerable (UNISDR, 2011; Nelleman et al., 2011). Highly cost-effective including “low-regrets” measures to limit damages and speed recovery are also inaccessible to many for lack of the capacity and up-front resources to implement them (IPCC, 2012a). Social and political factors, including illiteracy and the over-exploitation of resources often exacerbate these problems (UNISDR, 2009).

CLIMATE MECHANISM

A warmer planet means a more active hydrological system, as water is evaporated faster from oceans and land, generating cloud and rainfall (Dore, 2005; Kharin et al., 2007). That means more rain overall and more energy in general in the global climate system as it heats up, leading to heavier downpours of rain, more variable or erratic rainfall, and more frequent heavy precipitation. Coupled with an earlier spring that discharges more water as glaciers continue to decline, the implications are that risk of flooding and landslides caused by weather, and not earthquakes or otherwise, are on an increase (Hidalgo et al., 2009; Radi and Hock, 2011; IPCC, 2007; Mirza et al., 2003; Jonkman et al., 2008; Bouwer et al., 2010). The evidence base for the flood trend is low, in particular due to inadequate gauge station records and confounding information linked to land use and engineering (IPCC, 2012a). The increase in heavy rainfall during short periods of time is assured and is not only the main trigger of flooding, but the main input variable to early warning tools to predict flooding (Prudhomme et al., 2002; Harris et al., 2007).

IMPACTS

Globally, climate change is already estimated to be responsible for close to an average of 3,000 deaths per year and around 10 billion dollars in economic losses through flooding and landslides. For every death, there can be as many as 10,000 people in need of emergency assistance; each year, over 25 million more people are affected than in earlier periods when climate change was not so marked. Over the next 20 years, the climate-related flood death toll is expected to increase only modestly to 3,500 deaths per year with economic losses more than tripling as a share of global GDP, reaching 95 billion dollars per year by 2030.

Approximately two-thirds of these losses are incurred in China and India alone. Populous emerging economies in Asia, such as Bangladesh, Pakistan, and Vietnam are particularly vulnerable, as are mountainous developing countries, such as Bhutan and Nepal. Effects are widely distributed around the world, with the number of countries labeled “Acute” doubling by 2030. Low-lying small island states, such as the Maldives, are unaffected by non-coastal flooding and landslides, whereas mountainous small islands, such as Haiti or Fiji are at high risk.

THE BROADER CONTEXT

The significance of socio-economic determinants of risk mean climate change is only one factor in the scale of damage generated by so-called natural disasters. Mortality risk due to extreme weather is known to fall over time with rising incomes (Pezuzzi et al., 2012). However, economic losses show increases in recent years (CRED/EM-DAT, 2012; Munich Re, 2012). These observations support the UN’s analysis that as socio-economic development improves, fewer people are killed, but infrastructure is at greater risk (UNISDR, 2009 and 2011).

VULNERABILITIES AND WIDER OUTCOMES

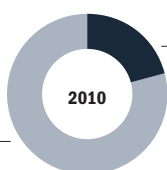
Vulnerability levels are often dictated by socio-economic development standing and the associated effectiveness of governments in putting in place measures that can limit dangers for populations. Poorly located, unprotected flood plain settlements are also at high risk, but sound governance should prevent or rationalize this type of development. Environmental degradation and unwise patterns of land



BIGGER PICTURE



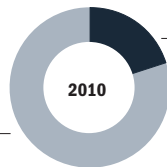
79%
NON CLIMATE



21%
CLIMATE



80%
NON CLIMATE



20%
CLIMATE



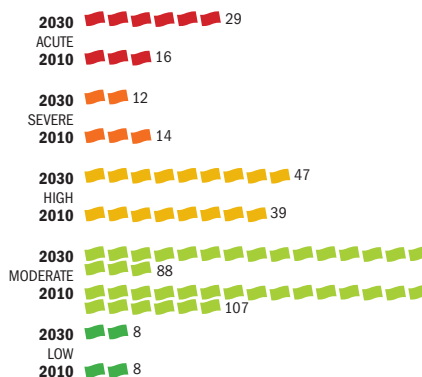
SURGE



OCCURRENCE



VULNERABILITY SHIFT



PEAK IMPACT



2004 HAITI 2,665	2010 CHINA 18,930
2005 INDIA 2,129	2002 GERMANY 11,600
2010 PAKISTAN 2,113	2008 UNITED STATES 10,002
2010 CHINA 1,911	2010 PAKISTAN 9,500
2007 BANGLADESH 1,230	2007 UNITED KINGDOM 8,448



GENDER BIAS



INDICATOR INFORMATION

MODEL: Kharin et al., 2007

EMISSION SCENARIO: SRES A1B (IPCC, 2007)

BASE DATA: CRED EM-DAT, 2012; Munich Re NATCAT, 2010 (economic data); UNEP GRID, 2012 (mortality data)



= Millions of USD (historic)



Estimated time between major weather events (years)



= 5 countries (rounded)

● Acute ● Severe ● High ● Moderate ● Low

usage, particularly deforestation, further exacerbate localized vulnerabilities, for example, by destabilizing hillsides and by increasing the flow of rainwater over land—effects especially significant in developing countries (Brashshaw et al., 2007). High rates of urbanization, common in most developing countries around the world today, often lead rural-urban migrants to settle in flood plain shanty towns adjacent to major urban centres, adding to the level of risk (Quarantelli, 2003). Flooding carries serious consequences for economic activity, especially for lower-income communities where insurance that otherwise speeds economic rebound is least prevalent (Dodman and Satterthwaite, 2008). Harm to poverty-reduction efforts has been shown to result more from widespread and regularly occurring small- to medium-scale disasters, since they repeatedly frustrate development progress, even though freak, high-profile, catastrophes typically receive more attention (Lavell, 2008). Flood damage—particularly ecological and social costs or diffuse disruptions to broad economic activities—is also difficult to fully quantify, and in extreme cases can persist for months (Messner and Meyer, 2005).

RESPONSES

Like other disasters, floods are considered to have three core components: hazard, exposure, and vulnerability. Hazard is a variable largely beyond immediate human control, so responses either aim to decrease vulnerability or exposure to hazard, or both. Measures such as rapid early warning systems, disaster education, building codes and their regulation, environmental protection against deforestation and land degradation, insurance for infrastructure or other economic assets, flood defences and storm drains, strengthening of local ecosystems, disaster volunteer programmes all reduce vulnerabilities, but may demand resources which many countries simply do not possess. Under pressure of economic and population growth, most increases in exposure are inevitable. But strategic municipal planning for infrastructure development can help minimize the extent of new exposure to risk. Urban centres with elevated population densities are also high-dividend opportunities for reducing possible disasters, provided urban authorities are willing and able to meet the needs of their residents

in managing risks (Dodman and Satterthwaite, 2008).




The capacity of governments to develop and implement a range of risk-reduction measures is considered a fundamental determinant of the success of national disaster prevention and recovery strategies; this includes the ability to incorporate considerations of disaster risk into wide-ranging state agendas, from education to municipal planning and fiscal tools. Capacity to do so is also most deficient in highly vulnerable, low-income settings (Ahrens and Rudolph, 2006).




A number of low-income countries, such as Bangladesh have nevertheless managed to reduce levels of vulnerability through cost-effective community and volunteer-based efforts, as alternatives to more resource-intensive measures (Khan, 2007). On the other hand, recent floods along the Mississippi and Missouri rivers in the US have shown how even the highly developed countries can be overwhelmed by large-scale events (Olson and Morton, 2012). New extremes and delays in policy changes to increase resilience mean that the world's humanitarian system should prepare for serious increases in flood response in the years ahead.




THE INDICATOR

The indicator combines exposure to floods and landslides with modeled mortality risk for estimations of deaths with socio-economic adjustments. For economic losses, a combination of 20 years of disaster data from different sources is relied upon as a baseline. The indicator then estimates how the change in, or increases in the occurrence of, heavy precipitation events would alter the current picture of flood and landslide risk. Uncertainty regarding precipitation change in some areas is an impediment to reliable national-level estimates of these changes. Likewise, country-specific variation in the effects of increased heavy rainfall is not accounted for, except through the worsening of the pre-existing topography of risk, as reflected in historic and modeled disaster data. Although records of floods are unreliable, models of the effects of climate change on heavy precipitation and observed rainfall changes do reveal the increasing trend (IPCC, 2007, IPCC, 2012a; Kharin et al.).

ESTIMATES COUNTRY-LEVEL IMPACT

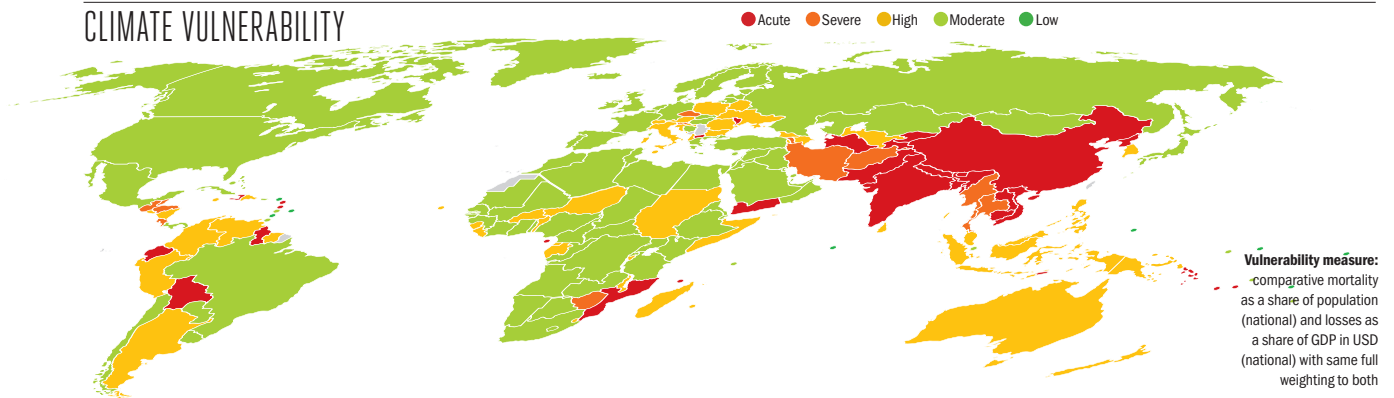
						
COUNTRY	2010	2030	2010	2030	2010	2030
ACUTE						
Bangladesh	75	100	300	3,000	600,000	900,000
Bhutan	1	1		1	15,000	25,000
Bolivia	1	1	30	300	10,000	15,000
Cambodia	10	10	20	200	65,000	85,000
China	200	150	4,500	50,000	2,000,000	1,500,000
Comoros	5	10			45,000	85,000
Dominica	1	1			2,500	3,000
Ecuador	1	5	30	300	25,000	30,000
Fiji	1	1	1	10	4,000	3,500
Guyana			10	100	2,000	1,500
Haiti	5	5	5	35	30,000	40,000
India	2,000	2,500	1,000	10,000	20,000,000	25,000,000
Kyrgyzstan	1	1	5	35	9,500	15,000
Laos	5	10	1	15	55,000	70,000
Macedonia			5	50	1,500	1,000
Moldova	1	1	15	100	5,500	5,000
Mozambique	1	5	10	85	20,000	30,000
Nepal	10	15	15	150	85,000	100,000
North Korea	10	10	550	6,500	100,000	85,000
Pakistan	30	45	350	3,000	300,000	450,000
Saint Lucia	1	1		1	6,000	6,000
Sao Tome and Principe	1	1			15,000	25,000
Solomon Islands	1	1			5,000	9,000
Tajikistan	5	5	40	300	30,000	45,000
Timor-Leste	1	1			25,000	25,000
Turkmenistan	5	10	5	25	55,000	80,000
Vanuatu		1		1	2,500	4,000
Vietnam	50	55	150	2,000	500,000	500,000
Yemen	1	1	35	250	7,500	25,000
SEVERE						
Afghanistan	5	10	5	35	55,000	90,000

						
COUNTRY	2010	2030	2010	2030	2010	2030
ACUTE						
Armenia	1	1		1	20,000	25,000
Belize				1	1,500	2,000
Costa Rica	1	1	5	55	6,500	10,000
Czech Republic			55	350	2,000	1,500
Guatemala	5	10	5	60	45,000	90,000
Honduras	1	1	5	70	15,000	20,000
Iran	10	10	200	1,500	40,000	50,000
Myanmar	35	45	5	40	250,000	350,000
Slovenia			15	95	2,000	1,500
Thailand	15	10	100	1,000	150,000	100,000
Zimbabwe	1	1	5	25	15,000	25,000
HIGH						
Albania	1	1	1	10	5,000	6,500
Argentina	5	5	70	700	15,000	20,000
Australia	1	1	65	200	2,500	5,500
Austria	1	1	30	90	5,000	6,500
Azerbaijan	1	1	5	30	10,000	10,000
Belarus	1	1	5	35	6,500	5,500
Benin	1	1	1	5	7,500	15,000
Brunei					1,500	1,500
Bulgaria	1	1	10	70	3,000	1,500
Burkina Faso	1	1	1	15	3,000	7,500
Burundi	1	1		1	10,000	20,000
Cape Verde					1,500	2,000
Colombia	10	10	50	450	35,000	45,000
Croatia	1	1	10	85	4,000	3,000
Dominican Republic	1	1	1	25	7,500	8,000
El Salvador	1	5		1	20,000	30,000
Equatorial Guinea		1			2,000	3,500
Gabon	1	1			1,500	3,000
Georgia	1	1	1	10	30,000	20,000
Indonesia	25	30	75	650	250,000	250,000

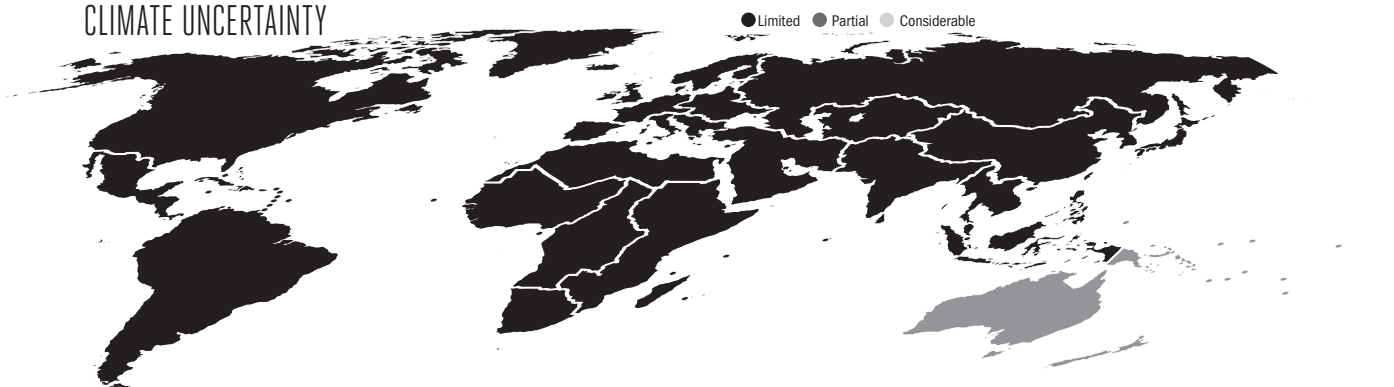
						
COUNTRY	2010	2030	2010	2030	2010	2030
ACUTE						
Italy	1	1	150	500	5,500	7,000
Jamaica	1	1	1	20	3,500	4,000
Liberia	1	1			5,500	15,000
Madagascar	5	5	1	15	30,000	55,000
Malawi	1	1	1	5	15,000	25,000
Malaysia	5	5	20	200	15,000	15,000
Malta			1	1	200	300
Mauritius		1			1,500	1,500
New Zealand	1	1	5	15	4,500	9,500
Nicaragua	1	5	1	5	20,000	40,000
Niger	1	5	1	10	10,000	25,000
Papua New Guinea	1	5	1	5	30,000	40,000
Peru	5	5	15	150	15,000	20,000
Philippines	25	25	30	300	200,000	250,000
Poland	1	1	85	600	5,500	4,000
Romania	1	1	40	300	8,500	6,000
Sierra Leone	1	5		1	15,000	30,000
Somalia	1	5	1	1	20,000	45,000
South Korea	5	5	95	800	25,000	20,000
Sri Lanka	5	5	15	150	45,000	40,000
Sudan/South Sudan	5	5	5	40	40,000	55,000
Suriname					550	650
Swaziland		1			3,000	4,000
Switzerland	1	1	25	75	2,000	3,000
Ukraine	1	1	40	300	25,000	15,000
Uzbekistan	10	15			95,000	150,000
Venezuela	5	5	30	300	15,000	15,000
MODERATE						
Algeria	5	5	5	60	15,000	20,000
Angola	1	5		1	20,000	45,000
Bahamas						
Bahrain			1		650	850



CLIMATE VULNERABILITY



CLIMATE UNCERTAINTY



COUNTRY	2010		2030		2010		2030		2010		2030	
	Skull	Dollar	Skull	Dollar	Skull	Dollar	Skull	Dollar	Skull	Dollar	Skull	Dollar
Belgium			1	1	5	1,500	2,000					
Bosnia and Herzegovina	1		1		5	3,000	2,000					
Botswana					1	650	700					
Brazil	5	10	20	200	30,000	30,000						
Cameroon	5	5			1	35,000	50,000					
Canada	1	5	30	100	9,000	20,000						
Central African Republic	1				6,000	9,500						
Chad	1	1			1	9,500	20,000					
Chile	1	1	5	50	4,000	4,500						
Congo	1	1			7,000	15,000						
Cote d'Ivoire	1	1			20,000	30,000						
Cuba	1	1	1	20	2,500	2,500						
Cyprus					750	1,500						
Denmark					1	250	350					
Djibouti					200	250						
DR Congo	10	25			1	90,000	200,000					
Egypt	5	10	5	30	65,000	80,000						
Eritrea	1	1			4,500	7,500						
Estonia					750	450						
Ethiopia	10	15			1	75,000	150,000					
Finland					1							
France	1	1	60	200	9,000	15,000						
Gambia					1,000	1,500						
Germany	1	1	100	350	4,500	6,500						
Ghana	1	1	1	5	6,500	10,000						
Greece	1	1	10	30	2,000	3,000						
Guinea	1	5			1	15,000	25,000					
Guinea-Bissau					950	1,500						
Hungary			10	65	1,500	900						
Iceland					1	150	250					
Iraq	5	5			35,000	60,000						
Ireland			1	5	1,000	2,500						
Israel			1	1	5	1,500	2,000					
Japan	5	5	150	400	20,000	35,000						
Jordan					1	2,000	3,000					
Kazakhstan	1	5	5	30	10,000	15,000						
Kenya	5	5	1	10	40,000	50,000						
Kuwait					150	200						
Latvia					1,000	750						
Lebanon	1	1			3,000	3,000						
Lesotho					3,500	3,500						
Libya			1	5	650	850						
Lithuania					1,000	900						
Luxembourg					1	200	500					
Mali	1	1			10,000	20,000						
Mauritania			1		1	2,000	4,500					
Mexico	10	10	55	500	40,000	40,000						
Micronesia												
Mongolia	1				1	4,500	3,500					
Morocco	1	1	5	30	15,000	20,000						
Namibia					1	1,000	1,500					
Netherlands	1	1	15	40	2,000	3,500						
Nigeria	10	15	1	20	85,000	150,000						
Norway					1	5	700	1,000				
Oman			1		1	1,500	3,000					
Panama	1	1	1	5	2,000	2,000						
Paraguay	1	1			1	10,000	20,000					
Portugal	1	1	10	30	2,000	3,000						
Qatar					300	350						
Russia	10	5	75	550	35,000	25,000						
Rwanda	1	1			15,000	25,000						
Saint Vincent												
Samoa												
Saudi Arabia			1	10	90	1,500	3,000					
Senegal	1	1	1	5	9,500	15,000						
Seychelles												
Singapore					1	5						
Slovakia	1		5	30	2,500	2,000						
South Africa	1	1	5	35	5,500	4,500						
Spain	1	1	10	35	4,000	5,500						
Sweden					1	400	600					
Syria	1	5			30,000	45,000						
Tanzania	1	5	1	10	20,000	30,000						
Togo	1	1			1	5,000	9,000					
Tonga												
Trinidad and Tobago					1	650	600					
Tunisia			1	5	45	3,500	4,000					
Turkey	5	10	30	100	15,000	35,000						
Uganda	1	5			1	15,000	35,000					
United Arab Emirates	1	1	1	20	2,500	3,000						
United Kingdom	1	1	100	350	3,500	5,500						
United States	5	5	600	2,000	15,000	35,000						
Uruguay	1	1	1	5	1,500	1,500						
Zambia	1	1			1	10,000	20,000					
LOW												
Antigua and Barbuda												
Barbados												
Grenada												
Kiribati												
Maldives												
Marshall Islands												
Palau												
Tuvalu												